# Exploring open innovation and collaboration in University - Industry Partnerships

by

Linda Tyrrell

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# Abstract

This interdisciplinary research study focuses on the creation of innovation through cross-sector collaboration and value-added factors between buyers (university academics) and suppliers (scientific equipment manufacturers) embedded in the context of a specific university's procurement tender process. The study's research questions are:

1) What is the success of cross-sector collaboration (CSC) and value-added factors that drive new product innovation and University-Industry collaboration?

2) What cross-sector collaboration (CSC) and value-added factors do buyers (university) and suppliers (industry) consider important when developing a collaboration and do the study participant's demographics influence these factors?

3) How can these cross-sector collaboration (CSC) success and value-added factors become integrated into the procurement tender process and documentation to make the process more conducive to cross-sector collaboration for innovation?

4) What model can drive buyer (university) and supplier (industry) collaboration for new product innovation?

Using a qualitative approach, the author explored a research focused university and identified 15 tenders that had resulted in collaboration. Examining secondary data including the tender specification template, invitation to tender, supplier tender returns and one research contract, the author confirmed if the research questions and literature gaps could be answered. As the secondary data was incomplete, the author conducted 9 buyer telephone interviews and 8 supplier virtual meetings, to obtain participant responses to close the literature gaps and answer the research questions.

The findings are diverse including both buyer and supplier participants having previously engaged in collaboration. The author has identified two new buyer types, the Individual Academic and Core Service Academic. Suppliers adopt a local market manufacturing approach to provide the value-added factors buyers require. That suppliers have embedded specific buyers into their innovation process and linked the buyer knowledge to a specific model, resulting in the development of new product ranges for the external market.

From the study's findings the author has theorised a visual model of university-industry collaboration, including the micro triple helix model, the value-added factors, CSC factors and tender recommendations to allow readers to understand the steps within the tender process that makes a collaboration a success (as shown in figure 9.1, Chapter 9).

Finally, the author made several recommendations to change the tendering documents and tender process, including adding equipment value-added factors to the tender specification template, a new value-added matrix, and a step-change to the tender process, to embed the value-added and CSC factors identified in this research study to make the tender process conducive to collaboration.

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To the Scientific Equipment Manufacturers (the suppliers) within the UK Higher Education Sector for providing their time and agreeing to participate in this research thesis. To the Principal Investigators (PI's) (the buyers) at the Research-Intensive University for providing their time free of charge to complete the interviews and finally to my parents (Pamela and John Tyrrell) for the amazing support, tolerance, and advice, and who I do not appreciate enough, thank you.

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# List of Abbreviations

| ***Abbreviations*** | ***Explanation*** |
|---|---|
| BBSRC | Biotechnology and Biological Sciences Research Council |
| BSc Hons | Bachelor of Science with Honours |
| Cambridge | Cambridge University |
| CAD | Computer Aided and Design |
| CAP | Customer Active Paradigm |
| CAT | Computerized Tomography Scanner |
| CIHE | Council for Industry and Higher Education |
| CEDR | Centre for Effective Dispute Resolution |
| CIS-3 | 3rd European Community Innovation Survey |
| Core | Core Facilities |
| Coll. | Collaboration |
| COVID | Coronavirus |
| CRUK | Cancer Research United Kingdom |
| CSC | Cross-Sector Collaboration |
| DHSS | Department of Health and Social Security |
| DNA | Deoxyribonucleic Acid |
| DoI | Department of Industry |
| Eng. | Engineering Department |
| EPSRC | Engineering and Physical Sciences Research Council |
| EU | European Union |
| EU Public Procurement Regulations | European Union Public Procurement Regulations |
| FTS | Find a Tender Service |
| HE Sector | High Education Sector |
| GC | Nuclear Magnetic Resonance Spectrometer |
| GCMS | Gas Chromatography Mass Spectrometry |
| HE | Higher Education |
| HEI(s) | Higher Education Institute(s) |
| HE Sector | Higher Education Sector |
| HPLC | High Performance Liquid Chromatography |
| IP | Intellectual Property |
| IPCA | Professional Engineers Association |
| ITT | Invitation to Tender |
| Imperial | Imperial College |
| KCL | Kings College London |
| Life | Life Sciences |
| Med | Medicine |
| MEAT | Most Economically Advantageous Tender |
| MPhil | Master of Philosophy |
| MRC | Medical Research Council |
| MRI | Magnetic Resonance Imaging Scanner |
| MLSM | Medical/Life Science Manufacturers |
| NHS | National Health Service |
| NIHR | National Institute for Health and Care Research |

| | |
|---|---|
| NPD | New Product Development |
| NME's | Large High-Tech Multinational Firms |
| NMR | Magnetic Resonance Spectrometer |
| OI | Open Innovation |
| OJEC | Official Journal of the European Community |
| Ops | Operations |
| Oxford | Oxford University |
| PCB | Printed Circuit Board |
| PCR | Polymerase Chain Reaction |
| PI (end-user) | Principal Investigator (End-User) |
| PhD | Doctor of Philosophy |
| PPP | Private Public Partnerships |
| Prof | Professor |
| R&D | Research and Development |
| REF | Research Excellent Framework |
| Res | Research |
| Research lab's | Research Laboratories |
| RIU | Research Intensive University |
| SME(s) | Small Medium Size Enterprise(s) |
| TED | Tenders Electronic Daily |
| TEF | Teaching Excellence Framework |
| TEM | Transmission Electron Microscope |
| TTO | University Technical Transfer Office |
| UCL | University College London |
| UK | United Kingdom |
| US | Ultralight Spectrophotometer |
| UKRI | UK Research and Innovation |
| Wel. | Welcome Trust |

# Chapter 1: Introduction

## 1.1 Introduction and Study Context

This study is set within the context of the UK Higher Education Sector (known as the HE Sector) and focuses on the creation of innovation through cross-sector collaboration between buyers (university academics) and suppliers (scientific equipment manufacturers) embedded in the context of a specific university's procurement tender process.

The UK HE Sector has increasingly become more competitive and subject to market forces, created by the UK Government's decision to transfer the cost of funding universities from the state (taxpayer) to individuals (students) (Belfield et al, 2017). The funding formula for UK universities have various income streams, firstly from student tuition fees. Currently UK students registered on a university course need to pay that specific university directly £9250.00 per annum for their tuition. In contrast international students registered on UK courses pay higher fees that are set by a specific university. The problem with this source of income is if the university does not fill all their course places, the university will face an income deficit (Universities UK, 2018).

Secondly, another part of the formula focuses on the rating each university receives in the Teaching Excellence Framework (known as TEF) which assesses the quality of teaching within UK universities. If a university performs badly and obtains a low mark, the university will face an income deficit. Thirdly, research is based on a block grant design to support university infrastructures and through the UK Research Councils providing specific grant funding for research projects. The block grant award is based on the rating the university receives for its quality of research via the Research Excellent Framework (known as REF). Failure to do well in the REF rating process can result in a university facing an income deficit.

The second part of the dual funding involves individual university academics competing against each other for grant funding of specific projects. This process is highly competitive and involves academics submitting applications and having their work assessed by a panel of experts to decide if their proposed project is funded (Adams and Bekhradnia, 2004; Harman, 2000; Hughes et al, 2013; Johnes, 1996). Another income stream comes from funding provided by the different research councils for research methods training within UK universities. Each year both the MRC and NIHR offer grant funding to perspective researchers to set-up "centres of excellence" in research methods training. Researchers that apply for the funding must be in award of existing or pending funds from the specific funder, the process is extremely competitive and runs in a similar way as individual grant awards (UKRI, 2022). This current competitive funding methodology has forced universities to develop decision making and internal resource allocation models mirrored on the UK government funding formula (Bolton, 2019).

Making some Universities more successful than others obtaining research income, for example as Warner and Palfreyman (2001) suggests that "Imperial College, UCL, Oxford and Cambridge – are increasingly in a super league of their own in terms of research income. The "Golden Triangle" universities were the only institutions each managing to attract more than £150 million of research funding in 1997-8, with a £60 million gap separating them from other institutions. Mergers of the larger London medical schools have had a dramatic impact on the position of UCL, Imperial and KCL, while Oxford, Imperial, Cambridge and UCL attracted over a quarter of the external research income from the UK Sector, securing 40 per cent of charitable funds, 30 per cent of research council income and 24 per cent of funding council grants" (Warner and Palfreyman, 2001, p32-p33).

Today, universities are expected to become more business focused and create profits to support their operations as Parker (2002) comments "international student recruitment, international courseware delivery, joint research projects with industry, commercialisation of research outputs, corporate consultancies, corporate in-house training programmes, short course delivery to industry and commerce, and strategic alliances with professional and business bodies" (Parker, 2002, p607). All these policies and changes have forced universities to compete against each other for not only resources, but also for the brightest students, the best staff and business partnerships.

As potential funding streams become more competitive to access, UK universities must manage their resources more effectively, as one of the biggest costs to a university is how to allocate overheads within its operation. As a significant part of the total cost of a university is made up of providing central services, like libraries, computing, and student support services (Lewis and Pendlebury, 2002). At the university departmental level, these costs are normally either top-sliced, charged out, taxed through department staff or student numbers, traded, and devolved down to the department budget. Any reduction in external funding to the university is passed down to the departments by the university reducing departmental operating budgets. Therefore, academics are looking to develop collaboration with firms to access resources they cannot obtain from their universities (Tyrrell, 2015).

Within the last 15- 20 years, universities have been looking to collaborate with business to generate additional revenue. According to the Council for Industry and Higher Education (CIHE), during 2003, the following interaction took place between UK universities and business:

On average each year these companies spend:

- about 80 million with HEI's on research and development projects.
- some £4 million on consultancy services.
- some £6 million on knowledge transfer activities.
- recruit on average over 2,200 graduates per annum.
- spend £7 million on student placements.

- provides some £5 million to sponsor students at HEIs.
- spend some £2 million supporting students on work experience.
- spend some £70 million per annum on developing their work force.
  (6 million of which is paid to UK HEI's for training and development)
- support HEI's in other ways such as funding chairs, supporting teaching, helping with curriculum development, sponsoring conferences, leading skills sessions, donating equipment and offer travel grants.
  (The problem is this support is difficult to quantify but could exceed 1 million per annum)

Source: CIHE (2003)

As collaboration can allow universities to access resources including funding, many universities, departments, and individual academics look to collaborate with firms to access knowledge, skills, resources, and funding. A case study analysis of a specific university procurement tender process which has resulted in collaboration (innovation), can identify not only the benefits of collaboration but identify where the buyer can access specific knowledge, skills, resources, and funding to mitigate external factors affecting the universities operation. The cases being investigated are based within a UK research focused university, which undertakes both a research and teaching activities at undergraduate, taught post-graduate and research postgraduate (MPhil/PhD) levels.

## 1.2 Theoretical Background of Study

### 1.2.1 Opening Innovation and the Triple Helix Model

The aims of the literature review are to develop an understanding of the existing research, paradigms, and debates within the fields of the Triple Helix Model, the Entrepreneurial University Model, Open Innovation Model, Lead-User Theory, the Concept of Value-Added, the Procurement Tender Process and Cross-

Sector Collaboration Factors. By conducting a literature review, the author can develop knowledge of these fields and identify how this study aims to interlink with existing knowledge in these fields.

In the past, innovation used to take place within the firm or by an inventor who created new goods, services or technology then started their own business to offer these innovations to the external market (Baldwin and von Hippel, 2011). Although some firms may continue to innovate in house, the concept of Open Innovation (known as OI) identifies that firms may not have all the resources internally to innovate successfully in house (Martin, 2016). In the Open Innovation model developed by Chesbrough (2003a; 2003b; 2004, 2006) a firm uses both internal and external knowledge to produce new innovations for the external marketplace (Margues, 2014). In contrast, the Triple Helix model is where universities, firms and the government come together to foster innovation and create economic prosperity (Etzkowitz and Leydesdorff, 2000).

Both OI and the Triple Helix model's share the same objective which is to find surplus value in bringing industry innovation closer to public research and development (Leydesdorff and Ivanova, 2016). In OI, the firm is central to innovation, in the Triple Helix model predominantly by Etzkowitz and Leydesdorft (see for example: Etzkowitz and Leydesdorft 1997; Etzkowitz, 2003a; Etzkowitz, 2003b; Etzkowitz and Leydesdorff, 2000 and Etzkowitz, 2008) central to innovation is the relationship between industry, universities and the government alongside the rise of the knowledge-based economy. The Triple Helix model puts the university at the heart of any national innovation system (Santoen et al, 2014) with each institution taking on the role of the other within the model (Etzkowitz and Ledydesorff, 2000; Leydesdorff and Meyer, 2006).

A core principle of the Triple Helix model is the concept of the entrepreneurial university, which focuses on altering organisational abilities by technology transfer through patenting, licensing, and incubation (creating a new venture capital spin off firm) to gain economic benefit. A gap in the Triple Helix literature identifies there is no clear link to the micro level of the university (Cai, 2013) and future research should focus on the relationship between individual academics and firms. As Tyrrell's (2015) research indicates that UK university academics are collaborating directly with firms to gain this economic benefit instead of collaborating through the university's Technical Transfer Office (TTO).

One of the key outcomes from the Triple Helix model is to generate innovation for economic benefits, this innovation can take the form of new product creation by the university through the technical transfer process. New product development (NPD) is the process of creating a new product from idea to launch in the external market and requires the firm to understand customer needs and wants (Tidd and Bessant, 2013). Tyrrell's (2015) research suggests that academics are developing relationships with firms for their own benefit at the micro level. These firms are then using the knowledge obtain through their relationship with university academics into their NDP process to create new innovations. The creation of new products is also a key feature of the OI Model.

The OI model aims to open the innovation process to other firms, individuals, research labs, universities, customers, and suppliers. To allow the smooth flow of ideas from both inside and outside the organisation and by doing so allow the firms to gain advantage by exploiting both internal and external resources (Rangus et al, 2017). In OI (Chesbrough et al, 2006) this absorbed knowledge is used to create internal innovation and release to the market new technology, goods and services or Intellectual Property (IP). Numerous empirical studies on OI implementation have been conducted on large high-tech multinational firms (NME's), comprising of, IBM, Intel, Microsoft, and Millennium Pharmaceutical (Chesbrough, 2003), Proctor and Gamble (Dodgson et al, 2006) in the electronics industry (Christensen et al, 2005) and pharmaceutical's industry (Melese et al, 2009).

Yet, the OI model is a broad concept (Nobel et al, 2014) and there have been various debates on whether open innovation is a field of study or if it is a communication barrier to theory development (Linstone, 2010; Wikhamn, 2013). However, the OI model needs to be defined within the context of the firm's stakeholders; end-users, suppliers, competitors, and their short/long term relationships which Chesbrough (et al, 2006) did not study when developing the OI model. As Chesbrough's (2003) original model was based on a firm generating innovation through accessing internal/external knowledge and finding a market for each of its output itself. There was no involvement with the firm's stakeholders; end-users, suppliers, and competitors, indicating a gap in the OI literature focusing on actors influencing the inputs and output factors of the OI model. Another gap in the OI literature indicates that there are few studies that identify the processes that firms adopt to effectively implement OI (Giannopoulou et al, 2011; Spithoven et al, 2013; West and Bogers, 2014) and how OI is implemented, and the processes used within public sector firms.

### 1.2.2 End-User Innovation

Some academic buyers within UK universities do not have the resources or skills to develop new scientific equipment themselves (Watson and Hall, 2015). Therefore, the buyer looks to collaborate with a manufacturer that has the resources to create a new working prototype (Tyrrell, 2015). Most of the empirical literature focuses on the end-user as the sole creator of new innovations (von Hippel 1976; von Hippel 1977; von Hippel 1986; Urban et al, 1988) and on products that do not require major capital investment (Franke and von Hippel 2003). Franke and von Hippel (2003) provided a summary of the different empirical studies that have resulted in innovation that has been created by the end-user as sole creator. Below is Table 1.1 which provides a summary of the empirical research conducted into sole creator innovation.

**Table 1.1 – Sole Creator Literature Summary**

| Commodity | Reference |
|---|---|
| Printed Circuit CAD software | Urban and von Hippel; 1988 |
| Pipe Hanner Hardware | Hersate and von Hippel,1992 |
| Library Information Systems | Morrison et al, 2000 |
| Apache Software | Franke and von Hippel, 2003 |
| Medical/Surgical Instruments | Lüthje, 2003a |
| Outdoor Consumer Products | Lüthje, 2003b |
| Extreme" Sporting Equipment | Franke and Smith, 2003 |
| Mountain Biking Equipment | Lüthje, 2003 |

Source: Franke and von Hippel (2003, p4)

Currently, there are only a few studies on end-user innovation that focuses on academics or clinicians being involved in the innovation process with medical or scientific equipment manufacturers (Hippel, 1976; Shaw, 1985; Shaw, 1988). Lüthje's (2003a) study of medical/surgical instruments in Germany indicated that the end-user collaborated with the manufacturer in NPD (Franke and von Hippel 2003). These studies do not investigate the reasons for collaboration, or the benefits obtained from collaboration for both parties. In contrast, Tyrrell (2015) studied medical/life science end-users (academics) in UK universities and concluded that 45% of end-users were engaged in NPD with the scientific manufacturer directly. However, Tyrrell's (2015) study did not investigate if this group of end-users had engaged in NPD through the procurement tender process. As the EU Public Procurement Regulations (2015) now allows public bodies (like universities) to restructure their tender processes to purchase goods and services not released to the market (Goudt, 2016).

As universities purchase goods/services to conduct their operations (Etzkowitz, 2008), the procurement tender process can be a method to implementing OI. By allowing the buyer and supplier to exchange new ideas during the tender process that can lead to new product innovations. For this study, the purchase of the goods is interlinked with future new product innovation, this allows the buyer to access new innovations long term. The purchasing department has long been associated with reducing costs and improving the firm's performance

(Ellram and Tate, 2015). Today's purchasing department has become strategic and goes beyond the goals of savings and cost reduction (Luzzini et al, 2015). Purchasing departments are now focused on developing strong buyer-supplier relationships (Bidault et al, 1998; Grudinschi et al, 2014) getting early supplier involvement in NPD and co-creation (Matthyssens et al, 2016).

Empirical studies on purchasing involvement in NPD processes have focused on private sector firms (Laursen and Anderson, 2016). The procurement literature fails to provide studies showing NPD processes in public sector firms, as there has been little interest in public procurement research (Bergman and Lundberg, 2013; Quayle and Quayle, 2000). Moreover, the term procurement and purchasing has become confusing and used inter-changeably. Therefore, the duties that procurement or purchasing department's carry out can vary between different organizations. Within a UK university context, purchasing involves the placing of orders for goods/services within academic departments. Procurement refers to the strategic sourcing (make or buy decision) (Murray, 2009) and contracting of suppliers, so that departments can raise orders. Traditionally public procurement focuses on the delivery of goods/services through a third-party provider, obtaining value for money, and ensuring that the public body complies with regulatory requirements (Meehan et al, 2017).

### 1.2.3 The Concept of Value-Added

As procurement provides services to internal stakeholders, the most important being the end-user, it is important, that procurement engages early with end-users to identify their needs to make sure the end-user follows the correct procurement process (Koppelmann, 1998). Therefore, procurement needs to identify what benefits or value-added factors the academic buyer considers important when making a purchase. The concept of value-added has been identified across various subject literature. Table 1.2 below is a summary of the value-added subject literature.

**Table 1.2 - Subject Specific Value-Added Factors**

| Literature | Reference |
|---|---|
| Procurement Literature | Bailey et al, 2015; Benton W. C. Jr, 2010; Cox, 1996; Ellram and Tate, 2015; Lysons and Farrington, 2016; Morris and Pinto, 2007; Preuss, 2000; Torvinen and Ulkuniemi, 2016; Wisern et al, 2019 |
| Marketing Literature | Kaufman, 2001; Jolibet et al, 2012; Matthyssens et al, 2016 |
| Innovation Literature | Amhed and Shepard, 2010; Abramovsky and Simpson, 2008; Baldwin and von Hippel, 2011; Brem and Viardot, 2013; Howells et al, 2012; Padilla-Meléndez and Garrido-Moreno, 2012; Smith, 2006; Tether and Swann, 2003; Vanhaverbeke and Du, 2010 |

Source: Tyrrell (2022)

Within each of the various subject literature, there are different factors that are considered important. For this study, the author will develop a table of value-added factors and identify what academic buyers consider is important when purchasing scientific equipment. Early engagement between procurement and the academics is enforced by university's financial regulations that require a tender process to be undertaken before an order can be raised for goods/services. For this study, procurement services are responsible for strategic sourcing, tender process management, developing supplier relationships and accessing supplier knowledge (Matthyssens et al, 2016). Interlinking procurement with the OI model concept that suppliers can be a source of knowledge, resources (Chesbrough, 2003a; 2003b; 2004; 2006) and a cross-sector collaborating partner.

### 1.2.4 Cross-Sector Collaboration Success Factors

Cross-Sector collaboration (CSC) involves industry and public sector institutions coming together as a single organisation (Bryans et al, 2006; Buffett and Eimickle, 2018) to solve problems, share resources, IP, knowledge, money, personnel or equipment, exchange know-how, expertise, and experience (Canker and Petkovšek, 2013). Within the CSC literature, the critical success factors identified by the author are summarized into a single table below in Table 1.3. These CSC factors are critical to the success or failure of the collaboration.

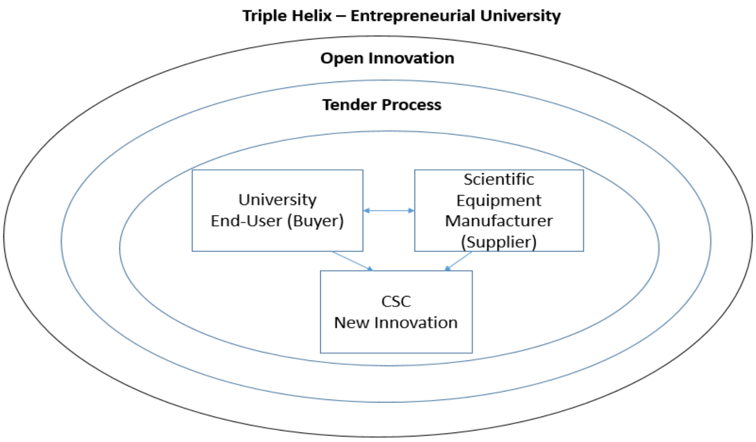
**Table 1.3 - CSC Factors Literature Summary**

| No | Critical Success Factor | Literature reference |
|---|---|---|
| 1. | Collaboration Context | Bryson et al, 2006; Clarke and Fuller, 2010; Hartman and Dhanda, 2018; O'Leary and Vij, 2012; Osborne, 2006; Perkmann et at, 2014 |
| 2. | Purpose of Collaboration | Austin 2010; Bryson et al, 2009; Clarke and Fuller, 2010; Johnson and Finegood, 2015; Ivascu et al 2016; Mayo et al, 2014; Mendel and Brudney, 2018; Mohr and Spekman, 1994; O'Leary and Vij; 2012; Perkmann et at, 2014; Vernis et al, 2006; Ukalkar, 2000 |
| 3. | Partner Selection Process and Capability | O'Leary and Vij, 2012 |
| 4. | Collaboration Motivation and Commitment | Clarke and Fuller, 2010; O'Leary and Vij, 2012; Mayo et al, 2014; Thune, 2011; Ukalkar, 2000 |
| 5. | Collaboration Structure and Governance | Bryson et al, 2006; Bryson et al, 2009; O'Leary and Vij, 2012 |
| 6. | Power | Bryson et al, 2006; Hartman and Dhanda, 2018; Mayo et al, 2014; O'Leary and Vij, 2012 |
| 7. | Accountability | Bryson et al, 2006; Bryson et al, 2009; O'Leary and Vij, 2012 |
| 8. | Communications | Austin 2010; Austin and Seitanidi, 2014; O'Leary and Vij, 2012; Mendel and Brudney, 2018; Mohr and Spekman, 1994; Perkmann et at, 2014; Vernis et al, 2006; Ukalkar, 2000 |
| 9. | Legitimacy | Bryson et al, 2006; O'Leary and Vij, 2012 |
| 10. | Trust | Austin, 2010; Austin and Seitanidi, 2014; Bryson et al, 2006; Couchman and Fulop, 2009; Forrer et al, 2014; Johnson and Finegood, 2015; Mohr and Spekman; O'Leary and Vij, 2012; Osborne, 2006; Perkmann et at, 2014; Vernis et al, 2006; Ukalkar, 2000 |
| 11. | Information Technology | Austin 2010; O'Leary and Vij, 2012 |
| 12. | Culture | Johnson and Finegood, 2015; Ivascu et al 2016; Mendel and Brudney, 2018; Mohr and Spekman, 1994; Vernis et al, 2006; Ukalkar, 2000 |
| 13. | Collaboration Monitoring | Austin 2000; Jamali and Keshishian 2009; Johnson and Finegood, 2015; Seitanidi et al. 2010; Von Tuder et al, 2016; Ukalkar, 2000 |
| 14. | Collaboration Evaluation | Austin 2000; Jamali and Keshishian 2009; Johnson and Finegood, 2015; Seitanidi et al. 2010; Von Tuder et al, 2016; Ukalkar, 2000 |
| 15. | Continuous Improvement | Johnson and Finegood, 2015; Ukalkar, 2000 |
| 16. | Leadership | Bryson et al, 2009; Crosby and Bryson, 2010; Malin and Hackmann 2019 |
| 17. | Partnership Length | Mendel and Brudney, 2018; Mohr and Spekman, 1994; Vernis et al, 2006; Ukalkar, 2000 |
| 18. | Cross-Functional Teams | Mendel and Brudney, 2018; Mohr and Spekman, 1994; Vernis et al, 2006; Ukalkar, 2000 |

Source: Austin 2010; Austin 2000; Austin and Seitanidi, 2014; Bryson et al, 2006; Bryson et al, 2009; Crosby and Bryson, 2010; Clarke and Fuller, 2010; Couchman and Fulop, 2009; Forrer et al, 2014; Hartman and Dhanda, 2018; Jamali and Keshishian 2009; Johnson and Finegood, 2015; Ivascu et al 2016; Malin and Hackmann 2019; Mayo et al, 2014; Mendel and Brudney, 2018; Mohr and Spekman, 1994; O'Leary and Vij; 2012; Osborne, 2006; Perkmann et al, 2014; Seitanidi et al. 2010; Thune, 2011; Tuder et al, 2016; Vernis et al, 2006; Ukalkar, 2000.

There is little empirical research into applying these success factors in CSC partnerships between a university and industry (Esteves et al. 2011, Halseth and Ryser, 2007) which would necessitate the proposed research study. This study aims to map the direct and indirect links between universities and firms by identifying if these can be embedded in the procurement tender process specification. This study is bound by the Triple Helix, Entrepreneurial Model of the University, Lead-User Theory, the Concept of Value-Added but applies the OI model and CSC factors, by exploring how knowledge flows in the context of the procurement tender process. The model below in Figure 1.1 provides a representation of the conceptual model for this study, this is the concept of the author of the project. As the study progresses, the author will add the value-added factors and cross-sector collaboration factors into the model. In the conclusions, the author will provide a final model for this study.

**Figure 1.1 - Conceptual Framework of University – Industry Collaboration**




Source: Tyrrell (2022)

Before starting this research study, the author undertook provisional research within the context of a UK research intensive university (known as RIU) to identify if there were any university tenders that had resulted in collaboration and if this secondary data could be used a basis for a research study. Once the author had identified the tenders that resulted in collaboration and reviewed the tender documents to ascertain what value-added factors had been added to the tender documents, the author was able to identify the name of the buyer and supplier engaged in the collaboration. After undertaking the literature review the author developed the research aims and questions for this project as listed below.

## 1.3 The Study Purpose

This study will firstly, identify the success factors created in cross-sector collaboration leading to new product development (NPD) and enhance our understanding of the motives and value-added factors that drive university academics and scientific manufacturing firms to collaborate. Secondly, this study will enhance the procurement tender process by integrating the success factors into the tender process to make the process more conductive to collaboration. Thirdly, this study will summarise all the value-added factors identified in the literature review that could be used to inform buyers of the value-added factors they could incorporate into the tender process.

The study’s, main questions are:

1) What is the success of cross-sector collaboration (CSC) and value-added factors that drive new product innovation and University-Industry collaboration?

2) What cross-sector collaboration (CSC) and value-added factors do buyers (university) and suppliers (industry) consider important when developing a collaboration and do the study participant’s demographics influence these factors?

3) How can these cross-sector collaboration (CSC) success and value-added factors become integrated into the procurement tender process and documentation to make the process more conducive to cross-sector collaboration for innovation?

4) What model can drive buyer (university) and supplier (industry) collaboration for new product innovation?

The study's, objectives are:

1) To explore the collaboration between buyers (university) and suppliers (industry) and identify which value-added and CSC (cross-sector collaboration) factors, drive new product innovation and collaboration through the examination of fifteen university procurement tenders.

2) To identify the CSC (cross-sector collaboration) factors, value-added factors and participant demographics that buyers (university) and suppliers (industry) consider important and influence the collaboration through the review of literature, secondary and primary data.

3) To understand how the value-added and cross-sector collaboration (CSC) success factors integrate into the procurement tender process and documentation to ensure a successful collaboration from the buyers' (university) and suppliers' (industry) perspective.

4) To develop a model based on the identified value-added and cross-sector collaboration (CSC) success factors that drive university-industry collaboration and new product innovation.

## 1.4 Study's Potential contribution to knowledge

Whilst numerous studies focus on implementing OI in large multinational (Chesbrough, 2003; Dodgson et al, 2006; Christensen et al, 2005; Melese et al, 2009), there are no studies that combine OI implementation in public sector firms and the processes used to create innovation outcomes. Within the procurement literature (Bidault et al, 1998; Ellram and Tate, 2015; Grudinschi et al, 2014; Luzzini et al, 2015) there are no studies that link OI buyer and supplier knowledge exchange with the procurement tender process (Tyrrell, 2015) due to a lack of research in public procurement (Bergman and Lundberg, 2013; Quayle and Quayle, 2000).

After investigating various literature on value-added factors and success factors for university (buyer) and industry (supplier) collaboration within the procurement, marketing, innovation, and cross-sector collaboration literature. There are no studies that interlink the value-added factors identified in procurement literature (Bailey et al, 2015; Benton W. C. Jr, 2010; Cox, 1996; Ellram and Tate, 2015;Lysons and Farrington, 2016; Morris and Pinto, 2007; Preuss, 2000; Torvinen and Ulkuniemi, 2016; Wisern et al, 2019), in the marketing literature (Kaufman, 2001; Jolibet et al, 2012; Matthyssens et al, 2016) or the innovation literature (Amhed and Shepard, 2010; Abramovsky and Simpson, 2008; Baldwin and von Hippel, 2011; Brem and Viardot, 2013; Howells et al, 2012;Padilla-Meléndez and Garrido-Moreno, 2012; Smith, 2006; Tether and Swann,2003; Vanhaverbeke and Du, 2010) (to name a few of the studies) into a single study or combine the value-added factors in a single table for further empirical research for both the buyer (academic end-user) and supplier (scientific manufacturer). Within the Triple Helix literature (Etzkowitz, 2003a; Etzkowitz, 2003b; Etzkowitz and Leydesdorff, 2000 and Etzkowitz, 2008), no studies have focused on the relationship between individual firms and academics in creating innovation.

This study investigates what the cross-sector collaboration success and value-added factors that drive new product innovation and University-Industry collaboration. Identifies what success and value-added factors do buyers(university) and suppliers (industry) consider important when developing a collaboration. Examines if these cross-sector success and value-added factors be integrated into the procurement tender process documentation. Explores what improvements can be made to the procurement tender process to make it more conducive to cross-sector collaboration for innovation. These literature gaps have been combined into a single study that investigates if cross-sector collaboration can be managed within the procurement tender process.

By exploring the methods used to transfer knowledge between cross-sector partners (Tether and Swan, 2003; Tyrrell,2015) and the success factors used for cross-sector collaboration (Mendel and Brudney, 2018; Mohr and Spekman,1994; Vernis et al,2006). Unfortunately, no studies have been conducted into university and firm cross-sector collaboration (Esteves et al, 2011, Halseth and Ryser, 2007).

After reviewing the literature on cross-sector collaboration, the author has summarized and identified the critical success factors into a single table that influence the success of the collaboration. A copy of able 1.3 below provides a summary of these cross-sector factors including:

## Table 1.3 - CSC Factors Literature Summary

| No | Critical Success Factor | Literature reference |
|---|---|---|
| 1. | Collaboration Context | Bryson et al, 2006; Clarke and Fuller, 2010; Hartman and Dhanda, 2018; O'Leary and Vij, 2012; Osborne, 2006; Perkmann et at, 2014 |
| 2. | Purpose of Collaboration | Austin 2010; Bryson et al, 2009; Clarke and Fuller, 2010; Johnson and Finegood, 2015; Ivascu et al 2016; Mayo et al, 2014; Mendel and Brudney, 2018; Mohr and Spekman, 1994; O'Leary and Vij; 2012; Perkmann et at, 2014; Vernis et al, 2006; Ukalkar, 2000 |
| 3. | Partner Selection Process and Capability | O'Leary and Vij, 2012 |
| 4. | Collaboration Motivation and Commitment | Clarke and Fuller, 2010; O'Leary and Vij, 2012; Mayo et al, 2014; Thune, 2011; Ukalkar, 2000 |
| 5. | Collaboration Structure and Governance | Bryson et al, 2006; Bryson et al, 2009; O'Leary and Vij, 2012 |
| 6. | Power | Bryson et al, 2006; Hartman and Dhanda, 2018; Mayo et al, 2014; O'Leary and Vij, 2012 |
| 7. | Accountability | Bryson et al, 2006; Bryson et al, 2009; O'Leary and Vij, 2012 |
| 8. | Communications | Austin 2010; Austin and Seitanidi, 2014; O'Leary and Vij, 2012; Mendel and Brudney, 2018; Mohr and Spekman, 1994; Perkmann et at, 2014; Vernis et al, 2006; Ukalkar, 2000 |
| 9. | Legitimacy | Bryson et al, 2006; O'Leary and Vij, 2012 |
| 10. | Trust | Austin, 2010; Austin and Seitanidi, 2014; Bryson et al, 2006; Couchman and Fulop, 2009; Forrer et al, 2014; Johnson and Finegood, 2015; Mohr and Spekman; O'Leary and Vij, 2012; Osborne, 2006; Perkmann et at, 2014; Vernis et al, 2006; Ukalkar, 2000 |
| 11. | Information Technology | Austin 2010; O'Leary and Vij, 2012 |
| 12. | Culture | Johnson and Finegood, 2015; Ivascu et al 2016; Mendel and Brudney, 2018; Mohr and Spekman, 1994; Vernis et al, 2006; Ukalkar, 2000 |
| 13. | Collaboration Monitoring | Austin 2000; Jamali and Keshishian 2009; Johnson and Finegood, 2015; Seitanidi et al. 2010; Von Tuder et al, 2016; Ukalkar, 2000 |
| 14. | Collaboration Evaluation | Austin 2000; Jamali and Keshishian 2009; Johnson and Finegood, 2015; Seitanidi et al. 2010; Von Tuder et al, 2016; Ukalkar, 2000 |
| 15. | Continuous Improvement | Johnson and Finegood, 2015; Ukalkar, 2000 |
| 16. | Leadership | Bryson et al, 2009; Crosby and Bryson, 2010; Malin and Hackmann 2019 |
| 17. | Partnership Length | Mendel and Brudney, 2018; Mohr and Spekman, 1994; Vernis et al, 2006; Ukalkar, 2000 |
| 18. | Cross-Functional Teams | Mendel and Brudney, 2018; Mohr and Spekman, 1994; Vernis et al, 2006; Ukalkar, 2000 |

Source: Austin, 2010; Austin 2000; Austin and Seitanidi, 2014; Bryson et al, 2006; Bryson et al, 2009; Crosby and Bryson, 2010; Clarke and Fuller, 2010; Couchman and Fulop, 2009; Forrer et al, 2014; Hartman and Dhanda, 2018; Jamali and Keshishian, 2009; Johnson and Finegood, 2015; Ivascu et al, 2016; Malin and Hackmann 2019; Mayo et al, 2014; Mendel and Brudney, 2018; Mohr and Spekman, 1994; O'Leary and Vij; 2012; Osborne, 2006; Perkmann et al, 2014; Seitanidi et al, 2010; Thune, 2011; Tuder et al, 2016; Vernis et al, 2006; Ukalkar, 2000

However, there is no single study that incorporates these success factors into a single research design. For this study, these CSC success factors have been incorporated into the data collection tools for both the buyer telephone interviews and supplier virtual meetings. This research can potentially make a practical contribution in relation to enhancing the procurement tender process by integrating the success factors discerned from both practice and theory. This research will, firstly, identify the success factors created in cross-sector collaboration leading to new product development (NPD) and enhance our understanding of the motives and value-added factors that drive university academics and scientific manufacturing firms to collaborate, leading to a contribution to both theory and practice. Secondly, the research will potentially contribute to enhancing the Chesbrough's (2006) OI model, by providing real world cases where the buyer (University) and supplier (Industry) exchange knowledge and integrate resources within the partnership as part of the inflow process of the OI model in the context of the public sector procurement. Finally, the research will potentially provide case examples of how OI can be implemented into the procurement tender process and allow a cross-sector partnership to access and integrate resource and knowledge that it does not possess. This would potentially inform how Industry can collaborate better with universities to create a competitive advantage (Christensen, 2001; Porter,1985; Powell, 2001; Wen-Cheng et al, 2011).

## 1.5 Study Layout

This research study is structured into several chapters, Chapter 1 focuses on the issues facing the UK Higher Education Sector (known HE Sector), an overview of the empirical research, literature and literature gaps overarching this study. The research questions and aims being investigated, an overview of the potential contribution to knowledge and the conceptual model for this research study.

Chapter 2 focuses on a detailed analysis and examines the various research studies, literature and literature gaps influencing this study, including end-user theory, open innovation (OI) theory, triple helix model theory, public procurement role, the tendering process and different tender processes, EU public procurement legislation, public private partnership theory, value-added factors theory and cross-sector collaboration factors (CSC factors) that make a collaboration successful. Chapter 3 explores the research methodology and data collection tools adopted to assemble the data from the tender specification, supplier tender returns, research collaboration and participant responses which include a buyer telephone interview and supplier virtual meeting interview schedules. Chapter 4 tests this research study's ethics and the author's decision to ensure that participants are not harm during the data collection, analysis, and write-up phase of this study.

Chapter 5 explores the buyer and supplier characteristics that influences the value-added and CSC factors present in university-industry collaboration and provides new theoretical models. Chapter 6 identifies the important value-added factors present in university-industry collaborations and provides new theoretical models. Chapter 7, identifies and examines the important CSC factors present in university-industry collaboration, those CSC factors not required for university-industry collaboration and provides new theoretical models. Chapter 8, focuses on recommendations to change the tender process, including methods for embedding the value-added and CSC factors identified in this study's findings to make any future tender process more conducive to collaboration. Chapter 9 provides a summary of the data analysis and research findings from chapters 5,6,7 and 8 and a summary of new theory created from the research findings. Including this study's contribution to knowledge, future research required and study limitations. The Bibliography provides a summary of all the references examined during this study's completion.

Finally, there are several appendices added after the references including the buyer telephone interview schedule, supplier virtual meeting schedule, participant information sheet and participant consent form that can be reviewed for other researcher's wishing to conduct a similar study within another setting.

# Chapter 2: Literature Review

## 2.1 Introduction

As the context of this study, is based within university innovation, with the academics and scientific equipment manufacturers engaged in collaboration through the tender process to develop innovation. The literature review begins with an overview on the existing research paradigms, and debates within the field of the Triple Helix Model, the Entrepreneurial University Model, Open Innovation Model, all these models suggest universities are engaged in innovation to create surplus revenue. However, these models do not investigate the involvement of the academic or supplier in the innovation process. Therefore, a literature review was conducted on Lead-User Theory to identify if end-users have been engaged in the innovation process and whether university academics have engaged in this form of collaboration. After examination, a small number of empirical studies have identified that end-users had engaged in collaboration within a university setting.

However, these studies did not identify the reasons or benefits obtained between the parties during the collaboration. Within the concept of value-added literature, the author identified several value-added factors that could be the reasons for both academics and suppliers forming a collaboration. Yet, these factors did not identify the type of processes that could be adopted to develop a collaboration between academics and firms. A literature review of the procurement tender process indicated that the tender process should be adopted to foster collaboration. Finally, a review of the cross-sector collaboration literature, identified the CSC factors that are required to make any collaboration successful. This study will identify which CSC factors are needed to be included in the tender process for future collaboration success. By conducting a review of this interdisciplinary literature, we can develop our knowledge of these fields and identify how this study aims to interlink with existing knowledge in these fields.

## 2.2. Innovation

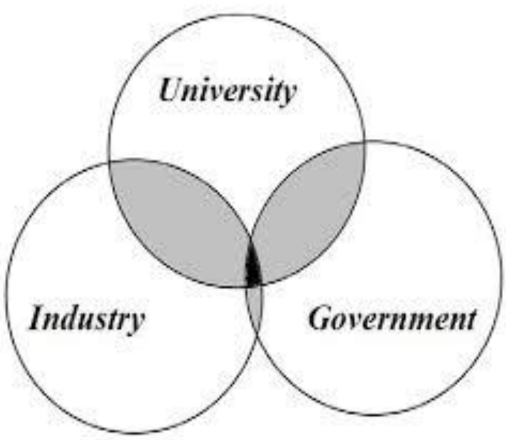
In the past, innovation used to take place within the firm or by an inventor who created new goods, services or technology then started their own business to offer these innovations to the external market (Baldwin and von Hippel, 2011). Although some firms may continue to innovate in house, the concept of Open Innovation identified that firms may not have all the resources internally to innovate successfully in house (Martin, 2016). In the Open Innovation Model developed by Chesbrough (2003a; 2003b; 2004; 2006) a firm uses both internal and external knowledge to produce new innovations for the external marketplace (Margues, 2014). In contrast, the Triple Helix Model is where universities, firms and the government come together to foster innovation and create economic prosperity (Etzkowitz and Leydesdorff, 2000).

Both OI and the Triple Helix Model's share the same objective to find surplus value in bringing industry innovation closer to public Research and Development (R&D) (Leydesdorff and Ivanova, 2016). In OI, the firm is central to the innovation process, in the Triple Helix model proposed by (Etzkowitz and Leydesdorft 1997; Etzkowitz, 2003a; Etzkowitz, 2003b; Etzkowitz and Leydesdorff, 2000 and Etzkowitz, 2008) central to innovation is the relationship between industry, universities and the government alongside the rise of the knowledge-based economy. The model compasses the research conducted by Lowe (1982) and Sábato and Mackenzi (1982) who examined the shift from a dominating industry-government dyad in the Industrial Society to the relationship between university-industry-government in the Knowledge Society (Ragus and Etzkowitz, 2013). University-industry innovation is now seen as an economic issue that shapes the conditions of future innovation and economic growth (Thune, 2011). Nevertheless, both theories do not investigate the benefits and reasons for individual universities and firms engaging with each other to create innovation, indicating a gap in the Triple Helix and Open Innovation literature. In the next section, the author discusses the various triple helix models, literature gaps and identifies how the model can influence buyer (academic) and supplier (firm) collaborations.

## 2.3 The Triple Helix Model

The Triple Helix model puts the university at the heart of any national innovation system (Santoen et al, 2014) with each institution taking on the role of the other within the model (Etzkowitz and Ledydesorff, 2000; Leydesdorff and Meyer, 2006). Figure 2.1 below shows a representation of the Triple Helix Model.

**Figure 2.1 - Triple Helix Model**




Source: Etzkowitz and Leydesdorff, (2000)

Over the last two decades, the Triple Helix has developed a significant body of theoretical and empirical literature including the (neo) institutional perspective. This perspective focuses on the development of national and regional innovation systems and their impact on entrepreneurship and innovation (Cai, 2013; Decter et al, 2007; Etzkowitz, 2003, Etzkowitz and Leydesdorff, 2000; Inzelt, 2004; Lee, 1996; Lawton Smith and Bagchi-Sen, 2010; Laursen and

Salter, 2004; Kalman and Balmenou, 2014; Mohen and Hoareau, 2003; Pugh; 2017; Rosa and Mohnen, 2007; Santonen et al, 2014; Wu, 2014). Most of these studies focused on various features of the university "third mission", to commercialise academic research and the involvement in socio-economic development (Perkmann et al, 2013). This drive to obtain revenue from knowledge and technological transfer is driven by successive UK governments restricting research funding, which has forced universities to undertake activities either to attract industrial funding or to generate income to finance their operations (Etzkowitz et al, 2000). In the next section, the author will discuss the different Triple Helix Models and how different configurations influence the relationship between university, industry, and government.

## 2.4 Different Triple Helix Models

Within the Triple Helix literature, there are number of different perspectives of the Triple Helix, the main perspectives are: the neo institutional perspective, the neo evolutionary perspective and the entrepreneurial university. Within the (neo) institutional perspective there are three configurations of university, industry, and government spheres: 1) a statist model, in which the government plays the lead role, driving universities and industry to innovate but at the same time restricts their capacity for transforming the economy, for example China, Russia, Latin American and Eastern European countries. 2) in a Laissez-faire model, with industry taking the lead as the driving force of innovation. Both government and universities function as support structures for industry. In this model, universities provide knowledge workers and government provides economic and social regulations to support industry innovation. 3) in a balanced model, in which universities and other knowledge institutions take the lead in innovation by forming a partnership with government and industry (Etzkowitz, 2003; Etzkowitz and Leydesdorff, 2000).

After examining the different Triple Helix Model configurations, the author concluded that each of the configurations have implications on the relationship formed and the length of the partnership. Hence, the author aims to investigate the relationship and the length of the partnership during the collaboration. Although there is an extensive theoretical and empirical literature within the Triple Helix paradigm at national and local level of the economy, very few studies have focused on collaborations between individual academics (buyers) and suppliers (firms) to create innovation which the supplier can sell to the external market, indicating a gap in the Triple Helix literature and empirical research. Yet individual universities and firms do engage in collaboration to develop innovation.

Within the UK, there are several universities that have engaged in collaboration with industry these include Cranfield University, Kings College London, University of Southampton, Queen Mary University of London, Plymouth University, University of Birmingham, University of Oxford, University of Glasgow, and Sheffield Hallam University to name a few (National Centre for Universities and Business, 2015). These universities have engaged in collaboration via the balanced form of the Triple Helix model. With most of the collaborations resulting in new product creation, joint venture and spin off companies with industry. The neo (evolutionary) perspective examines the Triple Helix model from a different viewpoint, that the Triple Helix is made up of functions focused on wealth generation (or, knowledge exploitation), knowledge (novelty) production and normative control (Leydesdorff, 2001; Leydesdorff and Meyer, 2006; Leydesdorff, 2010; Leydesdorff and Deakin, 2011). According to Leydesdorff (2001) reviewing each sphere’s functionality (university, industry, and government) has become difficult to identify, as each function operates at the national, regional innovation level and the functions can overlap. The aim of the neo-evolutionary perspective is to examine the synergies between the different functions which help to support the knowledge based at national, regional, and local level (Audretsch and Phillips, 2007). However, these cases of individual universities and firms that have engaged in collaboration, only focus on the new spin-off or joint venture firms created by the partners and the revenue created in the wider national and local economy. Indicating a literature gap on the benefits each partner receives from collaborating. Next the author reviewed the Systems of Innovation Theory within the Triple Helix literature, to identify if this theory could underpin the study.

## 2.5 Triple Helix - Systems of Innovation Theory

Range and Etzkowitz (2013) developed the concept of the Triple Helix Systems of Innovation, a new analytical framework for examining the key features of the Triple Helix based on a systems theory of a set of components, relationships, and functions within the model. Within the framework, there is a distinction between 1) R&D and non-R&D innovators, 2) “single-sphere” and “multi-sphere” (hybrid) institutions and 3) individual and institutional innovators. Within the model the relationships between components are blended into five main types: collaboration and conflict, technology transfer, collaborative leadership, substitution, and networking. The overall aim of the Triple Helix Systems of knowledge and innovation is to provide an explicit framework for examining interactions between Triple Helix actors and gain comprehensive review of the flow of knowledge and resources in the model. That can help identify blockages and gaps in the flow of knowledge and resources that can advance innovation theory and practice (Range and Etzkowitz, 2013).

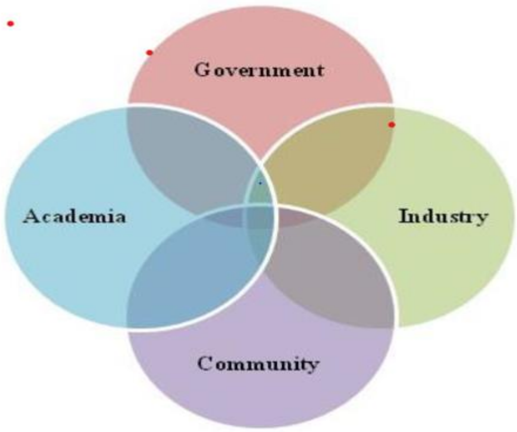
However, the use of the Triple Helix Systems of Innovation model, is primarily used to support government policy making decisions to increase innovation activity within the economy and thereby enhance GDP output. The author has not used the Triple Helix Systems of Innovation model, as this model does not explain the relationship and innovation outcomes from buyer (academic) and supplier (firm) collaboration and its wider impact on the buyer teaching or research activities nor the firms use of the innovation indicating a literature gap.

Next, the author reviewed the Quadruple Helix to identify if this could explain university-industry collaboration.

## 2.6 Quadruple Helix

Recently the Triple Helix has added another dimension that of civic society to become the Quadruple Helix. The representation of the model can be found below in Figure 2.2:

**Figure 2.2 - Quadruple Helix Model**




Source: Demawan (2016)

Based around the idea that universities, business, and public-sector organisations come together to create innovation and economic prosperity for the local community (Kolehmainen et al, 2016; Lawton-Smith 1990; Miller et al, 2016; Rieu 2014). Most studies focus on the macro level of the university and its external activities, these studies do not focus on the individual university operations and departments engaged in innovation, nor the impact of collaboration on the partners operations. Instead, they focused on the benefits of the local community from the spin-off or venture capital firms like increase employment in the local area and spillover of the revenue on local businesses. However, the Triple Helix models apart from the Systems Innovation Theory, does underpin this study, indicates that universities and firms can collaborate and develop innovation together.

A core principle of the Triple Helix model is the concept of the entrepreneurial university, that focuses on altering organisational abilities by technology transfer through patenting, licensing, and incubation (creating a new venture capital spin off firm) to gain economic benefit (Etzkowtiz et al, 2000; Etzkowitz, 2003; Etzkowitz, 2004; Etzkowitz, 2008). Within this model, government takes on the role of venture capitalist in addition to providing the regulatory framework the two other spheres operate within. As firms within the model become more high-tech, these firms start to engage more with universities to provide training and sharing knowledge (Grant et al, 2014). Next the author examines the literature on the entrepreneurial university to identify if these theories can underpin this study.

## 3. The Entrepreneurial University

Within the literature there are two different perspectives of the function of an entrepreneurial university, within the higher education literature, Table 2.1 below provides the main goals of an entrepreneurial university according to (Schulte, 2004) are:

**Table 2.1 - Entrepreneurial University Goals**

| | |
|---|---|
| 1. | For the university student to not only be a jobseeker but through study and education become a job-creator (become entrepreneurs themselves). |
| 2. | To cope with difficulties that might arise in the universities external market, university management should develop a multidisciplinary approach to research. |
| 3. | Research output should not just focus on publication, but ideas should be the starting point for creating new business, with these new innovations benefiting the economy and society. |

Source: Schulte (2004)

Within the Higher Education Literature, Shattock (2003) suggests that one of the main features of an entrepreneurial university is that funding is diverse. Although the UK Government wants universities to diversify their funding streams, the current competitive funding methodology has forced universities to develop decision making and internal resource allocation based on the UK government funding formula (Bolton, 2019). The funding formula for UK universities has several income streams, firstly from student tuition fees. Currently UK students registered on a university course needs to pay that specific university directly £9250.00 per annum for their tuition. In contrast international students registered on UK courses pay higher fees that are set by a specific university. The problem with this source of income is if the university does not fill all their course places, the university will face an income deficit (Universities UK, 2018).

Secondly, another part of the formula is focused on the rating each university received in the teaching excellence framework (TEF) which assesses the quality of teaching within UK universities. If a university performs badly and obtains a low mark, the university will face an income deficit. Thirdly, research is based on a block grant design to support university infrastructures and through the UK Research Councils providing specific funding to research projects. The block grant is awarded on the rating the university received for its quality of research through the Research Excellent Framework (known as REF). Failure to do well in the REF rating process can result in a university facing an income deficit. The second part of the dual funding involves individual university academics competing against each other for funding of specific projects. This process is highly competitive and involves academics submitting a grant application and having their work assessed by a panel of experts to decide if the project will be funded (Adams and Bekhradnia, 2004; Hughes et al, 2013).

A truly entrepreneurial university does not develop an organisational structure that supports the funding decisions made by the UK research councils but accepts all funding (including state funding) as a single income stream, with departments accepting that the university will allocate resources based on its own priorities (Shattock, 2003). This perspective focuses on the university structure, university governance, funding streams and diversity of research, not on the output of an entrepreneurial university. Nor does this education perspective, explore the benefits of an individual academic engaging with a firm to create innovation at a departmental level. However, the second perspective focused on the Triple Helix theory of innovation which focuses on the university gaining benefits for becoming entrepreneurial.

## 3.1 The Entrepreneurial University Objectives

The second perspective is within the Triple Helix Literature, the entrepreneurial university's main objectives are not only to carry out teaching and research but to obtain economic returns from generating knowledge and technology transfer (Etzkowtiz et al, 2000; Etzkowitz, 2003; Etzkowitz, 2004; Etzkowitz, 2008). An entrepreneurial university aims to empower teams of researchers, students, and businesses to work face-to-face or electronically together to develop new organisational networks, relationships and construct new spin-off activities (Audretsch, 2014; Ferreir et al, 2018).

In contrast, Zhou and Etzowitz (2006), suggests the characteristics of an entrepreneurial university are 1) entrepreneurial activities are supported and accepted internally, 2) the university has a mechanism in place to commercialise innovation, 3) that there are many staff that can form new firms. Another characteristic of an entrepreneurial university is its culture, the attitudes that stem from the top to the bottom of the organisation, scientists that want recognition for their research and focus on research having a commercial output (Etzowitz, 2008). From these different perspectives we can conclude that researchers cannot agree what constitutes an entrepreneurial university or its core components (Meyers and Pruthi, 2011). However, this innovation perspective, only focuses on commercial output and revenue created for the university and firms, not the benefits an individual university stakeholder receives from the collaboration directly indicating a gap in the triple helix literature.

For this study, the entrepreneurial university will adopt characteristics for both higher education and entrepreneurial literature (Etzkowtiz et al, 2000; Etzkowitz, 2003; Etzkowitz, 2004; Etzkowitz, 2008; Schulte, 2004; Shattock, 2003). Although the University’s main objective is still teaching and research, the university sets up a separate internal department, division or a new firm that provide services to support and develop spin off firms, internal incubators on campus and joint collaborations with industry. The entrepreneurial university will be defined as having an entrepreneurial attitude that flows through the organisation. Departments are encouraged to engage in innovation with industry and courses are designed to develop entrepreneurial skills for its students. With the aim of supporting their students to develop new innovations and set up businesses. This form of university accepts all income as a single income stream and departments accept the priorities and budget set by the university. As the author has adopted the characteristics of both higher education and entrepreneurial perspectives, this study is underpinned by the concept of the entrepreneurial university. However, the entrepreneurial university has various methods for generating and defusing knowledge to create innovation, the author now investigates the innovation activities from the entrepreneurial university.

## 4. University Innovation Activity

As the university continues to develop its links with industry, new commercial organisations are created. There are various streams of literature that focuses on the output of university innovation, these include the impact of science parks on regional innovation (Bellegarde et al 2014; Etzkowitz and Leydesdorff, 2001; Lawton-Smith; 2006). Science parks are industrial parks that have an association with a specific university and have tenant firms that are either affiliated and/or owned by the university or have independent firms working in proximity to the university, allowing the firm located on the science park access to external knowledge from the interaction with the local university (Chan et al, 2010; Díez-Vial and Frenández-Olmos, 2015; Fukugawa, 2006; Phan et al, 2005; Vedovello, 1997).

Another stream on the innovation output from the entrepreneurial university focuses on universities using their expertise in teaching and research to develop new technology, scientific goods and services to create new firms (spin-off) (Ferreira et al, 2018; Piterou and Birch, 2014; Lawton-Smith and Glasson, 2005; Mas –Verdú et al, 2015: Shane, 2004; Stal et al, 2016; Wright et al, 2007; Wu, 2014). These spin-off companies normally gain access to government funding for developing the R&D phase of the goods and services, or venture capital to start the company up, the intellectual property (IP) profit related is normally shared back between the researcher, university, and venture capital provider (Saputra, 2018).

Another literature stream of the entrepreneurial university is university business incubators that support, provide resources and facilities to develop newly established business and the benefits of starting a business with university support (Grimaldia and Grandi, 2005; Lasrado et al, 2016; Main, 1996; Phan et al, 2005). The university business incubator services can include shared space, advanced equipment, managerial support, networking and access to national and international markets, patenting, and IP protection (Fayolle and Redford, 2014; Jamil et al, 2015). Another benefit of using a university incubator is that the new start-up company can access academics support, access research facilities, and have access to the university students as future employees – reducing the cost of recruitment (Allan and O'Shea, 2014).

However, spin-off firms, venture capitalist firms, incubators, and science parks, focus on the flow of innovation between partners and the economic output from this collaboration and it benefits to the national and local economy. The literature neglects to investigate innovation activity created between individual firms collaborating with an individual academic at a university departmental level. Consequently, the author did not use the university innovation activity literature to underpin this study, as this study does not look at collaboration through creating a new firm.

## 5. Triple Helix Model Limitations

However, there are limitations and gaps in the Triple Helix model, firstly the model fails to recognise the national setting that impacts on the university, industry, and government relationships (Shinn, 2002). Secondly, the model does not take into consideration the different innovations systems in each country which has not clearly been defined (Elzinga, 2004). Thirdly, the Triple Helix model presumes that all universities will engage in the model, however a small number of universities will have difficulty changing. As a case study by Tunnainen (2002) suggests not all universities will engage in innovation because of internal conflict causing difficulty developing structures with industry to commercialise their technology, suffer from conflict between internal management and the researchers over who owns the IP rights and who should be paid for the IP rights, the university, department, or the researcher engaged in the project.

Another issue is even if the university becomes entrepreneurial, the entrepreneurial activities may not have a big impact on society, just the local economic environment it operates within. Finally, another gap in the Triple Helix literature is that the Triple Helix model needs a clear link to the micro level of the university (Cai, 2013) and should look at the potential relationship between individual firms and academics. As UK university academics are collaborating directly with firms in new product development (NPD) without the involvement of their University's Technical Transfer Office (TTO) (Tyrrell, 2015). The aim of the

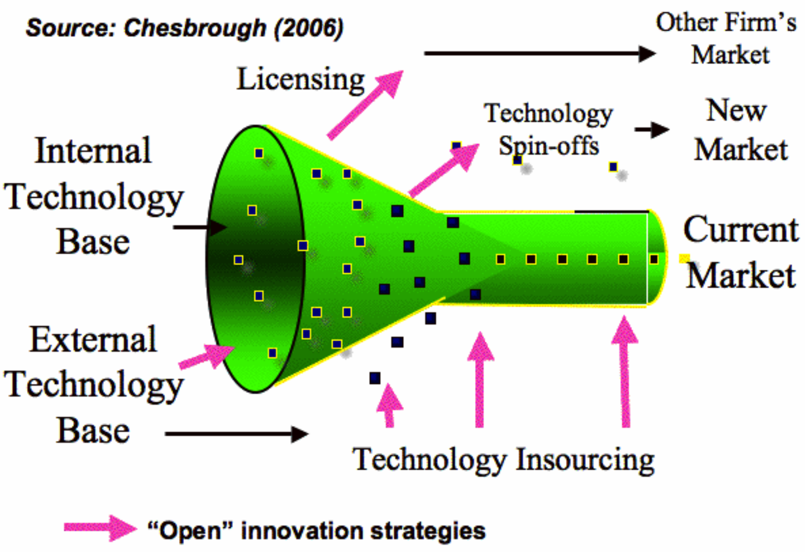
TTO is to develop an internal mechanism within the university to identify technology, goods, and services which can be commercialise to potential external customers (Etzkowitz, 2008).

New product development (NPD) is the process of developing a new product from idea to external market that requires the firm to understand customer needs and wants (Tidd and Bessant, 2015). Tyrrell's (2015) research suggests that academics are developing relationships with firms for their own benefit at the micro level. These relationships at department and individual (academic) level have been informal and some-time run in parallel with formal agreements focused on tailor making education courses to meet the firm's requirements (Thune, 2011). Next the author investigated the Open Innovation literature to examine if the theory can be used to underpin this study.

## 6. Open Innovation Model

The OI model aims to open the innovation process up to other firms, individuals, research labs, universities, customers, and suppliers. To allow the smooth flow of ideas from both inside and outside the organisation which allows the firm to gain advantage by exploiting both internal and external resources (Lichtenthealer, 2011; Rangus et al, 2017; Tidd and Bassant, 2015). Another source of ideas includes charities, application developers, content providers, technology, and design houses, and from various "open" communities like innovation networks, standard agencies, and end-users (O'Connell, 2011). Below is Figure 2.3 shows a representation of the Open Innovation Model:

**Figure 2.3 - Open Innovation Model**




Source: Chesbrough, (et al, 2006)

Figure 2.3 shows knowledge flows as a linear process and leads to a set of outputs resulting in new innovations. However, some projects will be redesigned, changed, or stopped during the research or development process and never make it to the external market. Chesbrough's (2003a; 2003b; 2004; 2006) model does not embed any of the stakeholders, like end-users, suppliers, competitors in the process and their long-term relationships. To make open innovation work, the firm needs to select the best partner or partners on complimentary technology or characteristics the firm lacks. In turn for the partnership to be success a high level of trust needs to develop between the partners during the open innovation process (Crawford and Di Benedetto, 2015; Forrer et al, 2014). However, in most cases OI does not substitute the internal innovation process but complements internal capabilities of the firm (Tidd and Bassett, 2015).

Chesbrough (2003a; 2003b; 2004; 2006) does not explain in the OI model if the IP licensing is just sold off to competitors or allocated to partners that have complementary core competences to support the firm's strategy (Hamel and Prahalad, 1994). A core competence can be defined as a set of unique skills and resources that a firm possesses that delivers benefits to its customers, through is offering of goods and services (Palmarudi and Hastan, 2012). The OI model does not evaluate or identify how knowledge spill over is managed or who benefits from this knowledge. Another flaw in Chesbrough's (2003a; 2003b; 2004; 2006) original research is the research only focused on high tech large firms in the USA, Chesbrough (2003a; 2003b; 2004; 2006) did not conduct research into the open innovation model being implemented within low tech firms or small medium size business (SME's) (Spithovern et al, 2013). Nor did the original research examine OI implementation in other countries around the globe. This model may not apply or need radical alterations to be relevant to SME's and firms located in other countries around the globe. Additionally, Chesbrough (2003a; 2003b; 2004; 2006) model failed to research, if public sector firms like universities, could implement OI internally, as part of a research and development strategy. Or if firms working with universities have incorporated individual academics into the firm's OI processes.

However, the author concluded that the Open Innovation Model may be able to explain supplier engagement with the buyer to create a new prototype, therefore the OI model underpins this study.

## 6.1 Chesbrough's Six Notion's Theory of Open Innovation

Chesbrough (2003a; 2003b; 2004; 2006) also presents six notions within the open innovation paradigm. Figure 2.2 below provides a summary of these six notions below:

### Table 2.2 - Chesbrough's Six Notions

| Closed innovation | Open innovation |
|---|---|
| 1 – All the smart people work in our organization. | 1 – Not all the smart people work in our organization. |
| 2 – To profit from R&D we have to discover, develop and supply everything ourselves. | 2 – External R&D can create value for our organization. |
| 3 – Only if we discover it will we manage to get it to market first. | 3 – Internal R&D is needed to grasp that value. |
| 4 – If our organization is the first to commercialize an innovation, we will beat our rivals. | 4 – We have to be involved in basic research to benefit from it, but the discovery does not have to be ours. |
| 5 – If we create the most and best ideas in our industry, we will win. | 5 – If we make better use of external and internal ideas and unify the knowledge created, we will win. |
| 6 – If we have full control over the innovation process our rivals will not be able to profit from our innovative ideas. | 6 – We should optimize the results of our organization, combining the sale or licensing of our innovation with the purchase of external innovation processes whenever they are more efficient and economic. |

Source: Marques, 2014, p199

To bolster his open innovation paradigm Chesbrough (2003a; 2003b; 2004; 2006) created the concept of the "closed innovation system". As these two concepts are opposites, it makes it easy for Chesbrough (2003a; 2003b; 2004; 2006) to champion his open innovation model. Under the closed innovation model, the firm focuses on developing new innovations internally, in their own Research and Development Facilities, then launch them directly to market without any external involvement. However, Chesbrough (2003a; 2003b; 2004; 2006) does not give credit to other researchers, as there are valid reasons for firms to adopt the Open Innovation Model. Although Chesbrough's six notions indicate the importance of implementing OI for a firm, it did not explain the reasons why a firm need to embed the model in the firm's research and development processes, this is discussed in the next paragraph. Consequently, the author has not used Chesbrough's six notions to underpin this study.

## 6.2 Reasons for Why Firms Adopt Open Innovation

According to Tether and Swann (2003), the reasons why firms chose to adopt an Open Innovation process is to reduce the cost of innovation, to reduce economic risk, they lack qualified personnel, have problems complying with regulations and standards within their industry, lacking technical and market information, have organisational rigidities and limited finance. Additional benefits of OI implementation can include developing a faster time to market for products, accessing knowledge the firms don't possess, better adaption of goods and services to meet customer needs, commercialisation of knowledge and technology which may have been wasted, sharing risk in innovation, and enhancing the firm's image or reputation (Padilla-Meléndez and Garrido-Moreno, 2012). However, the IO literature fails to provide examples of how IO can be implemented in an organisation's processes, or if it can be implemented in a public sector organisations like universities, or if firms working with UK universities use the knowledge that has been shared to incorporate into the firm's research and development process.

Indicating that the firm does not possess all resources required to make a successful innovation in house (Markman, 2016), therefore the external environment may provide access to these resources. For a struggling firm with limited resources and a small market share, open innovation can provide a lifeline for survival. However, Tidd and Bassett (2015) suggest there are several challenges to a firm adopting OI, these include, how to identify and find sources of knowledge, how to develop mechanisms to transfer knowledge and external R&D is also available to a firm's external competitors. Creating an idea is only one part of the innovation process, a firm needs to develop a cost evaluation to identify ideas that have value against those that do not, there can be a conflict between commercial internal and strategic direction of the firm, it takes time to negotiate acceptable terms for IP licenses. The firm needs to develop a business model that reduces time to negotiate with other actors in the innovation process and a firm needs to develop a sufficient R&D capability to identify, evaluate and adopt external R&D to meet internal capabilities. However, the concept of OI has many different perspectives, the author will now examine the perspective and terms in the next paragraph.

## 6.3 Defining Open Innovation

However, there is confusion over the concept of open innovation, which can be analysed from several different perspectives and terms, the most common being; distributed innovation, free innovation, collegial innovation, collaborative innovation, free knowledge disclosure and open knowledge disclosure (Del Guidice et al, 2013). Additional confusion comes from the concept of open-source software where a software source code is free to access, modify and distribute by the public and open science where research data, lab notes and lab process are freely available to replicate any underlying data or methods used in the original study (Baldwin and von Hippel, 2011).

For this study the concept of OI is based on Chesbrough (2003a; 2003b; 2004; 2006) model using external ideas and absorbing this knowledge to create internal innovation and release to the external market; new technology, goods/services, or Intellectual Property (IP) (Chesbrough et al, 2006). This study will investigate if OI model has been applied by the university or supplier during it collaboration to create the new scientific equipment or software.

Numerous empirical studies on OI implementation have been conducted on large high-tech multinational firms (NME's), comprising of Lucent, IBM, Intel, Microsoft, Cisco, and Nokia and Millennium pharmaceutical (Chesborough, 2003), Proctor and Gamble (Dodgson et al. 2006) in the electronics industry (Christensen et al, 2005) and pharmaceutical's industry (Melese et al, 2009). Chesbrough (et al, 2006) did look briefly on university and firm innovation within the open innovation model which focused on US universities and the protection of IP rights. Advocating that universities are an external source of ideas and knowledge to the innovation process. However, within US universities, the federal government policy has been to encourage universities to generate more commercial application for their research and increase their patent protection to create revenue to support university operations (Chesbrough, 2006).

With many innovations, scholars have focused on the relationship between large innovative firms and upstream players including universities, research labs, and specialist suppliers, service companies and knowledge brokers like Innocentive, Ninesigma, Yourencore and other (Vanhaverbeke and Du, 2010). The problem with innovation is a company or region may take a specific path to innovation, but when this is transferred to another setting the innovation fails as innovation techniques adopted are not tailored to meet the context in which they are going to be applied (Markman, 2016).

As OI is a broad concept (Nobel et al, 2014; Tidd and Bessant, 2015) the OI model needs to be defined in the context of the firm's stakeholders, like end-users, suppliers, competitors and their short/long term relationships, a concept that Chesbrough did not study when developing his model. As goods and services that have a high novelty require a higher interaction between the actors involved in the innovation and richer mechanism for sharing knowledge (Tidd and Bassett, 2015). This indicates a gap in the literature on how these actors influence the inputs and outputs factors of the OI model. Another literature gap is OI research needs to identify the processes adopted to effectively implement OI (Giannopoulou et al, 2011; Spithoven et al, 2013; West and Bogers, 2014,) and the OI implementation and processes used in public sector firms. Indicating that current empirical research on open innovation, is general and has not been applied in specific contexts (Tidd and Bassant, 2015).  In addition, on the OI model input side, there is a gap in the literature on the integration of lead-user in the model, as previous studies have focused on firm's interaction with the supplier (Padilla-Meléndez and Garrido-Moreno, 2012; Vanhaverkek and Du, 2010).

In contrast to the traditional approach of inhouse innovation, the OI Model involves new stakeholders working together during the development process, these new stakeholders consist of government bodies, suppliers, competitors, universities, and end-users. As a key component of new product innovation is future users of goods and services, it is invaluable to make end-users central to the innovation process, as collaboration with end-users can provide an understanding of the technical and functional requirements needed to fulfil buyer expectations (Choi, 2015). If a firm's main market is to sell goods and services to UK universities, the end-user that the firms must engage with to obtain knowledge is the academic buyer. However, there are limited studies that investigate OI models within universities and the inclusion of the end-user in the creation of innovation. The impact of the end-user on innovation will be examine in the next section.

## 7. End-User Innovation

As some academic buyers within UK universities do not have the resources or skills to develop new scientific equipment themselves (Watson and Hall, 2015), the buyer looks to collaborate with a manufacturer that has the resources to create a new working prototype (Tyrrell, 2015). Within the innovation literature, a pioneer on the concept of the end-user being a source of innovation is Eric von Hippel. Hippel (1976) first studied innovation in scientific instruments by focusing on four important instrument types: gas chromatography (GC), the nuclear magnetic resonance spectrometer (NMR), the ultralight spectrophotometer (US) and the transmission electron microscope (TEM). According to von Hippel (1988, p12) "my innovation sample for each of the four instrument families included the initial, first-of-type device as it was first commercialised and the many commercially successful major and minor "improvements" innovations that enhanced the performance of the basic device over the succeeding 20 or more years".

Von Hippel (1976) reasoned that by studying a reducing sample size of scientific equipment using a longitudinal approach it would remove any variables in the market/industry structure which could distort the level of innovation (Tyrrell, 2015). From the four scientific instruments studied, Martin (1994, p182) suggests that von Hippel "found that all of the first-of-type of these instruments were developed by end-users. Also, in his sample of 44 major and 63 minor improvements to the original instruments, 36 (82%) and 32 (70%) were developed by users respectively”. However, von Hippel study fails to investigate what academics do if they do not have the resources to develop the new prototype into a final model, before handing this over to the supplier to implement into mass production, nor the benefits they receive from this process. Next von Hippel continued his research into end-user innovation by developing a step process to explain how innovations are created.

## 7.1 Von Hippel’s Innovation Process

From the data set, von Hippel (1988) developed a step process for the development of new scientific instruments based on involving the end-user in the innovation process. Table 2.3 below, shows the steps to create innovation.

**Table 2.3 - Steps to create a New Innovation**

| | |
|---|---|
| 1) | Identifying a need to advance the instrumentation. |
| 2) | Create the instrument. |
| 3) | Build a prototype. |
| 4) | Identify the prototype’s value and apply it. |
| 5) | Diffuse the knowledge on how the instrument can be replicated and defuse the value of the invention. |

Source: Von Hippel (1988)

Only after the end-user has completed all the steps in the process does the supplier become involved in steps 4 and 5. During the innovation process, the supplier only provides engineering work on the new device to improve its operation and reliability. The supplier then assembles and markets the new device to the external market (Hippel, 1988).

There are several literature gaps in von Hippel’s study, including von Hippel’s study failing to focus on the relationship between end-user and manufacturer in creating the innovation, nor did the study assess the length of time it took to develop the new innovations or how often basic, minor, and major innovations were released to the external market. The concept of basic, minor, and major innovation was not defined in any detail. The step process for developing and diffusing scientific instrument innovation created by von Hippel, suggests that the end-user is the sole creator of the new scientific instruments, and that the supplier only produces the final prototype (Smith, 2006). Both the supplier and end-user may brainstorm to find new ways of developing the functionality of the equipment through a process of trial and error.

However, von Hippel's (1976) study did not investigate if the end-user benefits from the development of the new innovations through revenues obtain from the IP once the innovation has been released to market. However, this approach by the end-user to create innovation can be in contradiction with the Universities Technical Transfer Office (TTO) that aims to develop commercial goods and services from public sector inventors to gain economic benefits for the university, transfer knowledge, create economic growth in their region and respond to social and public expectations (Brescia et al. 2016; Decteret al, 2007; Etzkowi, 2008; Etzkowitz and Leydesdorff 2000; Miller et al, 2009; Tyrrell 2015). Although von Hippel expanded this research to investigate end-user innovation in the semiconductors industry, to transfer this theory to a new setting.

## 7.2 Von Hippel's Research in the Semiconductors Industry

After exploring end-user innovation in scientific instruments, von Hippel (1988) conducted a second study to determine if users as innovators dominated the field of the semiconductor and electronic sub assembly industry. Traditionally innovation within the semiconductors and electronics subassembly industry assumed that the manufacturer was the one to develop the innovation internally and deliver this to the external market for commercialization (1977). In this research study, von Hippel (1977) aimed to explore the patterns of innovation process shared in a new industry – process machinery rather than addressing the management implications of user dominated innovation. The population von Hippel (1977) studied was the manufacturers of silicon-based semiconductors (including transistors, integrated circuits etc.) and manufacturers of electronic subassemblies which consist of printed circuit boards with integrated wiring and electronics components. By analysis the process steps with the manufacturing process of both the semiconductor and PCB manufacturers, von Hippel (1988) was able to identify which product lines had successfully resulted in new innovations.

Data was collected by reviewing the process flow sheets used to organize the manufacturing process of semiconductor and electronic subassemblies, this identified each step used to manufacture the final components. These steps remained consistent over time, however the technology used to covert the raw material into finished products my changed due to machinery innovations (1977).

Around 60 innovations were identified in the study, the Table 2.4 below provides a summary of the innovations identified in the Silicon Semiconductor and for Printed Circuit Board Subassembly Processing Industry.

**Table 2.4 - Innovation in the Silicon Semiconductor and for PCB Subassembly Processing Industry**

| Major Process Step | Initial Commercial Practice | Major Improvements |
|---|---|---|
| **Silicon Semi-Conductor products** | | |
| 1. Growth and single silicon crystal | Crystal puller | Resistance heated based puller<br>Dislocation-free crystal puller<br>Automatic |
| 2. Wafer Slicing | High Precision Saws | ID saw |
| 3. Wafer Polisher | Optical polishing equipment and technique | Chemical/mechanical polishing ($SiO_2$) |
| | | Chemical mechanical polishing (Cuprie Salts)d |
| 4. Epitaxial processing | Pancake reactor | Horizonal reactor |
| (optional process step) | | Barrel reactor |
| 5. Oxidation | Not examined | |
| 6. Resist coating | Water spinner | High acceleration wafer spinner |
| 7. Mask alignment and wafer exposure | Mask aligner | Split field optics aligner |
| 8. Oxide etching | Not examined | Automated mask aligner |
| 9. Silicaon junction fabrication | Grown junction | Diffused junction furnace |
| 10. Mentalization | Not examined | |
| 11. Scribing and dicing | Jig and fixture | Mechanical scriber and dicer |
| 12. Mounting | Not examined | |
| 13. Wire bonding | Solder bonding | Thermocompression bonding |
| 14. Encapsultion | Not examined | |
| 15. Mask graphics | Handcut rubylith patterns | Optical-pattern generator |
| | | Electron bean pattern generator |
| 16. Mask reduction | Two-stage step and repeat reduction process | Not examined |
| **Electronic subassembly manufacture** | | |
| 1. Circuit fabrication | PC board | Not examined |
| 2. Component insertion | Hand Component insertion | Single-component-per-station<br>Component insertion<br>X-y table component insertion<br>Numerically controlled-driven<br>X-y table component insertion<br>Sequenced components insertion |
| 3. Mass soldering | Dip solder | Wave solder |
| 4. Assembly | Not examined | |

Source: Von Hippel,1988, p21.

From this action, von Hippel was able to identify the first firm that commercialised the innovation and the date the innovation was launched to the external market. Next von Hippel conducted structured telephone interviews with everyone directly involved or had knowledge of the commercialisation of the innovation within the firm being studied. During the telephone interview, respondents were asked to provide contact details of other potential candidates that could contribute to the study by undertaking a structured telephone interview. In conjunction to the telephone interview, von Hippel analysed appropriate technical literature to examine when the first reference to the new innovation's functionality was published in the relevant technical journals. Authors were then contacted and asked to undertake a telephone interview with the aim of identifying the knowledge in the end-user community, general scientific community of the benefits and use of the innovation. Parallel to the first firm to commercialise the innovation, von Hippel, sought out and interviewed the staff from user-innovation firms. From these data collection tools, the raw data was assembled, and any discrepancies noted. The interviewees were later contacted to clarify the discrepancies in their responses (1977, 1988). However, there are several limitations in von Hippel's research which is examined in the next paragraph.

## 7.3 Limitations of Eric von Hippel's Research

Eric von Hippel (1977) concluded that in the machinery process industry, innovation was dominated by end-users. Overall, only nine cases from the sample indicating that the manufacturer was dominant in creating the innovation, compared to 29 cases which were dominated by end-users. Indicating that like the scientific instrument sector, end-user innovation dominates the Semiconductor and Electronic Subassembly Industry (1977,1988). However, von Hippel did not clearly define the concept of the end-user within this study, as the concept of the end-user can be sub-divided into consumer innovation, those end-users that consume the goods or service and intermediate users that are firms that use equipment made by the producers to create goods and services (Bogers et al, 2010). Von Hippel's study does not identify which innovation was created by consumer or intermediate users. Finally, von Hippel's study does not explain the reasons and benefits of why this group of firms collaborate. As the manufacturers not only benefits from the reduced cost of innovation but also the reduction in the uncertainty associated with the new product development process (Foxall and Tierney, 1984). In contrast, collaboration allows the firm to improve their strategic position in the external market, offer organizational learning, reduce risk, provides technology exchange, overcoming government trade or investment barriers, blocks competition and embed the partners in the firm's value chain (Child and Faulkner, 1998).

In the case of SME (Small Medium Enterprises), the motive for collaboration can be to access external expertise that will improve organisational knowledge and in the long terms keep them competitive. Unfortunately, universities tend to pursue collaborations with larger firms, who have an extensive knowledge base of their own (Piterou and Birch, 2014). Other benefits from collaboration can include collaborating with a university that is strong on industrial liaison and technological transfer, thereby increasing the chance the collaboration is successful. Or where the university has created a specialist innovation ecosystem which has created an environment where large firms and research coexist. Or with a university that offers a dedicated location and team on both an informal and formal basis that provide services and manages the interactions within the collaboration (Markman, 2016). There are various ways that publicly funded research can benefit the economy and industry, including developing a research partnership, developing joint research services, creating academic entrepreneurships, human resource transfer, creating informal interactions, commercialising property rights, and co-authoring scientific publications (Padilla-Meléndez and Garrido-Moreno, 2012). Finally, von Hippel identified that not all end-users have the resources to create a new piece of equipment, therefore von Hippel developed the concept of the "customer-active paradigm" which is discussed in the next paragraph.

## 7.4 Von Hippel's Customer-Active Paradigm (CAP) Model

After recognising that users can be a source of innovation, von Hippel (1977, 1978, 1988) developed a concept of innovation called the "customer-active paradigm" (CAP), in this model the customer develops the idea and then selects a supplier that can make the product. The role of the manufacturer in this model, is to wait until the customer approaches them with an idea for a new product, review the ideas and select the ideas to develop, that provides the most promise for the manufacturer’s perspective (1978). Von Hippel reasoned this concept would replace the traditional manufacturer-active paradigm where the customer act only as a respondent e.g., being asked for ideas. The manufacturer’s role in this model, is to obtain the information from the customer on the proposed modification or new product design, evaluate the data, develop a product idea, and measure this against customer perception before creating a new product (1987, 1988). While the CAP model suggests that end-users should play a more active role with producers in development of innovation, the model does not explain the reason actors get involved or their motivations. Indicating a literature gap in the motivation for collaboration, as within the field of scientific instruments the scientist seeks approval for their accomplishment from their peers while the scientific manufacturers seek to gain reward by monetary profit (Bogers et al, 2010; Riggs and von Hippel, 1994). Von Hippel now theorised that end-user needs must be better interpreted between the end-user and the manufacturer; therefore, von Hippel theorised a new four step process to include the end-user in the innovation process.

## 7.5 Von Hippel’s Four-Step Process engaging End-User in the Innovation Process

As end-user’s needs can be badly interpreted by intermediates between the end-user and manufacturer like sales executives and experts (Hani and de Marcellis-Warin, 2016). Von Hippel developed a typology of the end-user, which he called “lead-user” and created a four-step process for firms to include lead-users in their innovation process, which would allow a firm to confirm the end-users needs. According to von Hippel (1986) the lead-user is defined as an end-user who has a specific need for a good or service before other users in the marketplace. The end-user obtains a benefit from accessing this good or service and is therefore likely to want to innovate. Von Hippel created a four-step process to engage the end-user in the innovation process, the four-step process is shown in table 2.5.

**Table 2.5 - Four-Step End-User Innovation Process**

| | |
|---|---|
| 1) | Find the market or technological trend – before identifying a lead-user, it is important to identify the underlying trend that the lead-user has a leading position on, and this trend must be reliable. Define the potential benefit – the potential benefit to the end-user includes firstly, previous user product development and product modification can identify the user benefit, as there has been previous innovation. Secondly, user dissatisfaction with existing products (services or processes) which is likely to lead to new innovations. |
| 2) | After the tender and benefits are identified, the manufacturer needs to screen the market base via a questionnaire to identify the optimal user base. |
| 3) | Generate the product/concept with the lead-user – Using the data select the lead-users, to obtain real-life experience of product attributes and/or product concepts that are of commercial interest. Invite these lead-users to a group session to pool potential user solutions and develop a new product concept or fully formed product. |
| 4) | Test user concept (product) as today's lead-user may not meet the exact needs of tomorrow's users, the next step is to assess how lead-user data is more typical of the target user market. Then employing traditional product testing procedures after separating the responses from lead-user and non-leader user segments of the target market. |

Source: Ahmed and Sheppard; 2010; Goffin and Mitchell, 2005; Le Masson et al, 2010; Urban and von Hippel, 1998; Von Hippel, 1988.

From this study, the author aims to identify the representative from the manufacturer that has direct interaction with the end-user, this could be a sales representative or technical services engineer etc. By using a case study approach focusing on computer-aided design (CAD) systems, von Hippel was able to study his lead-user theory and four stage process. As the printed circuit board market, was large, growing at a rapid rate and was experiencing technological change. The study examined CAD systems that used to design printed circuit boards that are used in electronic products. The study aims to identify 1) who was designing the high-density board now and 2) who was likely to gain advantage from the increase in board density (von Hippel, 1988). To collect the data to answer these questions, von Hippel restricted his interview sample to only US firms that had a list of members that belonged to the relevant professional engineering association (IPCA) and a list of current and potential customers provided by the suppliers cooperating in the study. Interviews were selected at random from this sample and data was selected from 178 qualified respondents who were given the option to answer questions over the phone or by mail. Respondents consisted of engineers, designers, CAD or printed circuit board managers, general managers, and corporate officers (von Hippel, 1988; Urban and von Hippel, 1988).

From this data set, von Hippel concluded that PC-CAD user innovation was present and that users gain a high benefit from innovation in board design. From this result von Hippel (1998) suggested that users within a user population possess two distinct characteristics that make them a lead-user. Firstly, this end-user is at the cutting edge of new trends, and they are likely to experience a need for new goods or services a month or years ahead of the rest of the user community. Secondly, the lead-user is likely to obtain a significant benefit by obtaining a solution to their needs (von Hippel, 1981; von Hippel, 1986; Urban and Von Hippel; 1988; von Hippel, 1988; Franke and von Hippel, 2003; Tyrrell, 2015). However, the concept of the lead-user does fail to appreciate that not all lead-users are current customer's or future customers of the goods and services undergoing innovation. Vanhaverbeke and Du (2010) suggest that there are three specific groups that are likely to be involved in innovation, these are the target customer, who is likely to determine the economic value or the innovation, current customers, those interested in future developments of the existing goods/service and the lead-user.

As the author intends to use the concept of the end-user to define the buyer population in this study, von Hippel's end-user theory underpins this study. However, there are several limitations in von Hippel's research, these are discussed in the next paragraph.

## 7.6 Gaps in Von Hippel's Research Studies

There are several literature gaps in von Hippel's research. Firstly, von Hippel definition of the end-user is very general and is not specific to different end-users in different business sectors of the economy. Von Hippel does not identify specifically in his study on scientific instruments who the lead end-user is, it implies this is a scientist, however this person could be an academic, lab manager, technician, or even a PhD student, the characteristics of the lead-user are not defined in the context of the universities where the study was conducted. Secondly, von Hippel does not define the benefits that manufacturers obtain from working with an end-user in any detail. Thirdly, von Hippel's research does not give any reasons and identify additional benefits the end-user can obtain from a collaboration with the manufacturer. As the increased pressure to publish articles in prestigious international journals and monetary incentives may be reasons why university professors are seeking to develop R&D partnerships with industry (Brem and Viardot, 2013). Fourthly, von Hippel presumes that the end-user has the resources to develop a prototype, this may be not the case and the end-user is looking to obtain resources from the manufacturer to create the prototype for use (Smith, 2006; Tyrrell, 2015). Another gap in the end-user literature in von Hippel's studies, is von Hippel does not identify if the end-user demographic (characteristics), has an impact on the end-user's decision to innovate or not. Nor what the reasons are for working with a partner on a collaboration. Using von Hippel's research, Shaw (1985, 1988) built on von Hippel's definition of the end-user, the author discusses Shaw's contribution to end-user theory in the next paragraph.

## 7.7 Shaw's End-User Theory

Building on von Hippel's empirical research, Shaw (1985, 1988) conducted empirical research in end user innovation in the UK medical equipment market by sampling 34 medical equipment innovations undertaken by 11 manufacturing companies. The study examined the interaction between end-users and manufacturers in fifteen undergraduate, six-postgraduate teaching, and research hospitals and twenty universities with a hospital teaching school. Shaw (1985,1998) adopted von Hippel's end-user typology of the lead-user but gave it another dimension by classifying the end-user as being a clinician or physician that works within a specific medical specialism that used the equipment to diagnose or used for therapy on patients (Smith, 2006).

In the study, Shaw (1985, 1988) adopted von Hippel's definitions of innovation which included basic innovation, minor innovation, major innovation, and a new category that Shaw (1985, 1988) added called "failure". However, neither von Hippel (1977, 1978) nor Shaw (1985) provides a definition of what each of these categories meant. Shaw (1985, 1988) reasoned that after a prototype had been developed, the equipment needed to be clinically assessed and trialled before being used in a hospital setting, this created a special relationship between the clinical advisers and trial team on the hospital and teaching side (buyer) and the manufacturer (supplier).

To collect the data, Shaw (1985, 1988) selected respondents at random from the technical press, from attending international medical exhibitions to identify the medical equipment manufacturers and asking from support from experts in the field of medicine to nominate key individuals to interview. Respondents were then asked to take part in a semi-structured interview and if any gap appeared in the data, interviewees were contacted again for a follow up telephone interview. From the interview data, Shaw (1985, 1988) identified several medical equipment types that had undergone the innovation process.

Table 2.6 below listed the medical equipment that has undergone the innovation process and if the innovation, was basic, minor, or major innovation or an innovation failure.

## Table 2.6 - Medical Innovation Types

| | | Basic Innovation | Major Improvement Innovation | Minor Improvement Innovation | Failure | Total |
|---|---|---|---|---|---|---|
| 1. | Electrocardiography | | X | | | 1 |
| 2. | Neonatal Oxygen Monitoring System | X | | | | 1 |
| 3. | Venous Oxygen Monitoring System | X | | | | 1 |
| 4. | Care System for Casualty Work | | | X | | 1 |
| 5. | Miniaturisation of Radiography Equipment | | | X | | 1 |
| 6. | Topical Magnetic Resonance Spectroscopy | X | | | | 1 |
| 7. | ECG Recorder | | | X | | 1 |
| 8. | EGG Recorder | | X | | | 1 |
| 9. | Multiple Detector Head Gamma Counter for Radioimmunoassay | | | X | | 1 |
| 10. | Portable Autoclave | | X | | | 1 |
| 11. | Autoclave for Sterilisation of Sealed Fluids | | X | | | 1 |
| 12. | Portable Chart Recorder | | X | | | 1 |
| 13. | Hot Air Sterilizar | | | X | | 1 |
| 14. | Radio Pill Telemetry System | | X | | | 1 |
| 15. | Cardiac Monitor | | | X | | 1 |
| 16. | EEG Wave Analyser | | | | X | 1 |
| 17. | Safety Tester | | | X | | 1 |
| 18. | Oxytocin Infusion System | X | | | | 1 |
| 19. | Powered Syringe Driver with Patient Operated Demand System | X | | | | 1 |
| 20. | Portable Battery-Operated Variable Speed Syringe Driver | X | | | | 1 |
| 21. | Fixed Speed Syringe Driver | | | X | | 1 |

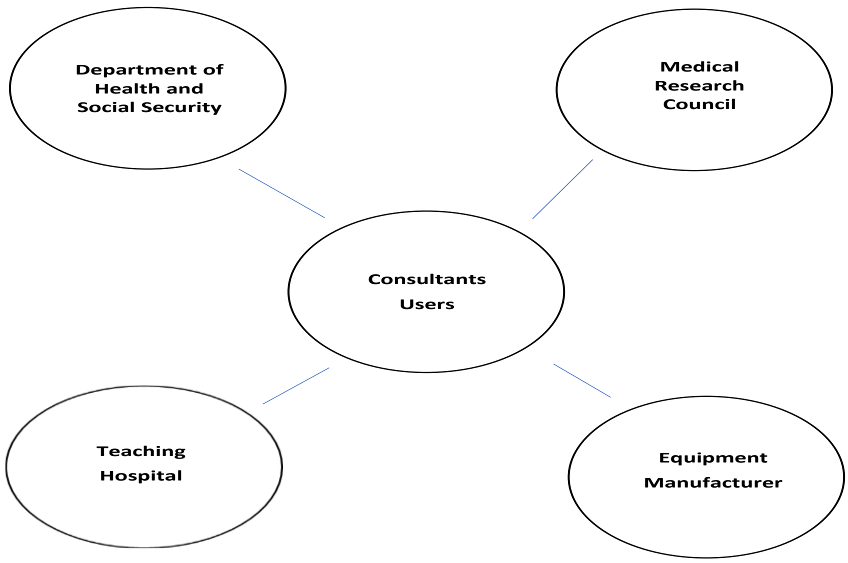
| | | | | | | |
|---|---|---|---|---|---|---|
| 22. | Continuous Syringe Driver with Boost Facility | | | X | | 1 |
| 23. | Respiratory Recording and Monitoring System | X | | | | 1 |
| 24. | Infusion Pump | | | | X | 1 |
| 25. | Foetal Monitoring /Oxytocin Pump Combination | | | | X | 1 |
| 26. | Wright Peak Flow Meter | X | | | | 1 |
| 27. | Mini-Wright Peak Flow Meter | | X | | | 1 |
| 28. | Perkins Hand-held Applanation Tonometer | | X | | | 1 |
| 29. | Transfer Test Apparatus | X | | | | 1 |
| 30. | Exercise Test Monitor | X | | | X | 1 |
| 31. | Oxylog | | | | | 1 |
| 32. | Nasal Airway Resistance Tester | | | | X | 1 |
| 33. | Mass Spectrometer | | | | X | 1 |
| 34. | Anaesthesia Equipment | | | X | | 1 |
| | Total | 10 | 8 | 10 | 6 | 34 |

Source: Shaw (1985, 1988)

From the data collected, Shaw (1985, 1988) concluded that within the field of medical equipment innovation, there was a network of actors that influenced the innovation process. These actors included Medical Research Council (MRC), Department of Health and Social Security (DHSS), the teaching hospitals and the Department of Industry (DoI) at the centre of this was the primary actor which is the end-user.

Smith (2006) provides a representation of the network below in figure 2.4 showing the interaction between the different actors in the innovation process researched by Shaw.

**Figure 2.4 - Medical Equipment Innovation Network Model**




Source: Smith (2006, p91)

Modifying von Hippel's (1976) step process for scientific innovation, Shaw (1988) reasoned that the medical equipment innovation process, starts with a consultant identifying a clinical need for new medical equipment. The consultant would then define the new equipment requirements and work with the hospital technicians to develop a hand-built prototype. Funding for the new prototype would be provided from the Department of Health and the Medical Research Council. After the prototype was built, it would then be tested and evaluated by the consultants in the hospital, if it passed this testing process the hospital would offer the medical manufacturers an option to take the design and introduce into production. Once the manufacturer has produced a batch of new equipment, these models would be sent out to the teaching hospital to be used in a clinical setting (Smith, 2006).

However, Shaw's research focuses on the clinician having all the funding from the MRC to develop the new equipment themselves, many university end-users do not have the resources or funding to develop the new equipment themselves, but require an external supplier to develop the prototype, this indicates a study gap and literature gap within the end-user theory created by both von Hippel and Shaw (1985) study. Building an von Hippel's innovation process, Shaw (1988) developed a 10-stage innovation model to expand on von Hippel's research, which is discussed in the next paragraph.

## 7.8 Shaw's 10 Stage Innovation Model

In 1988 Shaw updated his original 1985 empirical research on medical innovation by using the data from the previous 1985 study to develop a 10-stage innovation model to explain the development cycle of medical equipment.

Below in table 2.7 is the stages of the innovation cycle.

**Table 2.7 - Shaw's Stage of the Innovation Cycle**

| | |
|---|---|
| 1) | Idea generation and screening, concept identification, test, and evaluation |
| 2) | Preliminary technical and market assessment |
| 3) | Prototype development |
| 4) | Prototype testing and evaluation |
| 5) | Final specification |
| 6) | Full production |
| 7) | Product launch |
| 8) | Marketing |
| 9) | User feedback |
| 10) | Re-innovation |

Source: Shaw (1988)

From the medical innovation studied, 18 out of the 34 innovations were developed and marketed as a collaboration. The new equipment created had the end-users needs incorporated, which reduced the development lead-time significantly. From this study, Shaw (1988) concluded that these teaching hospitals and those designated by the medical research council as a "centre of excellence" ensured credibility in the equipment, as it was not only the function test that influenced the use of the equipment but also the network of consultants (lead-users) that carried out the testing and published the results (Smith, 2006).

These consultants then influence other teaching schools and hospital consultants to adopt the new technology. The author has included this study, as it provides a breakdown of the innovation cycle, that can be adapted within university-industry collaboration. However, there are several limitations to Shaw's research, this is discussed in the next paragraph.

## 7.9 Limitations of Shaw's Research

There are several flaws in both Shaw's (1985, 1988) empirical research designs, firstly, since Shaw conducted both studies, the structure of medical teaching has changed, many of the independent medical schools have merged with different UK Universities, for example the Hammersmith Royal Postgraduate Medical School independent status as a medical training school changed with its merger in 1997 with Imperial College London. Now the role of clinician is merged with the role of an academic, who works for the university teaching and/or undertaking research. Consequently, Shaw's (1985, 1988) definition of a lead-user, being a clinician is very simplistic, it does not provide any specific characteristics of the clinician, for example, is innovation undertaken by a male clinician over the age of 60? Or if the clinician is more likely to innovate if they have already undertaken collaboration with a specific manufacturer before or is the clinician a first-time innovator?

Secondly, the equipment selected for review was low value, it was not capital intensive to make, like Magnetic Resonance Imaging Scanners (MRI) or Computerized Tomography Scanners (CAT). Thirdly, Shaw (1985, 1988), failed to identify that this new equipment would need to be procured via the appropriate tender process, if the manufacturer has not been awarded a framework agreement, the clinician would not be allowed to purchase the new equipment. Fourthly, both studies do not identify the time it takes to develop the new equipment, nor the number of interactions needed between the lead-user and manufacturer. Fifthly, Shaw (1988) ten stage innovation model, presumes that the innovation process is linear, yet some of these steps may be repeated, for example if the concept results in the prototype not working correctly, the prototype design may be reconfigured to provide a new functionality not identified in the original concept.

The author included Shaw's 1985 study as it refined von Hippel's definition of the end-user by showing end-user innovation is taking place within a clinical setting. However, Tyrrell's (2015) research study, underpins this study's objectives, as it shows that end-user (academic buyers) can engage in collaboration with firms to create innovation. As Tyrrell's (2015) study builds on von Hippel's and Shaw's typology of the end-user and innovation cycle, Tyrrell's study is discussed in detail in the next paragraph.

## 7.10 Tyrrell's contribution to End-User Theory

Tyrrell's (2015) study builds on both Shaw (1985, 1988) and von Hippel's, (von Hippel, 1981; von Hippel, 1986; Urban et al, 1988; von Hippel, 1988; Franke and von Hippel, 2003) research into lead-user innovation. Tyrrell (2015) studied UK University Principal Investigators (PI end-users) to examine if this lead-user group was involved in the innovation process with Medical/Life Science Manufacturers (known as MLSM) to create new scientific equipment.

In the study, Tyrrell (2015) built on the research conducted by both Shaw (1985, 1988) and von Hippel 1976; von Hippel 1977; von Hippel 1986; Urban et al, 1988 research, by developing a new typology of innovation, innovation now had specific definitions.

Table 2.8 provides a summary of Tyrrell's (2015) new types of innovation.

**Table 2.8 – Tyrrell's New Innovation Types**

| | |
|---|---|
| 1) | Basic innovation: refers to change appearance in the equipment including colour, shape, and case. |
| 2) | Minor innovation: refers to increased sensitivity in function of the equipment and updated software. |
| 3) | Major innovation: involves changing the performance, characteristics, product design and attributes of the equipment so the materials and components are significantly different to the previous manufactured equipment. These new innovations provide output that have completely different functionality and consists of new technologies that can be combined with existing technologies to be used in new ways. |
| 4) | Failure: The new software or equipment failed to be introduced into a final model that is sold to the external market. |

Source: Tyrrell, (2015)

## 7.11 Tyrrell's End-User Typology

Modifying Shaw's (1985, 1988) definition of end-user and enhancing von Hippel 1976; von Hippel 1977; von Hippel 1986; Urban et al, 1988 definition, Tyrrell (2015) developed a new end-user characteristics typology, the PI end-user was defined as being a Professor, Doctoral Fellow, Research Fellow, or Reader, who receives a large publicly awarded grant to carry out medical or life science research. This PI end-user also receives a large publicly awarded grant to carry out medical or life science research and benefits by obtaining the equipment 6 to 12 month before market release, thereby speeding up and improving their research output.

The study was split between 27 Medical and Life Sciences Manufacturers, which Tyrrell (2015) defined as the primary Medical/Life Sciences manufacturers that provides the final assembly capital equipment to the PI end-user. Then sub divided into a group of 17 MLSM that had an EU contract to provide Capital equipment to the Higher Education Sector (HES) and 10 MLSM that did not hold an EU contract. MLSM, were invited to complete a telephone interview to identify if they consider the PI end-user was an important source of information and innovation. Then the MSLM was asked if they had previously collaborated with a PI end-user to develop new scientific equipment and the innovation was defined as basic, minor, major or had resulted in failure. The scientific equipment studied was split into categories on value above 100K, which included Atomic Force Microscope, Confocal Microscope, CT Scanner, Diffraction Apparatus, DNA Sequencers (Next Generation), Florescent Microscope, Flow Cytometer, Gamma Camera, Mass Spectrometer, MRI Scanner, NMR (nuclear magnetic resonance spectrometers), Photon Microscope, Scanning Electron Microscope, Thermal Camera, and Transmission Electron Microscope.

The second scientific equipment category studied was equipment below 100K consisting of Cell Imaging, Cell Sorter, Digital PCR machine, DNA Analyser, DNA Sequencers, Florence Cell Analyser, Gas Cylinders, Gas Chromatography, GCMS, HPLC, Ion Chromatography, Lasers, Liquid Chromatography, Liquid Handling Robots, Real Time PCR Machine and Centrifuges.

The MLSM data was then triangulated with online survey responses from the PI end-user. Both MLSM's and PI end-users were asked the same question, apart from the PI end-user who was asked an additional question. The question asked the PI end-user "if they did not engage in innovation with a MLSM what the reasons for was not engaging in innovation" (Tyrrell, 2015). After analysing the responses from the telephone interviews and online surveys, Tyrrell (2015, p3) suggests that "the results showed that 51.9% of MLSM's consider PI end-users to be a very important source of information for innovation. 48.1% of MLSM's consider PI end-users a "very important" source of innovation and 81.5% of MLSM's have already been involved with PI end-users to develop new scientific equipment. In contrast, 25.6% of PI non-innovators, confirmed that the reasons why they did not innovate was because they have the internal resource to complete the innovation. Another 25.6% of PI end-users do not want to innovate and 25.6% of PI end-users felt that the MLSM's did not want to innovate with their department". From the data Tyrrell (2015, p92) concluded one of the main reasons many PI end-users collaborate is because “35.9% PI end-users (14 respondents) confirmed that their department has PhD studentships with MLSM’s”.

From the research findings of this study, Tyrrell (2015) confirmed that 59% of the respondents within the sample selected for the study, conformed to the typology of the PI end-user, defined as a Clinician, Medical Researcher or Life Sciences Researcher. However, Tyrrell’s research findings, did not provide any empirical evidence to confirm that the PI end-user conformed to the other criteria set out in Tyrrell’s (2015), PI end-user typology. The research findings for Tyrrell’s (2015) study enhanced the empirical data supporting end-user innovation in von Hippel’s (1976, 1977, 1978, 1981, 1986, 1988) studies and Shaw’s (1985, 1988) studies. However, there are several limitations of Tyrrell’s (2015) research study, which are discussed in the next paragraph.

## 7.12 Building on Tyrrell’s Research

There are a few limitations in Tyrrell’s (2015) research study, firstly, the characteristics of the PI end-user was simplistic and was not linked to any specific independent variables which could be used to run inferential statistics. As little previous research has been conducted into the characteristics (demographics) of the end-user’s population within UK Universities engaged in innovation with scientific manufacturers to create new equipment. In contrast Ogawa and Pongtanalert (2013) developed characteristics (demographics) of the end-user in their 2010 Japanese online study of the demographics of community innovators vs independent innovators. Von Hippel, et al (2011) also studied the demographics of end-users making consumer innovations. Von Hippel, et al (2011, p28) concluded that “consumer-innovators are significantly more likely than the average citizen to be highly educated (with bachelor’s masters’ or Ph.D. degrees), to have a technical education (in science or engineering or as a technical professional) and to be male”.

A further gap in the literature is very little research has been conducted into the demographics of the end-user's population within UK Universities engaged in innovation with scientific manufacturers to create new equipment. Nor has the characteristics (demographics) of the supplier being studied been defined in any detail. There are no dichotomous questions like market characteristics (industry type, size of the firm, market share, location of business, business type and revenue) and so on. These gaps in the literature will be explored in the study.

This study will redefine the PI end-user demographic criteria used by both Ogawa and Pongtanalert (2013), Hippel, et al (2011) and Tyrrell (2015) by adding the additional dimensions of the PI end-users funding provider, level of funding received from the funding bodies, number of research papers produced and whether the PI end-user is female or male. Another gap in Tyrrell's (2015) study was that some of the scientific equipment categories studied are interdisciplinary and are also used by engineering and physical science PI's. This PI end-user group was not invited to take part in the original research study. Therefore, in Tyrrell's original (2015) study the average lead time for the development of new scientific equipment was missing data for the following product groups: Atomic Force Microscope, Diffraction Apparatus, Nuclear Magnetic Response Spectrometers (NMR) Photon Microscopes, and Thermal Camera's.

In the original study, Tyrrell (2015) defined the supplier as a Medical/Life Sciences manufacturer (MLSM) who provides the final assembled capital equipment to the PI end-user. The problem with this definition is focused only on one characteristic of the supplier. There are no dichotomous questions like market characteristics (industry type, size of the firm, market share, location of business, business type, revenue) etc and so on (Ekinci, 2015).

According to Laursen and Salter (2004) a possible reason for lack of innovation between the PI end-user and manufacturer is because some universities and industries have weak and distant relationships, that impact on innovation. In contrast to other firms that located near specific universities because of their reputation and expertise in specific subjects. As Abramovsky and Simpson (2010, p4) comment “For example, chemical firms located closer to high-rated material science departments are more likely to co-operate with local universities”. Yet these manufacturers were also absent from the population being surveyed. Consequently, this research study aims to investigate if innovation is taking place between both engineering, physical sciences, life sciences and medical PI end-users and the scientific equipment manufacturers.

A further flaw in Tyrrell’s (2015) study is that it failed to identify if different geographical locations and different university types had an impact on the number of innovations created. As the original population observed was based on University College London (UCL) and one department at Oxford University (the pilot study). Both Universities are research focused and based in geographical areas with a high level of knowledge spill over. Knowledge spill over is where knowledge created by a university diffuses to local firms through a variety of communication channels that allows firms to benefit from the knowledge without paying for it (Acost et al, 2011). These channels include spin-out companies, consultancy, or the supply of trained post-graduate scientists (Abramovsky and Simpson, 2008) and through joint collaborations on projects and the sponsorship of PhD scholarships by local spillover firms. In the traditional paradigm of geographical location, a firm’s location can have an important effect on its growth, profits, and overall development (Howells et al, 2012). Consequently, the firm needs to be located near to a university to be able to benefit from this diffusion of knowledge and access the talent obtained by hiring its graduates (Piterou and Birch, 2014).

However, the MLSM’s interviewed in Tyrrell’s (2015) research study were not located in London or Oxford, but are global firms located in other parts of the country or outside the UK, yet these MLSM's continued to innovate with these universities. However, Gust Bardon (2012) suggests that the geographical proximity of the manufacturer to the University no longer matters as new ICT methods have changed the way knowledge and information is generated, absorbed, stored, and defused.

However, there has been little research into why the scientific equipment manufacturers engage with specific university end-users that are not in their local geographical area. Perhaps the reason why these manufacturers engage with these university end-users based in a different geographical location is because of the prestige of innovating with that specific university. Most of the empirical literature focuses on the end-user as the sole creator of new innovations (von Hippel, 1976; von Hippel, 1977; von Hippel, 1986; Urban et al, 1988) and on products that do not require major capital investment. Franke and von Hippel (2003, p4) provide a summary of these empirical studies that include "printed circuit CAD software (Urban and von Hippel; 1988); Pipe Hanner Hardware (Hersate and von Hippel,1992); Library Information Systems (Morrison et al, 2000); Apache Software (Franke and von Hippel, 2003); Medical/Surgery Instruments (Lüthje, 2003a); Outdoor Consumer Products (Lüthje, 2003b); "Extreme" Sporting Equipment (Franke and Smith, 2003) and Mountain Biking Equipment (Lüthje, 2003)".

For this study, the author adopted the concept of the lead buyer theorized by Eric Von Hippel, with the end-user engaging with the scientific equipment manufacturer to develop new scientific equipment. The author does not perceive the end-user as a sole innovator for this study but must collaborate with the scientific equipment manufacturer to access the resources to develop a new equipment prototype.

However, many studies on end-user innovation focus on the end-user as the sole innovator, this is discussed in the next paragraph.

## 7.13 End-User as Sole Innovator

In later research, von Hippel focused on developing techniques involving the end-user in the new product development process, to support firms that operated in product markets with fast-changing customer needs. These tools kits created by Eric von Hippel and Ralph Katz (2002) allowed firms to abandon the research themselves and outsource the research to the end-user to complete. However, for this to be successful the end-user needs to be provided by the firms the capabilities and tools to develop the design and products themselves. Each tool kit must be specifically geared to the product category or field otherwise the end-users could not come up with specific solutions themselves which would allow the firm to pick up early in end-user needs (Ahmed and Shepard, 2010). Meaning that end-users are unlikely to develop goods and services that required capital intensive equipment to manufacturer or service.

Unfortunately, von Hippel's empirical research did not on the co-creation between end-user and firms to create new goods and services, although Urban and von Hippel (1998) did propose that firms involve the lead-user in their innovation process to acquire a deeper understanding of buyer needs and wants in the marketplace. These lead-users are defined as a select group of individuals whose needs are likely to reflect the general marketplace buyer in the future. These individuals, obtain a benefit from obtaining the solution to their needs, develop their own innovation and applications, perceived to be pioneering and are ahead of the market in identifying new requirements thereby making them a valuable target sample for market research (Ahmed and Shepard, 2010; Tidd and Bessant, 2015).

Other end-user benefits from collaboration can be once the new design is launched, other end-users find additional ways to improve the innovation for mutual benefit of the user community and those that collaborate with the manufacturer may enhance their reputation by accessing future innovations at a cheaper price than other end-users (Baldwin and von Hippel, 2011).

In contrast Lüthje's (2003a) study of medical/surgical instruments in Germany indicated that the end-user collaborated with the manufacturer in NPD (Franke and von Hippel, 2003). In contrast, Tyrrell's (2015) studied medical/life science end-users (academics) in UK universities and concluded that 45% of end-users were engaged in NPD with the scientific manufacturers directly. However, Tyrrell's study did not identify if those end-users involved in the NPD had done so by the procurement tender process. As a recent change to the EU public procurement regulations (2015) now allows public bodies (like universities) to purchase goods and services that have not been released to the market via the tender process (Goudt, 2016).

As the author aims to investigate university (buyer) and firms (supplier) collaboration which results in the creation of new scientific equipment or software, von Hippel's tool kit will not underpin this research study nor will the concept of the end-user as the sole creator. However, as the author is interested in the tender process as a method for driving collaboration, the author examines the target university's tendering process and public procurement regulation to identify if these rules govern the tender process at the university being studied.

## 8. Public Procurement

As universities purchase goods and services to conduct their operations (Etzkowitz, 2008), the procurement tender process can be a method to implementing OI. By allowing the buyer and supplier to exchange new ideas during the tender process that can lead to new product innovations. Within the university sector procurement takes place at five specific levels, on a departmental level, institutional, local, regional, or national level (CVCP, 1993).

This study focused on procurement at central level procuring goods/service on behalf of the various university departments. Traditionally in public sector procurement, the tender has been used as a selection process to identify a good supplier. Table 2.9 provides a summary of the characteristics of a good supplier.

**Table 2.9 - Characteristics of a Good Supplier**

| | |
|---|---|
| 1) | Delivering the goods and/or service on time |
| 2) | Provide consistent quality |
| 3) | Provides a good price for goods and/or services |
| 4) | Is financially stable |
| 5) | Responds to the buyer and/or the organisation needs |
| 6) | Keeps its promises |
| 7) | Provides consistent technical support |
| 8) | Keeps the buyer and/or the organisation informed of progress. |

Source: Bailey et al, 2015; Benton W. C. Jr, 2010; Lysons and Farrington, 2016.

The only problem with this list, is different firms may place more importance on one factor against the other in the list. For example, a firm that competes within the market on price only, may not be interest in technical support from the supplier. Only the cost of the goods and services provided to the firm.

## 9. The Tender Process

According to Lysons (1993, p172) tendering is “a purchasing procedure whereby potential suppliers are invited to make a firm and unequivocal offer of the price and terms, which on acceptance, shall be the basis of the subsequent contract”. Lysons definition of tendering is very simplistic, and there are different types of tender procedure that a buyer can used to obtain the goods and services required within the public sector. These tender processes are governed by the EU procurement directives, that govern the way works are contracted (the design and execute of building or civil engineering works), supplies contracts (purchase, lease, rental or hire purchase with or without option to buy, of products like scientific equipment, printers, etc) and service contracts (consultancy, catering etc). The EU procurement directives requires all purchases at a specific threshold to be tendered and advertised through the Official Journal of the European Community (OJEC) and through its databased TED (Bovis, 2015; European Commission, 2018; Gelderman et al, 2006). The aim of the EU Procurement Directive main objective is to provide procedures to ensure efficient use of public funds. The other strategic objectives:

- make public spending more efficient.
- clarify basic notions and concepts to ensure legal certainty.
- make it easier for SMEs to participate in public contracts.
- promote integrity and equal treatment.
- enable contracting authorities to make better use of procurement in support of innovation and common societal and environment goals; and incorporate relevant case-law of the Court of Justice of the European Union.

Source: European Commission (2018, p11)

The types of tendering process include the open process, this process is adopted when the contracting authority believe that there is a limited number of suppliers in the marketplace that can provide the goods and services to the technical requirement of the contracting authority. A contracting authority can be defined under the EU Procurement Regulations 2015, defined as a public body, comprising of state and regional local authorities and any other body covered by public law, this includes charities and universities (Bright, 1994; Bovis, 2015; Sanchez Graells and Gideon, 2016: Sigma, 2011). If the public body is not a contracting authority, the public body are under no obligation to adopt the EU procurement regulations for purchasing goods and services for their operation. The main objectives of the EU Procurement Regulations 2015 are to operate a fair and transparent procedure that allows all suppliers to compete on the same conditions (Behzad Ghorbany Darabad, 2017; Khaled Mustafa and Waheed, 2019; Osei-Afoakwa, 2014; Thai, 2004). With the contract being awarded either on lowest cost or most economically advantageous tender (MEAT) (Mercado Kierkegaard, 2006). However, the tender process only comes into effect once the goods or services required hits a specific limit. The current thresholds are for goods purchases, spend must be over £181,302, works must be over £4,551,413 and services must be over £181,302 (Gov, 2020). Contracting Authorities must undertake tenders at this level but must aggregate similar spend to tender under these thresholds.

The principle of a transparent procedure is adopted when a university is outside the regulations, to make the process fair for all bidders (Behzad Ghorbany Darabad, 2017; Khaled Mustafa and Waheed, 2019; Osei-Afoakwa, 2014; Thai, 2004). As undertaking a fair process, ensures that the university, has a mechanism for reducing corruption. As all UK universities must comply with the Bribery Act 2010, which makes universities put procedures in place to prevent persons associated with the university from being bribed (Ministry of Justice, 2010). The tender documents that are issued to potential bidders through the different threshold's is referred to as Invitation to Tender (ITT). Table 2.10 below provides a summary within the study university the ITT structure.

**Table 2.10 - Study University ITT Structure**

| Section | Content |
|---|---|
| Section 0 | ITT (invitation to tender – providing information on the tender process, timeline for award, marking scheme, budget, and background to the procurement). |
| Section 1 | Non-collusive tendering certificate – supplier agreement that they have not colluded when submitting the response to the university. |
| Section 2 | Suitability questions – asking supplier financial, technical, health and safety, environmental and indemnity questions that must be answered to progress to the next stage of the tender. |
| Section 3 | Freedom of information – request form |
| Section 4 | Mandatory questions – questions that the supplier must agree to before being considered for the bid. These are pass/fail questions. |
| Section 5 | Equipment Specification and supplier response section |
| Section 6 | Pricing Submission Form |
| Section 7 | Additional Information for the tender |
| Section 8 | Contract Terms |

Source: Tyrrell (2022)

Samples of these sections have not been included in this study, as each section would identify the university under investigation (e.g., wording, layout, style, information requested from supplier etc). These documents are advertised to potential bidders using the EU procurement directives via email or a tender portal.

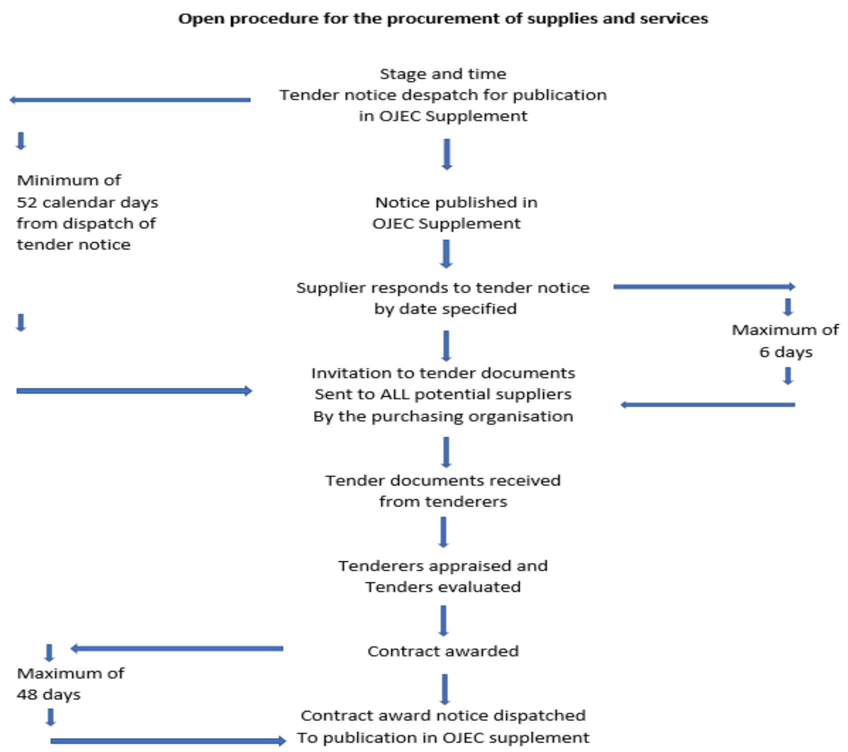
### 9.1 Open Tender Process

Traditionally, the open procedure has been time sensitive, open to all suppliers and adopted for high value goods and services that are required urgently. The procedure requires the contracting authority to have all the contract and supporting documents (pricing schedule, award criteria, specification, mandatory questions, and prequalifying questions) to be ready to issue. The minimum time that the contracting authority can request receipt of tenders is 52 days from publication of the OJEC Notice. Once the tender return is marked, the tender is awarded to the bidder that best meets the award criteria in the tender documents (Bailey et al, 2015; Bovis, 2015; Heijboer and Telgen, 2020; Lysons, 1993).

This award criteria specifies the technical ability, financial and economics standing the bidder must possess so they are not excluded from the tender process for misconduct, insolvency, failure to pay tax etc (Bright, 1994).

Figure 2.5 below, provides a step-by-step approach to undertaking an open tender procedure.

**Figure 2.5 - Open Procedure**



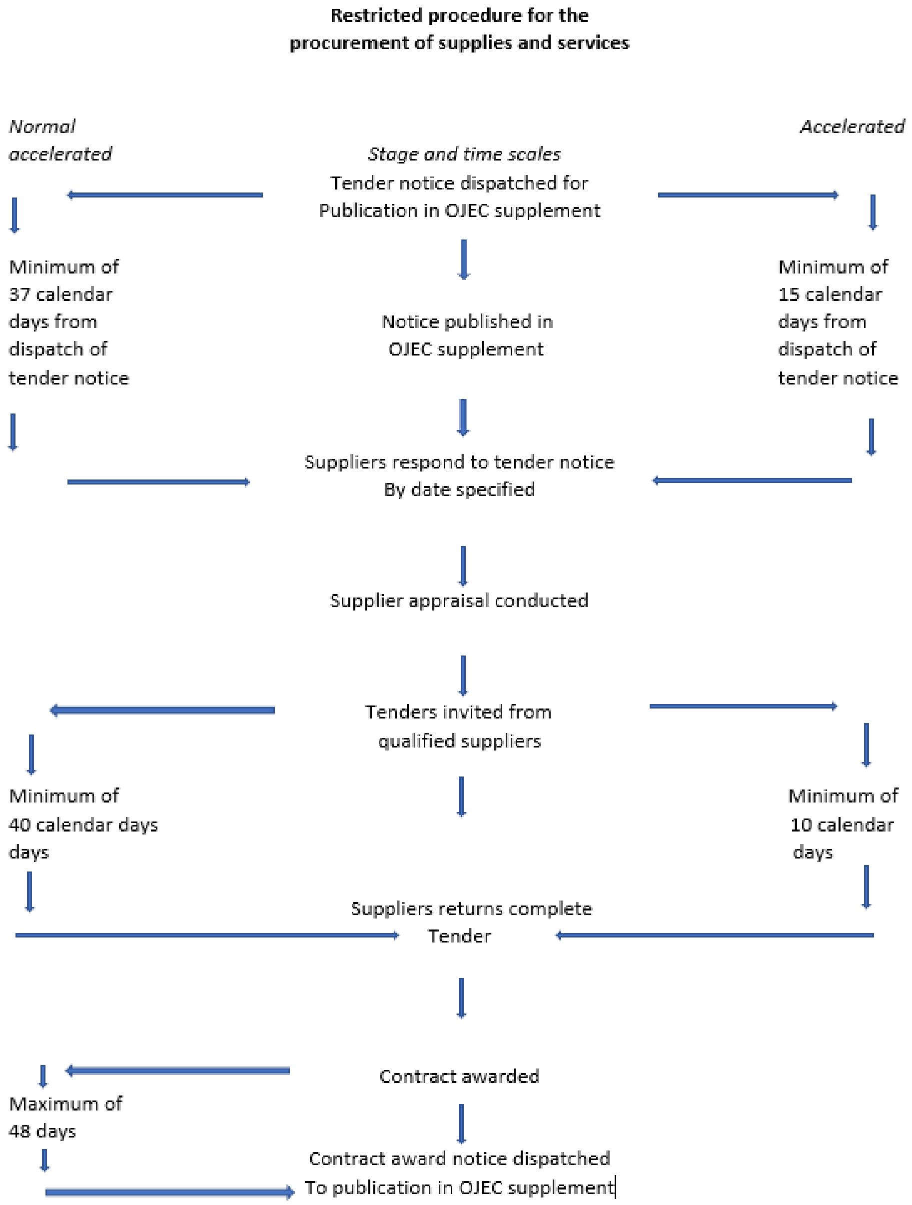

Source: Baily et al, (2015 p132)

## 9.2 Restricted Tender Process

Another tendering process is the restricted procedure, this process has two stages, designed to restrict the number of suppliers that can bid for the goods and services required by the contracting authority. The procedure is favoured by government departments sourcing their supplies and services for front line public requirements. In this procedure, the contracting authority issues a tender notice via the OJEC supplement advertising the requirements for the tender. Suppliers interested in the tender then contact the contracting authority to confirm their interest in the tender. The contracting authority then issues those interested suppliers a pre-qualifying document (Bailey et al, 2015; Bovis, 2015; Edh Hasselgård, 2017; Lysons, 1993). Under this procedure the minimum deadline for requests to participate is 37 days from the publication of the OJEC Notice. From that point onwards the bidders are selected based on objective criteria (normally stated in the questionnaire part of the tender documents) (Bovis, 2015).

The starting point for restricting bidders can be based on the bidder having a poor credit history, county court judgements or has been bankrupt in the past. Other exclusion factors can include technical capability, specific license required to operate, and qualifications held. The bidders that fail to meet the objective criteria are not considered further. There needs to be a minimum of 5 bidders that meet the award criteria, otherwise all bidders will be selected to the second stage. Next the contracting authority issues an invitation to tender to all bidders that have passed to the next stage. The minimum deadline that the contracting authority can obtain the tender receipts is 40 days after the invitation to tender is issued. Once the returns have been received, the contract is awarded to the supplier the best meets the award criteria (Bailey, 2015; Bovis, 2015; Heijboer and Telgen, 2020; Lysons, 1993). The benefit of an authority adopting this approach is that it does not allow the bidder to negotiate the contract terms and a bidder cannot be resubmitted. This reduces the risk of the authority being challenge by one of the bidders about the process not being fair (Edh Hasselgård, 2017). Figure 2.6 below, provides a step-by-step approach to undertaking the restricted procedure.

## Figure 2.6 - Restricted Procedure




Source: Bailey et al, (2015, p134)

### 9.3 Accelerated Restricted and Negotiated Tender Process

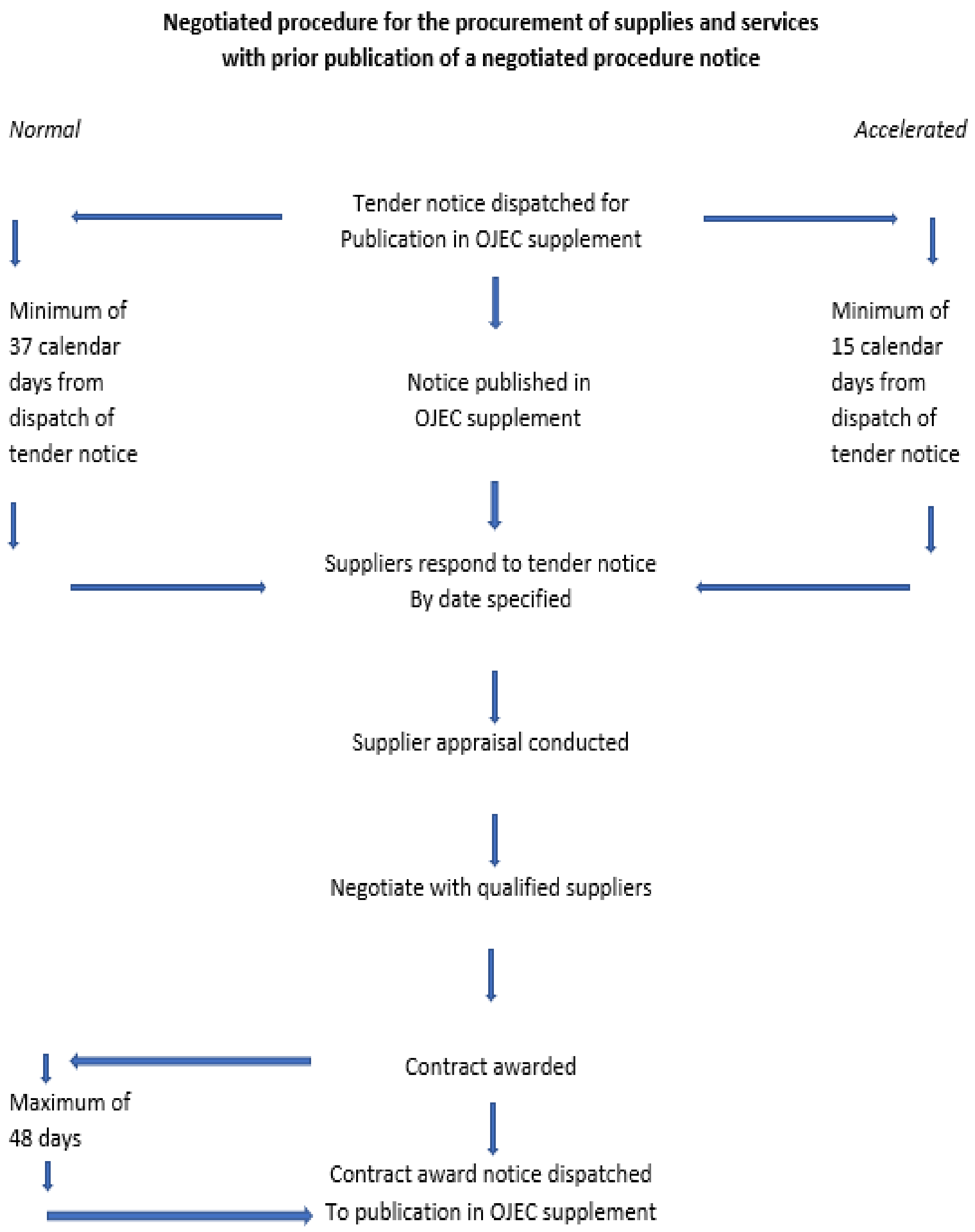
In addition, there is also an accelerated restricted procedure, designed to shorten the advertisement time of the ITT and only when the contracting authority has an operational need which makes the normal accelerated procedure difficult. For this procedure to be applied the contracting authority needs to state this in the OJEC Notice. Under the accelerated restricted procedure number of advertised days changes, in the ITT from 37 and 40 days to 15 and 10 days respectively (Bailey, 2015; Bovis, 2015; Heijboer and Telgen, 2020; Lysons, 1993).

Within the EU procurement directives, there is an option in certain circumstance to negotiate the terms of a contract directly with one or several suppliers, for example during the recent COVID pandemic the UK government allowed public sector firms to adopt this approach. Ideally, the contracting authority needs to advertise in OJEC that the tender process is a negotiated procedure and once the negotiation is complete, a contract award notice is issued in OJEC.

This process can also be accelerated but only if a tender notice has been published prior to the negotiation taking place. The process allows the contracting authority to issue an ITT and request returns within 15 days of the notice issued in OJEC. The contracting authority must confirm that the accelerated negotiated procedure has been adopted in the OJEC Notice (Bailey et al, 2015; Bovis, 2015; Edh Hasselgård, 2017; Lysons, 1993).

Figure 2.7 below, provides a step-by-step approach to undertaking the restricted negotiated procedure with prior publication.

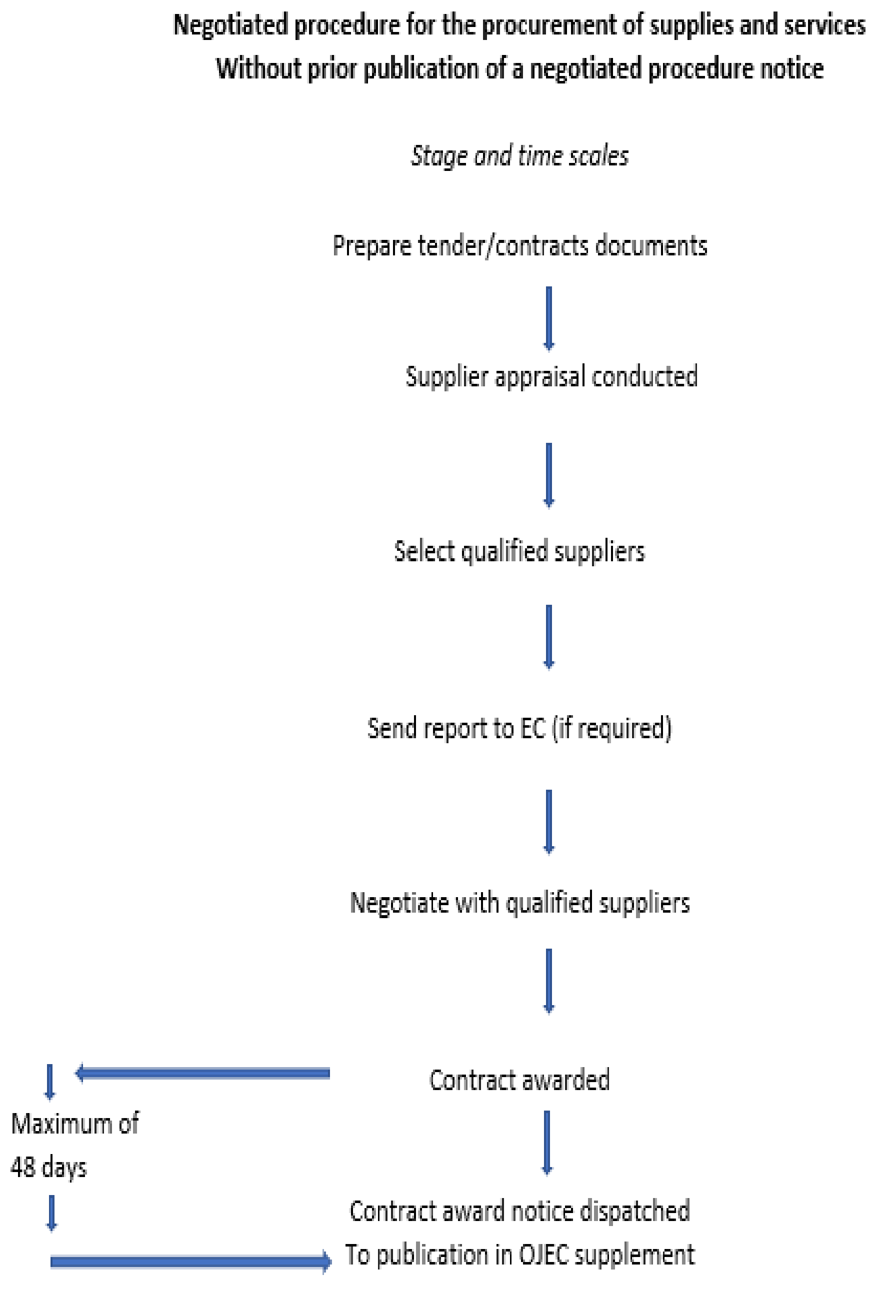
### Figure 2.7 - Restricted Negotiated Procedure with Prior Publication




Source: Baily et al, (2015, p135)

Figure 2.8 below, provides a step-by-step approach to undertaking the restricted negotiated procedure without prior publication.

**Figure 2.8 - Negotiated Procedure (without prior publication)**




Source: Baily et al, (2015, p135)

Alternatively, a contracting authority can decide to adopt a selected tender process, for a public sector this involves using a vetted list of suppliers or approved list that have already undertaken an open or restricted tender procedure. Therefore, these suppliers can be defined as competent and have good financial standing allowing the buyer the opportunity to speed up the tender process (Lysons, 1993). Ideally to replace the restricted process, a new tender process has been developed to add to the current EU Procurement Regulations is called the competitive dialogue process. Ideally, the competitive dialogue is easier for contracting authorities to avoid a challenge to the award when procuring large complex infrastructure contracts and used to implementing Private Public Partnerships (PPP) (Burnett, 2009).

However, competitive dialogue can only be used in specific circumstances when the contracting authority cannot define the specification requirements to meet their purpose. When the contracting authority cannot identify the financial and legal requirements for the project and where a restricted or open process is not possible. Ideally, the contracting authority needs a record of this decision and issue this in the contract notice in OJEC (Designing Buildings Ltd, 2020; Savvides, 2011).

Competitive dialogue requires the contracting authority to run a pre-qualifying process before inviting bidders that pass this stage (minimum of three) to a dialogue process, in which the nature of the project is discuss, possible solutions and outcome developed. After a discussion has taken place, the bidders submit a final tender to meet the requirements of the project (Bovis, 2015, Koninck et al, 2015; Savvides, 2011). The weaknesses of using the competitive dialogue approach includes it is labour intensive, time consuming, requires high level of expertise of staff and it leaves the contracting authority with a weak position during negotiations. Leading to the contracting authority accepting terms that are less favourable than under an open or restricted process (Burnett, 2009, European Commission, 2018).

The final tender process that a contracting authority can adopt is the innovation partnership process. This process allows the purchase of goods and services that have not come to market yet (Bovis, 2015). An innovation partnership can be set up when one of more of the partners is conducting research and development activities. Under this procedure, the tender process is like the competitive procedure, but the contracting authority can only adopt the process under strict rules. These rules state that the contract must be for innovation. With the partnership dealing with both the development and purchase of the innovative products or services. In an innovation partnership, the contracting authority must determine the upfront contract objectives (Koninck et al, 2015). Once the tendering process is complete and the contracting authority has received the tender returns, the marking process for the tender award begins, errors in the marking process can result in a challenge to the tender award, in section 9.4 the author discusses the tender marking process in detail.

## 9.4 Tendering Marking and Award Process

Once the contracting authority has completed the specific tender process required to purchase the goods, services or infrastructure required, the contracting authority undertakes a marking process to award the contract. The marking process begins with the procurement professional evaluating the tender, comparing costs and benefits of the goods or services being purchased.

Table 2.11 below, provides a summary of the factors that effects the selection of the winning supplier.

**Table 2.11 - Factors Effecting the Winning Bidder**

| | |
|---|---|
| 1) | Status of firms involved: financial viability, design capability, production, capability, quality assurance status and track record, delivery record. |
| 2) | Equipment offered: extent to which it meets minimum requirements, design/artistic qualities (where appropriate), compatibility with equipment already in use, “extras” above minimum requirement which offer cost-effective advantage, scope for improvement or “stretch” by later modifications or “add-ons” etc, conformity with standards (national. International, NATO etc), scope of value engineering, reliability – proven record, maintainability, defect reporting and rectification arrangements, repair/service arrangements. |
| 3) | Immediate cost of acquisition: initial price, firmness of price (e.g. fixed, with or without variation of price, cost plus etc), basis for agreeing prices on associated or follow-up orders, differences in cost-escalation formula, foreign exchange risk and costs, payment terms (on delivery or progress/stage payments etc), cost of financing interim payments, financial guarantee requirements, duties and taxes, credit terms, transport costs, cost of working capital for stocks, discounting factors, difference in administrative cost (including overheads) to purchaser, warranties and technical guarantees offered, product liability arrangements, scope for, and cost of, accelerating or delayed performance. |
| 4) | Delivery: conformity with requirement, reliability of offer, operational and financial effects of earlier/later availability, cost, and trade-offs with stockholding cost at various locations, liquidation of damages. |
| 5) | Operating costs: running cost, cost of spares – present and future, servicing and maintenance costs, storage, and other support costs. |
| 6) | Product support: quality of after-sales facilities, ease if legal recourse to supplier. |
| 7) | Replacement arrangements: receipts from eventual disposal, commitment to replacement equipment, replacement time frame. |
| 8) | Strategic and structural: safeguarding vital sources of supply, length of the supply chain and its vulnerability to disruption, offset considerations, effect of procurement on price; availability and competition for future supplies (e.g., arising from dumping or artificially depressed quotations) including, as appropriate, supplies for other public purchasers, effect on competitiveness of suppliers, encouragement of innovation offering improved value for money. |

Source: CVCP, 1993, p17 and p18.

Although this provides a list of possible factors to consider when awarding a contract to a supplier, this list’s innovation as only one factor to consider as part of the overall supplier appraisal. This approach fails to identify that the tender award process can be modified and used to select a partner for collaboration. For this study, the author recognises the tender process as a method of selecting a suitable partner to collaborate with on new equipment innovation. Once marking is complete, the award letters are sent out to the winning bidder and the unsuccessful bidders. The contracting authority cannot start the contract until at least 10 days (by email) and 15 days by mail has passed during the stand still period. During this period, a bidder that has been unsuccessful can challenge the award and request more information on why their bid was unsuccessful from the contracting authority (Bailey, et al, 2015; Bovis 2015; Hanson and Stephenson, 2012; Treumer and Lichére, 2011).

If the contracting authority fails to apply the correct procedure for tendering their requirements for goods, services, utilities and infrastructure, the unsuccessful bidder who feels harmed by this infringement of the procurement process can obtain compensation from the court under the Remedies Directive 2007/66. The Remedies Directive allows the member state courts to review the procurement process run by the contracting authority and can decide if an infringement has taken place (OECD, 2020; Sharpe and Pritchard, 2014 Schebesta, 2016). If the court decides the contracting authority has infringed the procurement process, it is within its right to suspend the contract award, suspend any decision made by the contracting authority during a tender, order the amendments of the documents or award damages (OECD, 2020; Sharpe and Pritchard, 2014; Schebesta, 2016). Consequently, it is very important that the contracting authority makes sure the tendering documents complies with the EU procurement directive rules.

The specification document is the core element of the procurement tender process; therefore, the structure and content must be of a sufficient quality to receive bids and prices to develop a suitable relationship with the supplier (Lysons and Farrington, 2016; Morris and Pinto, 2007). Ideally, the specification the buyer must state details of the product in terms of its physical characteristics including size, shape, delineation of components parts, diagram of its wiring or other physical parameters, material use, the output or performance of the equipment or goods required (Sherman, 1991). Within private sector firms, the specification is created by the buyer to meet the needs of the organisation (Morris and Pinto, 2007). Within public sector firms, the specification is normally developed by a group of stakeholders. The specification is the starting point of the tender process, table 2.12 provides a summary of the basic procurement process for private sector firms.

**Table 2.12 – Private Sector Basic Procurement Process**

| | |
|---|---|
| 1) | Specification: Stating the requirements in the specification template. |
| 2) | Source: finding a supplier that meets the technical requirement of the specification. |
| 3) | Negotiation: During a tender process the buyer issues a set of terms and conditions to govern the contract. During the process, the supplier may request modification to the terms. |
| 4) | Contract: either the buyer or supplier rights up the details of the negotiation into a formal document. Within a public tender process, the supplier submits a response to the tender documents, and this is the basis of the final contract. |
| 5) | Contract follow-up: the process of implementing and evaluation of the contract to ensure the supplier delivered what has been agreed. |

Source: Cheverton and van der Velde, 2011; Dimitri et al, 2006.

## 9.5 Applying EU Public Procurement Process in Higher Education

Within the UK, not all Universities are subject to following the EU public procurement regulations. For example, the University of Cambridge has declared on its website that:

"The University of Cambridge is not a public body within the meaning of the Public Contracts Regulations 2015 (Directive 2014/24/EU) as amended by the Public Procurement (Amendment) (EU Exit) Regulations 2020 and is not subject to the European procurement legislation. Where the University advertises contracts via the UK e-notification service, it does so on a voluntary basis and does not undertake any obligation to comply with the procurement legislation. The University reserves its rights in full to adapt or step outside the procedures in the procurement legislation as the University considers necessary. Where the University advertises contracts in the Official Journal of the European Union (OJEU), it does so on a voluntary basis and does not undertake any obligation to comply with the procurement legislation.

The University reserves its rights in full to adapt or step outside the procedures in the procurement legislation as the University considers necessary. The University will only advertise contract opportunities in the OJEU where the requirements of project funding mandate that it is tendered under the Regulations. In such circumstances, a contract opportunity notice will also be published on the Governments Contracts Finder portal if the value of the opportunity is over the thresholds set by the University. In exceptional circumstances only where the regulations may apply to a specific procurement, authorisation to not follow the Public Contract Regulations may be granted by the Director of Finance (for goods and services) or the Director of Estates Division and Building Services (for property and construction and related procurement) in accordance with Regulation 32 of the Public Contract Regulations." (University of Cambridge, 2020)

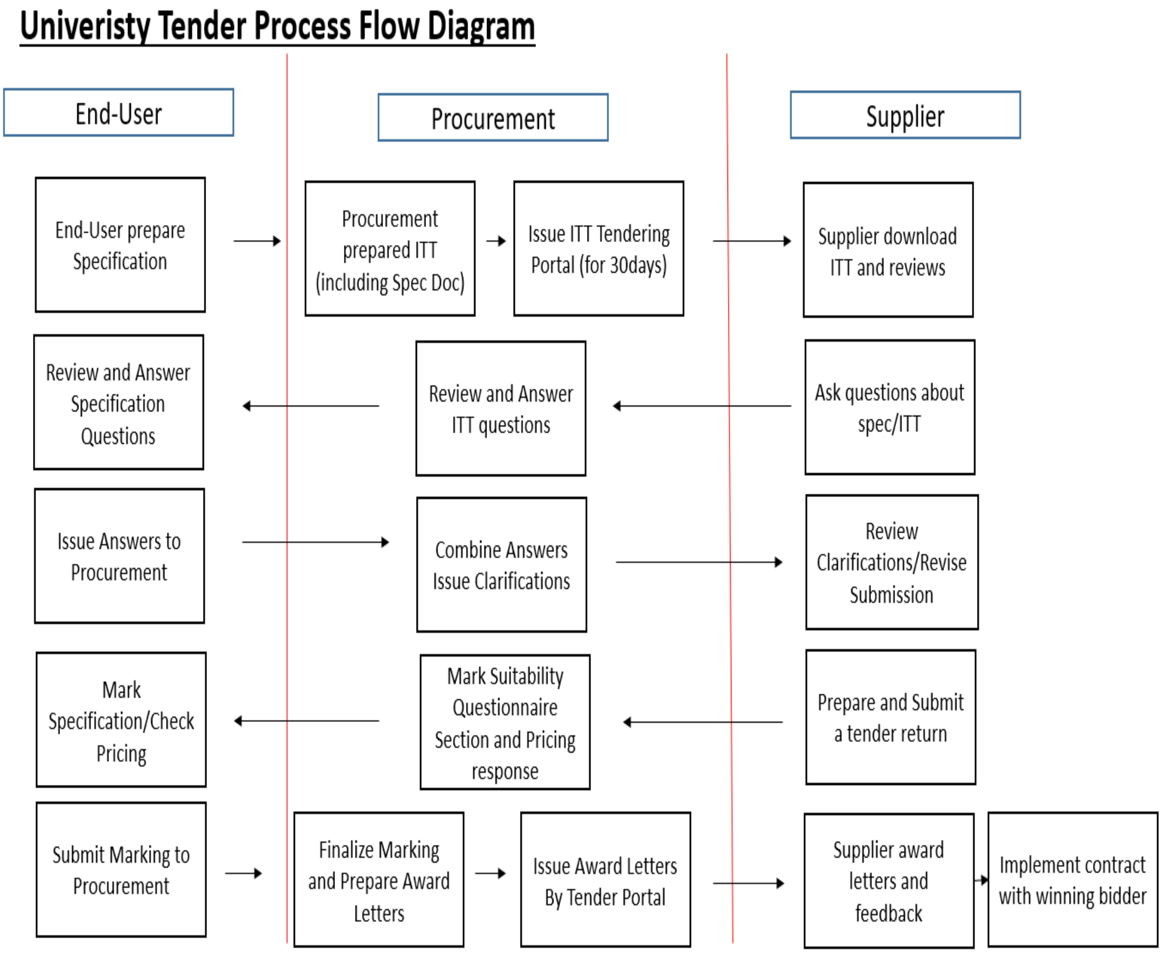
UK Universities outside the public procurement regulations do not adopt the different procedures and timelines of the EU procurement directives but still tender for goods and services based on their own financial regulations and internal policies.

The RIU being studied, is no longer classed as a public body, as the university has undertaken a financial assessment and concluded they are a private body (with over 50% of the funding coming from private sources), the university being studied does not need to apply the Public Procurement Regulations 2015. Therefore, the author, has not used the Public Procurement Regulations to underpin this study.

However, the University being studied does not have a formal diagram of the hybrid tender process and has an internal policy of advertising the ITT for 30 days only. The stakeholder and procurement professional for that category then decides the marking process and award process.

After reviewing the tender document from the case university being studied, a summary of the tender process is shown below in a Figure 2.10.

**Figure 2.10 - University Tender Process Flow Diagram**




On 31st December 2020, the United Kingdom ceased to be a member of the European Union. From 1st January 2021, UK contracting authorities, no longer place an advertisement in OJEC but now place the notice in the new UK government Find a Tender Service website (FTS) (Cabinet Office, 2020). The current tender process and thresholds remain the same under the UK Public Procurement Regulations 2015.

For this study, the purchase of the goods is interlinked with future new product innovation, this allows the buyer to access new innovations long term. The Purchasing Department has long been associated with reducing costs and improving the firm's performance (Ellram and Tate, 2015). Within private firms, purchasing's role has focused on being a gatekeeper by determining which goods and services can be supplied by the firm. The quality of the goods is defined by internal users and is linked to the quality of the output provided by the firm to the external market (Preuss, 2000). Traditionally, the role of public sector procurement has focused on the primary aim of the acquisition of goods, supplies and equipment enabling public employees to successfully discharge their legal responsibilities. However, in the 1980's, this changed within the UK under the management of then Prime Minister Margret Thatcher who was concerned about the level of public expenditure by decreeing that public procurement should focused on delivering core government services through independent contractors not from developing internal services (Lawther et al, 2005; Saunder, 1997).

Prime Minster Thatcher was focused on developing a high-quality procurement function that could obtain value for money for public spending. The benefits of this approach included stakeholders having a greater influence on services provided, developing the procurement into a professional service with specialist procurement professionals managing specific areas, greater standardization, improved resources, and reduced costs (William and Smellie, 1985). Today the focus of public policy is concerned with the legality of the competitive tender process and public accountability for use of taxpayer's money on providing public services (Van Weele, 2018).

However, the role of procurement service within the organisation can have an impact on the outcome of the tender process, for example is the tender outcome focused on getting the goods purely on transaction basis or about developing strong buyer-supplier relations, the author will discuss the role of procurement in the next paragraph and the role of the RIU procurement service being investigated in this study.

## 10. The Role of Procurement

Today's purchasing's role has become strategic and goes beyond the goals of savings and cost reduction (Luzzini et al, 2015). Purchasing Departments are now focused on developing strong buyer-supplier relationships (Bidault et al, 1998; Grudinschi et al, 2014) getting early supplier involvement in NPD, co-creation, and value-added creation (Benton, 2010; Burt and Pinkertonet, 1996; Matthyssens et al, 2016). Within the public sector there has been a move to develop close relationships with suppliers, by engaging in joint activities with suppliers focusing on planning and forecasting demand, discussing specifications, exchanging information, cost reductions and sharing cost savings (Cox, 1996).

Empirical studies on purchasing involvement in NPD processes have focused on private sector firms (Laursen and Anderson, 2016). Within the literature there is limited evidence of studies that apply to public-sector firms, because there has been little academic interest in public procurement research (Bergman and Lundberg, 2013; Quayle and Quayle, 2000) as the majority of research focuses on the application of the EU public procurement directives and the expectation that the tendering process could provide substantial savings through three effects: 1) direct trade effect resulting in lower prices, 2) a competition effect through improving competitiveness in enterprise, 3) obtain efficiency from business structure.

As the procurement of goods and services by public bodies account for a percentage of a country's GDP, policy makers have used public procurement as a driver of public policy initiatives. These policies include driving sustainable procurement, the inclusion of small and medium sized enterprises (SMEs) in the tender process and the public procurement of innovation (Obwegeser and Müller, 2018; Pihlajamaa and Merisalo, 2021; Talebi et al, 2022). The author will briefly discuss the theory of public procurement of innovation in the next paragraph and confirm if this theory will underpin this study.

## 11. Public Procurement of Innovation (PPI)

Within the Public Procurement of Innovation (PPI) literature, there are various terms to define “Public Procurement of Innovation”, these include “innovation procurement”, “public technology procurement”, “innovate procurement”, and “pre-commercial procurement”, all the terms have discernible differences but share one common factor in the that a public body engages with private firms to promote innovation of some kind (Rolfstam, 2013). In contrast PPI according to Talebi et al, (2022, p422) refers to “public sector organisations using their sizeable procurement budgets to engage with the private sector in encouraging innovation to address societal needs”. Alternatively, Castelnovo and Molin (2021, p412) argues “PPI occurs when public authorities place an order for a product or a service that does not yet exist in the market, or is not commercially available on a large scale, but which could be developed within a reasonable timeframe”. From these quotations, the author concluded that PPI aims to drive the creation of new goods and services developed with an external supplier to sell to the market. However, if the public authority needs the goods or services urgently, then PPI is not a suitable approach.

Within the PPI literature, one of the main focuses of research has been the UK government’s implementation of different PPI policies as an innovation tool to stimulate demand and generate economic benefits at national and regional level, while obtaining best value for money and solution to society’s needs (Elder and Yeow, 2013; Obwegeser and Müller, 2018; Pihlajamaa and Merisalo, 2021; Vecchiato and Roveda, 2014). For a public body to implement PPI into its tendering process and tender documentation, to make the process more conducive to innovators and SME's, the European Commission (2014) made the following recommendations as part of the PCR 2015 Regulations:

1) Undertake early supplier engagement – to check the market for solutions and let potential innovators and SME's aware of the project.
2) To attract SME's, contracting authority should remove the need for suppliers to submit legal, financial, economic, health and safety and environmental certificates to self-declaration of requirements. This removes the administrative burden for SME's.
3) Remove the financial requirement for bidders to have turnover of at least twice the value of the contract, as this eliminates SMEs from bidding for a tender.
4) Public buyer should introduce a lotting structure, to attract innovators and SME's.
5) If the winning bidder is an SME, where possible arrange advance payment or a shorter payment period.
6) Technical specification should be based on functional requirements to ensure SME's and innovators can apply.
7) Contracting authorities should allow suppliers to submit variant bids to promote SME's and innovators to apply.
8) Change the award criteria from lowest price to most advantageous tender (MEAT) criteria, to encourage innovators and SMEs to bid.
9) Pricing should be based on the whole life costing of the goods or services, as this will allow public buyers to obtain more innovative products and services.

Source: European Commission (2014)

As the RIU is not a contracting authority and is not subject to PCR 2015 regulations, the implementation of PPI is not a mandatory requirement, as the RIU is not a driver of public policy. The decision to implement a PPI approach as at the discretion of the RIU. The author confirmed this by reviewing the tender documents and none of the supplier selection questions in the supplier questionnaire promotes PPI policy. Consequently, PPI theory will not be underpinning this study, as the RIU has not applied this innovation policy. Interlinked with PPI theory is early supplier engagement, as this encourages innovators and SMEs to engage in the tender process for goods and services, the author will now briefly review if supplier early engagement (ESE) theory should underpin this study.

## 12. Early Supplier Engagement (ESE)

Early supplier engagement (ESE) focuses on firms collaborating with its suppliers and making joint decisions in developing design ideas, restructuring components and systems design. In the ESE process, the supplier crosses organisational boundaries and joins the firm's internal innovation processes, instead of just supplying goods and services to the firm (Harland et al, 2013; Johnsen, 2011; Saunders et al, 2015; Yepeng et al, 2022). Indicating the relationship with the supplier has changed from an adversarial and transactional relationship to a strategic partnership between the supplier and firm. ESE theory is a part of the OI model, where the firm opens the innovation process to other firms like universities and customers to gain advantage by exploiting both internal and external resources (Lichtenthealer, 2011; Rangus et al, 2017; Tidd and Bassant, 2015).

Within the ESE literature, one main field of research has focused on the benefits private sector firms like manufacturers can obtain from early supplier engagement in new product development. By including the supplier in the firm's internal innovation processes allows the firm to increasing the speed of new product development, enhanced quality, obtain flexibility in product configuration, access to supplier resources, lowering of uncertainties, improved access to technology and knowledge (Birou and Fewcett, 1994; Corswant and Tunälv, 2002; Dyer and Singh, 1998: Harland et al, 2023; Ragatz et al, 1997; Wieteska, 2020). By engaging the supplier early, a firm can reduce its operating costs of developing new products and services, which can keep the firm competitive in the marketplace. However, for early supplier engagement to be successful, partners need to develop, trust, share training, risk and reward sharing, effective communication, gain approval from the senior management team, agree performance measures and supplier capability confidence (Anderson et al, 2022; Johnsen, 2010; Wieteska. 2020). Indicating that both partners in ESE need to develop specific cross-sector collaboration (CSC) factors to ensure the process result in ESE. The author reviews the Cross-Sector Collaboration (CSC) factors literature later in this Chapter.

However, strict legal rules under the PCR 2015 regulations and organizational procedures, can cause problems for a contracting authority to create collaborative arrangements through ESE (Holma et al, 2020). It is not possible to change the contract terms under PCR 2015 regulations, once the tender documentation has been issued to suppliers (Edh Hasselgård, 2017). Although the RIU being studied does not need to comply with the PCR 2015 regulations, as the university is not a contracting authority, due to the amount of private funding it receives. Implementing ESE is problematic within the university, as the funding stream for scientific equipment comes from public grants.

The grant application process involves individual academics competing against each other for grant funding of specific projects. This process is highly competitive and involves academics submitting applications and having their work assessed by a panel of experts to decide if their proposed project receives funding (Adams and Bekhradnia, 2004; Harman, 2000; Hughes et al, 2013; Johnes, 1996). As grant funding cannot be guarantee because of the competitive process of peer review (Grimpe, 2012), funding is awarded at short notice and spent within a brief period (within 6 months). Consequently, the procurement service team must ensure that the equipment is delivered, installed, commissioned, and invoiced with the timescale set out by the funder, otherwise lose the funding. This makes the implementation of ESE impossible, due to the uncertain grant funding process. Consequently, the author concluded the ESE theory will not underpin this research study. In the next section, the author explores if university-industry collaboration can be explained using the theory of Public-Private Partnerships.

However, due to the cost of some goods and services provided to the taxpayer via public sector bodies, in 1991, the UK government introduced Public-Private Partnership to operation efficiency, provide an alternative source of funding, the creations of value-for-money through risk sharing between partners and incentives for the private partner to meet time and budget requirements for project (Healthcare UK, 2013).

## 13. Public-Private Partnerships

Many studies within procurement that implement an innovation process, focus on the development of Public-Private-Partnerships (known as PPP). A public-private partnership is a contract issued to a private sector contractor to take over the risk and responsibility for building new infrastructure. Then provide the goods and services associated with running the building. (Ahadzi and Bowles, 2004; Hoppe et al, 2013; Roehrich et al, 2014). The benefit to the public provider of using a PPP approach, is that private sector firms always are responsible for raising the finance required to deliver the project (Bower, 2003). Additional benefits for local government of partnering with a private firm includes access to technical expertise, management training, volunteer support, board participation and their ability to leverage relationships with other stakeholders and policy makers (Halseth and Ryser, 2007).

Traditionally PPP has been used to finance new hospitals and school buildings for local authorities. Torvinen and Ulkuniemi (2016) studied end-user engagement in public procurement by focusing on a single case study of PPP for a school property procurement in northern Finland. Data for the case was collected through semi-structured open-ended interviews with the key informants in the case study, the procurers, suppliers, and end-users. The main aim of the study was to get an authentic insight into the respondent's experiences of the procurement process, the completed interviews where transcribed and thematical analysis used until the data reached saturation point (no new interviews provided any fresh insight) (Torvinen and Ulkuniemi, 2016).

Additional data was collected from secondary data, including calls for bids, winning offer, project reports, property drawings, records of the decision making and meeting minutes in which the end-user participated in. Torvinen and Ulkuniemi (2016) concluded from the single case study, that the end-users informal and proactive approach during the procurement process, had a positive impact on the innovativeness of the project, customer satisfaction and financial success. From the study, end-users benefitted from entering dialogue with the procurer to define the functional requirements for the school's space to be purchased.

## 13.1 Private-Public Partnerships Limitations

The limitation to this study is the conclusions are based on a single case study, though this translates to the procurement process for PPP's schools, this does not translate to other public sector firms like universities, hospitals, or local government including county councils. Tovinen and Ulkuniemi (2016) fail to build on the definition of the lead-user (von Hippel 1976; von Hippel 1977; von Hippel 1986; Urban et al, 1988), and does not define, who the end-user is in this case. The reader is left to assume that the end-users could be teachers, students, parents, a head teacher, or administrators. Another gap in the study is that this approach may only be applicable in Finland, due to differences in procurement procedures within different EU countries (Torvinen and Ulkuniemi, 2016). Finally, the study does not identify in detail the benefits the end-user received for becoming involved in the procurement process.

However, as the majority of PPP's have focused on the development of new schools, hospitals, and roads, with a large capital budget, and is linked to government policy using the public Procurement Regulations 2015, the author concluded the PPP approach would not underpin this study. As the RIU is not a public body, they do not need to follow this government policy.

Successive UK governments have continuously focused on enriching the delivery of public service through improving the public procurement process, in recent years there has been a drive to increase competition in the supplies market by contracting authorities engaging in ongoing dialogue outside of the tender process. With the aim of fostering trust and developing innovation in public sector contracts for this process to be effective, there has been a shift to hire procurement professionals with commercial skills to be able to make and close deals more efficiently (CBI, 2006). Although the EU rules does allow public sector clients to promote innovation, through the most economically advantageous tender, it does not allow the client to enter direct dialogue with the bidders (Haugbølle et al. 2015) as public sector firms are required under the regulations to comply to a duty of equal treatment and fairness to all bidders (Sidwell et al, 2001). The new regulations in 2015, allow for more flexibility in the tender award process.

The term procurement and purchasing has become confusing and used inter-changeably. Within a UK university context, purchasing involves the placing of orders for goods and services within academic departments. Procurement refers to the strategic sourcing (make or buy decision) (Murray, 2009) and contracting of suppliers, so that departments can raise orders. Traditionally public procurement focuses on the delivery of goods/services through a third-party provider, obtaining value for money, and ensuring that the public body complies with regulatory requirements (Meehan et al, 2017). As procurement provides services to internal stakeholders, the most important being the end-user, it is important, procurement is included early in the process of identifying the end-user's needs (Koppelmann, 1998).

To understand the end-user's needs, the procurement service personnel need to comprehend how procurement can add to the tender process and what the end-user (buyer) consider is value-added to support their teaching and research activities. Therefore, the author examines the concept of value-added in the next paragraph.

## 14. The Concept of Value-Added

Within the marketing literature, value can be defined as benefits orientated, where the supplier provides certain benefits or a solution to a problem for the customer (Jolibet et al, 2012). Within the procurement literature, according to Eglin (2013, p79) "Value is the benefit(s) we gain from ownership of something. The price is what must be given up receiving those benefits. The cost is the expense incurred in realising a product or service". In contrast, Woodside et al (2019, p4) suggest "Value, from the perspectives of customers and marketers, is a multidimensional concept. Value as a concept represents a net score that includes measurement of total benefits perceived or realized and total costs of acquiring, using, and disposing of a product or service". Both these quotes indicated that the concept of value is complex, that value can be perceived as a short-term gain or long-term benefit.

Value can also be defined as the products attributes (product-orientation) using price, product availability, how well the goods perform, ease of use, quality, the cost of ownership and social acceptance including status, image, reputation, and trust, (Kaufman, 2001; Jolibet et al, 2012; Matthyssens et al, 2016). Alternatively, value can be defined as the brand itself, the customer relationship between the manufacturer, distributor and the customer and the type of distribution channels used to supply the customer with the goods or services required (McDonald et al, 2006).

Within the public sector, value can be defined as the cost of the goods or services over time, the status and professional standing of the suppliers, the specific details of the requirement, goods or services offered, the financial aspects of the contract (payment terms, transport cost, contract terms), extent of supplier support during the life of the equipment and assistance from the supplier in disposal of the product or equipment when it is no longer required (Baily et al, 2015). Alternatively, Whole-Life Costing, focuses not only on the original cost of the equipment, but the associated shipping charges, equipment power consumption, cost of operating the equipment and any spare parts, service or insurance required to run the equipment (Morris and Pinto, 2007). Additional factors included in whole life costing incorporates the quality of the equipment, the achieved delivery times and the financial viability of the supplier being used to purchase the goods (CVCP, 1993) and the cost of disposing of the equipment once the equipment is no-longer economical to repair or can provide the latest techniques (Morris and Pinto, 2007).

However, within the public sector, this may be the perspective of procurement by senior management, not the perspective of what constitutes value by the end-user using the goods or services. Value can also be created through the relationship between the customer and service provider (Relationship Perspective) (Grönroos, 2007: Wisner et al, 2019). In the purchasing literature, value traditionally focuses on sole cost/price related perspective (Eglin, 2013; Hamilton and Chernev, 2013; Hong and Boong Kwon, 2012; Teichgräber and de Bucourt, 2012). In contrast, by developing a collaboration between university and industry, this approach can improve cost-effectiveness, quality, efficiency, risk assessment and a more transparent procurement process (Torvinen and Ulkuniemi, 2016). For both public and private sector firms the biggest decision is to make short term savings (Ukalkar, 2000) or focus on long-term cost reductions. Within the purchasing literature, there are several steps for a firm to move from a price-reduction to cost-reduction and finally value-creation approaches. Table 2.13 provides a summary of the steps required to move from price reduction to value creation approach to procurement.

**Table 2.13 - Value Creation Approach**

| | |
|---|---|
| 1) | Pay less for goods and services. |
| 2) | Produce the goods or service for less. |
| 3) | Use an alternative product or service. |
| 4) | Eliminate the cost. |

Source: Benton W.C. Jr, 2010; Cheverton and van de Vele, 2011; Harrison et al, 2014.

One method of moving from price focused to cost focused approach is to rationalise and standardise the goods or services the organisation uses in its operations. Standardisation requires the firm to adopt uniformity and reducing the variety of goods and services supplied to the external market. Standardisation requires a reduction in items used, stock or items that a brought in and/or made. This does not happen naturally in a firm but is identified and managed by the procurement department working with technical employees to modify goods or services provided by the firm (Bailey et al, 2015; Cheverton and van der Velde, 2011).

Once this has been achieved, the next step is for the firm to move from a cost focused perspective to a total cost of ownership or total cost of acquisition, based on the unit price of the product, the warranty offered by the supplier on the product, ordering cost, shipping cost, payment terms, if the supplier offers a cash discount, maintenance cost and other qualitative costs that may not be easy to access (Baily et al, 2015; Wisern et al, 2019). After these factors have been identified, procurement can work within a cross-functional team to develop product specifications linked to R&D, ensuring new products are made to the lowest possible cost of ownership (Cheverton and van der Velde, 2011). Finally, the move from cost to value, requires the firm to eliminate cost but keep the customer perceived benefit of the good or service at the same or higher level (Harrison et al, 2014).

Within the innovation literature, value to the customer can be defined in the technical features of the new products created and that these superior features compared to competitors offering, resulting in the customer willing to pay a premium for this advantage (Ling et al, 2015: Menezes and Quelch, 1990; Vanhaverbeke and Du, 2010). Other possible value-added factors for the equipment could include a dedicated account manager or engineer to manage the account, equipment faults being fixed within 24 hours at no extra cost to the buyer. The purchase of the equipment could be used as leverage on another collaboration project or offer a free of charge upgrade to similar equipment in the laboratory. Another possible value-added factor could be the university houses the supplier's technical support team (engineering team) on campus thereby reducing the supplier costs but offering the university instant access to the supplier's technical expertise.

However, the concept of value varies between industries and market segments and can be defined by the value provided to the firm's customers in the marketplace (Hassan 2012: Chopra and Meindl, 2016). Additionally, the concept of value can change due to cultural, environmental, and social situations, where people need to adapt to this change (Haugtvedt et al, 2008). Today purchasing views value as a creation process, access to innovations and relationships (Lysons and Farrington, 2016; Matthyssens et al, 2016). As there are very few empirical studies into academic (end-users) concept of product value, this study will adopt these definitions to identify which factors are most important to academic buyers in the specification.

Within UK universities, the financial regulations require all end-users to undertake a tender process, with procurement to purchase scientific equipment. For this study, procurement services are responsible for strategic sourcing, managing the tender process, developing supplier relationships, and accessing supplier knowledge (Lysons and Farrington, 2016; Matthyssens et al, 2016). Linking procurement with the OI model concept that suppliers can be a source of knowledge (Chesbrough, 2003a; 2003b; 2004; 2006) and a cross-sector collaborating partner.

## 14.1 Value-Added Factors Literature Gaps

Within the academic literature, there are multiple definitions of the concept of value-added factors that the partners can obtain by collaborating. These are general benefits not specific to an exact university or scientific equipment manufacturing firm. However, these general factors relate to purchasing a specific good or service from a firm, these factors are not specific value-added factors that are specific to a university teaching and research activity. After reviewing the procurement, marketing, management, and innovation literature on the concept of value-added. The author has below summarized the value-added factors that the literature has identified as being important to buyer's when deciding to purchase a good or service. These value-added factors are explained in more detail in Table 2.14 entitled "Value-Added Factors for PI end-user Collaboration".

**Table 2.14 - Value-Added Factors for PI end-user Collaboration**

| **Value-Added Factors** | **Reference /Literature** |
|---|---|
| Certain benefit (customer specific) | Jolibet et al, 2012 (Marketing Literature) |
| Solution to a problem for the customer | Jolibet et al, 2012 (Marketing Literature) |
| Price | Hamilton and Chernev, 2013; Eglin, 2013; Kaufman, 2001; Jolibet et al, 2012; Matthyssens et al, 2016 (Marketing Literature)<br>Baily et al, 2015; Eglin, 2013; (Procurement Literature)<br>Teichgräber and de Bucourt (2012)<br>Hong and Boong Kwon (2012)<br>(Procurement Literature) |
| Price (Over time) | Baily et al, 2015 (Public Sector Literature) |
| Product availability | Kaufman, 2001; Jolibet et al, 2012; Matthyssens et al, 2016 (Marketing Literature) |
| Technical features | Ling et al, 2015 (Marketing Literature)<br>Vanhaverbeke and Du, 2010 (Innovation Literature) |

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| | Menezes and Quelch, 1990 (Management Literature) |
| Superior features compared to competitors offering | Vanhaverbeke and Du, 2010 (Innovation Literature) |
| The customer will have to pay a premium for new product features | Vanhaverbeke and Du, 2010<br>(Innovation Literature) |
| Goods Performance | Kaufman, 2001; Jolibet et al, 2012; Matthyssens et al, 2016 (Marketing Literature)<br>Menezes and Quelch 1990<br>(Management Literature) |
| Ease of Use | Kaufman, 2001; Jolibet et al, 2012; Matthyssens et al, 2016 (Marketing Literature) |
| Quality | Kaufman, 2001; Jolibet et al, 2012; Matthyssens et al, 2016 (Marketing Literature)<br>Hong and Boong Kwon, (2012) (Procurement Literature) |
| Cost of ownership – Status | Hamilton and Chernev, 2013; Kaufman, 2001; Jolibet et al, 2012; Matthyssens et al, 2016<br>(Marketing Literature) |
| Cost of ownership - Image | Hamilton and Chernev, 2013; Kaufman, 2001; Jolibet et al, 2012; Matthyssens et al, 2016<br>(Marketing Literature) |
| Cost of ownership - Reputation | Hamilton and Chernev, 2013; Kaufman, 2001; Jolibet et al, 2012; Matthyssens et al, 2016<br>(Marketing Literature) |
| Cost of ownership – Trust | Kaufman, 2001; Jolibet et al, 2012; Matthyssens et al, 2016 (Marketing Literature) |
| Equipment power consumption | Morris and Pinto, 2007 (Whole-Life Costing Literature) |
| Cost of operating the equipment | Morris and Pinto, 2007 (Whole-Life Costing Literature) |
| Spare Parts | Bin Dana, et al 2018 (Procurement Literature)<br>Morris and Pinto, 2007 (Whole-Life Costing Literature) |
| Service | Bin Dana, et al 2018 (Procurement Literature)<br>Hamilton and Chernev, 2013; (Marketing Literature)<br>Morris and Pinto, 2007 (Whole-Life Costing Literature) |
| Warranty | Bin Dana, et al 2018 (Procurement Literature) |
| Insurance required to run the equipment. | Morris and Pinto, 2007 (Whole-Life Costing Literature) |
| Status and professional standing of the suppliers | Baily et al, 2015 (Public Sector Literature) |
| The financial aspects of the contract - Payment terms | Baily et al, 2015 (Public Sector Literature) |
| The financial aspects of the contract –<br>Transport cost | Baily et al, 2015 (Public Sector Literature)<br>Morris and Pinto, 2007 (Procurement Literature) |
| The financial aspects of the contract –<br>Terms of Contract | Baily et al, 2015 (Public Sector Literature) |
| Extent of supplier supporting during the life of the equipment | Baily et al, 2015 (Public Sector Literature) |
| Assistance from the supplier in disposal of the | Baily et al, 2015 (Public Sector Literature)<br>Morris and Pinto, 2007 (Whole-Life Costing Literature) |

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| product or equipment when it is no longer required | |
| Brand | McDonald et al, 2006 (Marketing Literature) |
| Customer Relationship | McDonald et al, 2006 (Marketing Literature) |
| Distribution Channels | McDonald et al, 2006 (Marketing Literature) |
| Discount | Baily et al, 2015; Wisern et al, 2019. |

Source: Baily et al, 2015; Hamilton and Chernev, 2013; Eglin, 2013; Hong and Boong Kwon, 2012; Kaufman, 2001; Jolibet et al, 2012; Ling et al, 2015; Matthyssens et al, 2016; McDonald et al, 2006; Morris and Pinto, 2007; Teichgräber and de Bucourt, 2012; Wisern et al, 2019; Vanhaverbeke and Du, 2010.

The key value-added factors were identified through the review of the procurement, marketing, innovation, and higher education literature. These factors inform the design of the data collection tools deployed for the collection of the primary data in this study. Additionally, this study looks at other value-added factors not identified in the literature that are specific to a project for both buyer and supplier. The key value-added factors emerging from the literature are deemed to influence a supplier to engage in innovation with a university academic buyer and are summarised in Table 2.15 below.

**Table 2.15 - Supplier Benefits of Collaboration with Buyer**

| **Supplier Value-Added Factors** | **Reference** |
|---|---|
| Access to Academic support | Allen and O'Shea, 2014 |
| Access to Research facilities | Allen and O'Shea, 2014; Howells et al, 2012 |
| Access to potential labour pool (Students) | Allen and O'Shea, 2014 Piterou and Birch, 2014; Tyrrell, 2015 |
| Access to shared space | Fayolle and Redford, 2014; Jamil et al, 2015 |
| Access to advanced equipment | Fayolle and Redford, 2014; Jamil et al, 2015 |
| Access to management support | Fayolle and Redford, 2014; Jamil et al, 2015; Markman, 2016 |
| Networking and access to national and international markets | Fayolle and Redford, 2014; Jamil et al, 2015 |
| Experience of patenting and IP protection | Fayolle and Redford, 2014; Jamil et al, 2015 |
| Government funding for developing the R&D phase of new goods and services | Saputra, 2018 |
| Venture capital to start the company up | Saputra, 2018 |
| Patenting | Etzkowtiz et al, 2000; Etzkowitz, 2003; Etzkowitz, 2004; Etzkowitz, 2008; |

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| | Fayolle and Redford, 2014; Howells et al, 2012; Jamil et al, 2015; Miller et al, 2009; Padilla-Meléndez and Garrido-Moreno, 2012 |
| IP Licensing | Etzkowtiz et al, 2000; Etzkowitz, 2003; Etzkowitz, 2004; Etzkowitz, 2008; Fayolle and Redford, 2014; Jamil et al, 2015; Miller et al, 2009; Padilla-Meléndez and Garrido-Moreno, 2012 |
| IP profit | Saputra, 2018 |
| Incubation (spin off of new venture capital firms) | Etzkowtiz et al, 2000; Etzkowitz, 2003; Etzkowitz, 2004; Etzkowitz, 2008; Miller et al, 2009 Saputra, 2018 |
| Improve their strategic position in the external market | Saputra, 2018 |
| Better adaption of goods and services to meet customer needs | Padilla-Meléndez and Garrido-Moreno, 2012 |
| Commercialisation of knowledge and technology | Padilla-Meléndez and Garrido-Moreno, 2012 |
| Sharing risk in innovation | Tether and Swann: 2003 |
| Enhancing the firm's image or reputation | Padilla-Meléndez and Garrido-Moreno, 2012 |
| Offer organization learning | Child and Faulkner, 1998 |
| Reduce Risk | Tether and Swann; 2003 |
| Provide technology exchange overcoming government trade or investment barriers | Child and Faulkner, 1998 |
| Block competition | Child and Faulkner, 1998 |
| Embed the partners in the firm's value | Child and Faulkner, 1998 |
| Working with a university with a specialist innovation ecosystem | Markman, 2016 |
| Location | Howells and Bessant, 2012 Markman, 2016 |
| Valuable target sample for market research | Ahmed and Shepard, 2010; Tidd and Bessant, 2015 |
| Economic benefit of technology Transfer | Miller et al, 2009 |
| Sharing knowledge | Padilla-Meléndez and Garrido-Moreno, 2012; Thune, 2010 |
| Technical Expertise | Halseth and Ryser, 2007 |
| Faculty Consultancy Services | Brandt et al 2009 |

Source: Allen and O'Shea, 2014; Ahmed and Shepard, 2010; Child and Faulkner, 1998; Etzkowtiz et al, 2000; Etzkowitz, 2003; Etzkowitz, 2004; Etzkowitz, 2008; Fayolle and Redford, 2014; Halseth and Ryser, 2007; Howells and Bessant, 2012; Howells et al, 2012; Jamil et al, 2015; Markman, 2016; Miller et al, 2009; Padilla-Meléndez and Garrido-Moreno, 2012; Piterou and Birch, 2014; Saputra, 2018; Tidd and Bessant, 2015; Tether and Swann: 2003; Thune, 2010; Tyrrell, 2015

These value-added factors have been grouped into four groups, the equipment value-added factors, the research value-added factors, the benefit to student's value-added factors and the collaboration value-added factors. The author has adopted these categories, as it identifies, the main valued-added factors groups that buyers consider important to add into the tender specification. This allows the author to develop a value-added matrix that the procurement professional can use to help the buyer identify the skills and resources they are lacking. Allowing the buyer to access value-added factors that support their teaching and research activities. By developing the four category groups approach, the author can high light area's that buyers may not have considered in their tender, which would provide additional value to the buyer's students or research objectives.

Table 2.16 below is a summary of the value-added equipment factors that have been identified across the different subject literature and the benefits the university academic (buyer) obtains when collaborating with a scientific manufacturer (supplier). These value-added factors for the buyer include obtaining the prototype at a lower price or free of charge, better quality equipment, and increase functionality to allow the PI to undertake additional/new techniques. The buyer can access additional or new resources provided by the supplier (free of charge) to develop the prototype. The collaboration offers a whole life benefit, there is no cost to the buyer for recycling existing equipment as the supplier offers this as part of the collaboration by replacing old for new equipment. The partnership offers the upgrade of existing equipment without any additional cost, allowing the buyer to reallocate these funds to other requirements. The partnership offers additional services, like dedicated account managers, service engineers or enhanced maintenance, if there are issues with the equipment, the buyer can call on this support to get the equipment up and running within 24 hours. This allows the buyer to focus on research and teaching activities and not lose time waiting for the equipment to be repaired. Allowing the buyer more time to apply for additional research funding and reducing the time to complete their publication deadline. The university buyer may enhance their reputation as a lead-buyer as they are constantly innovating and creating cutting edge equipment to drive science forward. Finally, as the equipment moves to mass production, the buyer community has access to the new functionality and techniques created from the collaboration, allowing these buyers to further their research.

Figure 2.16 below is a summary of the equipment value-added factors that the author has identified from the literature and combined into a single table.

**Table 2.16 - Equipment Value-Added Factors**

| Equipment Value-Added Factors | References |
|---|---|
| Price | Bailey et al, 2015; Benton W. C. Jr, 2010; Ellram and Tate, 2015; Lysons and Farrington, 2016; Kaufman, 2001; Jolibet et al, 2012; Matthyssens et al, 2016 |
| Price (Over time) | Bailey et al, 2015 |
| Functionality of the equipment | Kaufman, 2001; Jolibet et al, 2012; Matthyssens et al, 2016; Torvinen and Ulkuniemi ,2016; Vanhaverbeke and Du, 2010 |
| Certain benefit (customer specific) | Jolibet et al, 2012 |
| Access to skill to develop new equipment | Watson and Hall, 2015 |
| Whole Life costing | Kaufman, 2001; Jolibet et al, 2012; Matthyssens et al, 2016; Morris and Pinto, 2007 |
| Solution to a problem for the customer | Jolibet et al, 2012 |
| Upgrade of similar type equipment by supplier | Tyrrell, 2020 |
| Equipment technical support | Tyrrell, 2020 |
| Dedicated Account Manager | Tyrrell, 2020 |
| Dedicated Service Engineer | Tyrrell, 2020 |
| Faults repaired within 24 hours | Tyrrell, 2020 |
| Enhanced maintenance | Baily et al, 2015; Wisern et al, 2019 |
| Develop new techniques and applications | Ahmed and Shepard, 2010; Tidd and Bessant, 2015 |
| Other end-user benefit from the new design | Baldwin and von Hippel, 2011 |
| Product quality | Kaufman, 2001; Jolibet et al, 2012; Matthyssens et al, 2016; Preuss, 2000; Torvinen and Ulkuniemi, 2016 |
| Product availability | Kaufman, 2001; Jolibet et al, 2012; Matthyssens et al, 2016 |
| Technical features | Ling et al, 2015, Menezes and Quelch, 1990; Vanhaverbeke and Du, 2010 |
| Social acceptance (including status, image, reputation, and trust) | Kaufman, 2001; Jolibet et al, 2012; Matthyssens et al, 2016 |
| Superior features to competitors offering | Vanhaverbeke and Du, 2010 |
| Customer prepared to premium for new product features | Vanhaverbeke and Du, 2010 |
| Goods Performance | Kaufman, 2001; Jolibet et al, 2012; Menezes and Quelch 1990 |

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| Ease of Use | Kaufman, 2001; Jolibet et al, 2012; Matthyssens et al, 2016 |
| Quality | Hong and Boong Kwon, 2012; Kaufman, 2001; Jolibet et al, 2012; Matthyssens et al, 2016 |
| Cost of ownership – Status | Hamilton and Chernev, 2013; Kaufman, 2001; Jolibet et al, 2012; Matthyssens et al, 2016 |
| Cost of ownership - Image | Hamilton and Chernev, 2013; Kaufman, 2001; Jolibet et al, 2012; Matthyssens et al, 2016 |
| Cost of ownership - Reputation | Hamilton and Chernev, 2013; Kaufman, 2001; Jolibet et al, 2012; Matthyssens et al, 2016 |
| Cost of ownership – Trust | Kaufman, 2001; Jolibet et al, 2012; Matthyssens et al, 2016 |
| Cost of operating the equipment | Morris and Pinto, 2007 |
| Spare Parts | Bin Dana, et al 2018; Morris and Pinto, 2007 |
| Service | Bin Dana, et al 2018; Hamilton and Chernev, 2013; Morris and Pinto, 2007 |
| Warranty | Bin Dana, et al 2018 |
| Insurance required to run the equipment. | Morris and Pinto, 2007 |
| Status and professional standing of the suppliers | Baily et al, 2015 |
| The financial aspects of the contract - Payment terms | Baily et al, 2015 |
| The financial aspects of the contract – Transport cost | Baily et al, 2015; Morris and Pinto, 2007 |
| The financial aspects of the contract – Terms of Contract | Baily et al, 2015 |
| Extent of supplier supporting during the life of the equipment | Baily et al, 2015 |
| Assistance from the supplier in disposal of the product or equipment when it is no longer required | Baily et al, 2015; Morris and Pinto, 2007 |
| Brand | McDonald et al, 2006 |
| Customer Relationship | McDonald et al, 2006 |
| Distribution Channels | McDonald et al, 2006 |
| Discount | Baily et al, 2015; Wisern et al, 2019. |

Source: Ahmed and Shepard, 2010; Bailey et al, 2015; Baldwin and von Hippel, 2011; Benton W. C. Jr, 2010; Bin Dana, et al 2018; Ellram and Tate, 2015; Ling et al, 2015; Lysons and Farrington, 2016; Hamilton and Chernev, 2013; Hong and Boong Kwon, 2012; Jolibet et al, 2012; Kaufman, 2001; Matthyssens et al, 2016; McDonald et al, 2006; Menezes and Quelch, 1990; Morris and Pinto, 2007; Preuss, 2000; Tyrrell, 2020; Torvinen and Ulkuniemi ,2016; Vanhaverbeke and Du, 2010; Watson and Hall, 2015; Wisern et al, 2019

Table 2.17 below is a summary of the student value-added factors that have been identified across the different subject literature and the benefits the academics, students and department can gain from the collaboration. The value-added factors include, the supplier providing funding of PhD studentships, allowing the academic to increase their research image. The interaction with the supplier provides students with the skills to make them more employable, this increases the department’s image with potential students. With the supplier helping to develop professional, new education courses and modifying existing courses, this brings the academic and department additional income and makes the department even more attractive to potential students and funders.

By offering funding and supporting Master and PhD students through conference and poster display funding, travel grants and bursaries, this free’s up the funds allocated by the university for these activities to be reallocated to other research and teaching activities. With the supplier offering student advice on a thesis topic, defining parameters for student dissertations, mentoring, offering internships, voluntary internships, or real-life case studies for the student to work on, all these factors add to students to develop the skills required to work in the corporate world. This entices future students to apply for study with this specific academic or university department. Career fairs and recruitment programs offer the university and industry chance to promote their collaboration to the external world enhancing both their reputation and image. Figure 2.17 below is a summary of the student value-added factors that the author has identified from the literature and combined into a single table.

**Table 2.17 - Student Value-Added Factors**

| **Student Value-Added Factors** | **References** |
|---|---|
| PhD scholarships | Abramovsky and Simpson, 2008; Tyrrell, 2015 |
| Increasing student work experience and skills to make students more employable | Jonbekova et al, 2020; Salminen-Karlisson and Wallgren; 2005; Thune, 2010. |
| Creating new professional and educational courses | Jonbekova et al, 2020; Howells et al, 2012: Salminen-Karlisson and Wallgren; 2005; Thune, 2010 |
| Modifying existing courses to meet employer requirements | Jonbekova et al, 2020; Salminen-Karlisson and Wallgren; 2005; Thune, 2010 |
| Providing teaching and learning activities with the firm providing equipment | Jonbekova et al, 2020; Harman, 2010; Prigge, 2005; Thune, 2010 |

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|---|---|
| Sponsoring Master and PhD student conferences | Tyrrell, 2020 |
| Sponsoring of Master and PhD student poster displays | Tyrrell, 2020 |
| Bursaries and travel grants | Tyrrell, 2020 |
| Thesis advice | Jonbekova et al, 2020; Salminen-Karlisson and Wallgren; 2005; Thune, 2010 |
| The firm defines the parameter for student projects | Jonbekova et al, 2020; Salminen-Karlisson and Wallgren; 2005; Thune, 2010 |
| Student internships | Harman; 2010; Howells et al, 2012; Jonbekova et al, 2020; Prigge, 2005; Thune, 2010. |
| The firm provides student and offer real life case studies | Thune, 2010 |
| Offer a bridge between studies and work life skills by offering voluntary internship | Harman; 2010; Howells et al, 2012; Jonbekova et al, 2020; Prigge, 2005; Thune, 2010. |
| Help through career fairs | Harman, 2010; Jonbekova et al, 2020; Prigge, 2005; Thune, 2010 |
| Help with other recruitment programs | Harman, 2010; Jonbekova et al, 2020; Prigge, 2005; Thune, 2010 |
| Mentoring | Harman, 2010; Jonbekova et al, 2020; Prigge, 2005; Thune, 2010 |

Source: Abramovsky and Simpson, 2008; Harman, 2010; Howells et al, 2012; Jonbekova et al, 2020; Prigge, 2005; Salminen-Karlisson and Wallgren; 2005; Thune, 2010; Tyrrell, 2015.

In contrast table 2.18 below is a summary of the research value-added factors that the author has identified across the different subject literature, combined into a single table, and the research benefits that the academic can obtain from the collaboration. Additionally, several of these factors can be benefits that the scientific equipment manufacturer can obtain from the collaboration with the buyer.

### Table 2.18 - Research Value-Added Factors

| **Research Value-Added Factors** | **References** |
|---|---|
| Training post-graduate scientists | Abramovsky and Simpson, 2008 |
| Access to resources | Watson and Hall, 2015; Smith, 2006; Tyrrell, 2015 |
| Access to funds | Bower, 2003; Tether and Swann, 2003; Brem and Viardot, 2013 |

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|---|---|
| Co-authoring scientific publications | Padilla-Meléndez and Garrido-Moreno, 2012 |
| Joint collaboration on projects | Abramovsky and Simpson, 2008 |
| Supplier technical support based on campus | Tyrrell, 2020 |
| Patenting | Etzkowtiz et al, 2000; Etzkowitz, 2003; Etzkowitz, 2004; Etzkowitz, 2008; Fayolle and Redford, 2014; Howells et al, 2012; Jamil et al, 2015; Miller et al, 2009; Padilla-Meléndez and Garrido-Moreno, 2012 |
| IP Licensing | Etzkowtiz et al, 2000; Etzkowitz, 2003; Etzkowitz, 2004; Etzkowitz, 2008; Fayolle and Redford, 2014; Jamil et al, 2015; Miller et al, 2009; Padilla-Meléndez and Garrido-Moreno, 2012 |
| Incubation (spin off - new venture capital firms) | Etzkowtiz et al, 2000; Etzkowitz, 2003; Etzkowitz, 2004; Etzkowitz, 2008; Miller et al, 2009 Saputra, 2018 |
| Access to research facilities | Allen and O' Shea, 2014; Howells et al, 2012 |
| IP shared profit | Saputra, 2018 |
| Access knowledge | Padilla-Meléndez and Garrido-Moreno, 2012 |
| New skills methods and techniques | Howells et al, 2012 |

Source: Abramovsky and Simpson, 2008; Allen and O' Shea, 2014; Brem and Viardot, 2013; Bower, 2003; Etzkowtiz et al, 2000; Etzkowitz, 2003; Etzkowitz, 2004; Etzkowitz, 2008; Fayolle and Redford, 2014; Howells et al, 2012; Jamil et al, 2015; Miller et al, 2009; Padilla-Meléndez and Garrido-Moreno, 2012; Smith, 2006; Saputra, 2018; Tether and Swann, 2003; Tyrrell, 2015; Tyrrell, 2020; Watson and Hall, 2015.

From table 2.18, the research value-added factor benefits for the buyer include, the buyer not having to train post-graduate scientists in scientific techniques and using the equipment. This is provided free of charge as part of the research collaboration for the academic's research team. The collaboration offers the academic access to additional resources like temporary staff, new skills, techniques, methods, knowledge, technical support, and funds that speed up the research process for the academic. These factors can enhance the academics image, career progression and increase the potential to access grant funding. New ideas and income can be generated through co-authoring of scientific papers, collaboration on new projects, patenting, IP licensing and new spin off companies to develop new goods and services. All these factors enhance the reputation, image, resources, and income of both the academic (buyer) and the scientific equipment manufacturer (firm).

Table 2.19 below is a summary of the collaboration value-added factors that have been identified across the different subject literature and the collaboration benefits that the buyer can obtain from the partnership. Some of these factors can also be benefits that the scientific equipment manufacturer can obtain from the collaboration with the buyer. These value-added factors include the technical expertise of the supplier to be able to make a working prototype of the scientific equipment, as the buyer does not have the resources to develop on their own. Access to the supplier R&D, this allows the buyer to develop their ideas into a functional prototype with the aid of the supplier design engineers. The collaboration can offer access to networks, these could include other suppliers, academics, private funders etc. These parties may be able to help develop research techniques, provide funding, offer resources, and provide knowledge to the academic's research and teaching activities.

Offering the possibility of new techniques being transferred to other possible stakeholders at a cost. The supplier can help to develop the buyers own internal research services by offering the expertise to commercialise ideas. Another benefit you can obtain from the collaboration, is the supplier may be able to obtain venture capital for the buyer to set up their own business. As the supplier may obtain a better loan rate than the buyer.

By forming a collaboration, the partners not only share resources but can manage risk, as this reduces the cost of the partnership failing. Another benefit is the supplier location near the buyer, can create informal interactions between the partners due to their proximity and increase knowledge transfer. Figure 2.19 below is a summary of the collaboration value-added factors that the author has identified from the literature and combined into a single table.

**Table 2.19 - Collaboration Value-Added Factors**

| **Collaboration Value-Added Factors** | **References** |
|---|---|
| Technical expertise | Halseth and Ryser, 2007 |
| Access supplier R&D | Brem and Viardot, 2013; Cheverton and van der Velde, 2011; Tether and Swann, 2003 |
| Access to networks | Fayolle and Redford, 2014; Jamil et al, 2015 |
| Leverage on another collaboration or relationships with stakeholders | Howells et al, 2012; Tyrrell, 2020 |
| Develop research services | Padilla-Meléndez and Garrido-Moreno, 2012 |
| Technology transfer | Miller et al, 2009 |
| Creating informal interactions | Padilla-Meléndez and Garrido-Moreno, 2012 |
| Manage risk | Ahadzi and Bowles, 2004; Hoppe et al, 2013; Roehrich et al, 2014 |
| Access to venture capital | Saputra, 2018 |
| Location of the supplier | Howells et al, 2012; Markman, 2016; Piterou and Birch, 2014 |

Source: Ahadzi and Bowles, 2004; Brem and Viardot, 2013; Cheverton and van der Velde, 2011; Fayolle and Redford, 2014; Halseth and Ryser, 2007; Hoppe, et al 2013; Howells et al, 2012; Jamil et al, 2015; Markman, 2016; Miller et al, 2009; Padilla-Meléndez and Garrido-Moreno, 2012; Piterou and Birch, 2014; Roehrich et al, 2014; Saputra, 2018; Tether and Swann, 2003; Tyrrell, 2020

From the equipment, student, research, and collaboration value-added tables, the author has identified the primary benefits the buyer receives from engaging with a supplier in a collaboration via the procurement tender process. Using this summary of value-added factors, the author can now incorporate these factors into the buyer’s telephone interview and supplier virtual meeting questions. This summary of value-added factors can be used to compare the value-added factors added by the buyer in the tender specification and the response from the supplier.

Consequently, after examining the value-added literature and identifying numerous value-added factors that could benefit the buyer’s teaching and research activities, the author concluded that value-added factors are a key concept that can underpin this study. As the study focuses on university-industry collaboration, to understand what makes a collaboration a success, the author examined the cross-sector collaboration literature in section 15. To investigate the secondary and primary data for this study, to identify which CSC factors are present or not present in University-Industry Collaborations.

## 15. Cross-Sector Collaboration

There has been increased amount of scholarship on public-private partnerships, these cross-sector partnerships include social, philanthropic, and non-government agencies whose primary purpose is to serve the public good. These cross-sector partnerships focus on a wide range of goals including research and development, local economic growth, poverty alleviation, and public health. With the aim of these partnerships solving impossible objectives and addressing unsolvable complex problems (Buffett and Eimicke, 2018). However, not all cross-sector partnerships focus on solving the problems in society, many focus on their own firm's objectives.

Cross-Sector Collaboration (CSC) involves industry and public sector institutions coming together as a single organisation (Bryans et al, 2006; Buffett and Eimickle, 2018) to solve problems, share resources, IP, knowledge, money, personnel or equipment, exchange know-how, expertise, and experience (Canker and Petkovšek, 2013). Alternatively, cross-sector collaboration can as Forrer et al, (2014, p9) involves "the interaction of two or more of the three organizational sectors: the public sector (governmental units at all levels, local, state, and national), the private or for-profit sector, and the nonprofit or not-for-profit sector. Collaboration could include any combination of the three sectors, including public-private, public-nonprofit, private-nonprofit, or public-private-nonprofit". Within this relationship the government provides the legal and regulatory framework and the economic, political and society conditions for the other partners to operate within. Business provides goods and services, generates profit for stakeholders, offer employment, innovation, and economic growth. The Non-Profit Sector provides support and services to those in society that are in need or excluded (Schuster and Holtbrügge, 2013). The Non-Profit sector includes charities, universities, and the National Health Service (NHS).

Possible reasons for collaboration for individuals working in the public sector can include career considerations, idealism, professional recognition, power, self-fulfilment, money, increased funding, ability to problem solve, increase in staff and public relations (Cankar and Petkovšek, 2013).

However, cross-sector collaboration can take various forms in scale, scope and in its purpose. Partnerships can be dyads to multiparty agreements, can be at local or global level, can be long-term or short term and can be on a voluntary basis or fully mandated between the parties (Selsky and Parker, 2005). Indicating that there are a variety of reasons why partners come together to collaborate, this will have an impact on the duration of the partnership and what the partnership aims to achieve during the life of the collaboration. For example, individuals working in private sector firms may be motivated to collaborate because it improves their career prospects due to idealism, provide self-fulfilment, offers money, power, and jobs security (Cankar and Petkovšek, 2013).

The ambition to form Cross-Sector Collaborations has been driven by changes in the relationship between science, industry and society and the way in which government funds science, distributes funding to institutions and the way they carry out research. The funding of science research is now influenced by market forces and social expectations. Other factors that influence CSC including how knowledge is created and distributed (such as through tertiary education), the globalisation of business, the emergence of new technologies and knowledge transfer through information and/or communication technologies (Garrett-Jones et al, 2005). CSCs are very common in environmental protection, with firms like IBM, General Motors, PepsiCo, and Eddy Bauer supporting its employee’s participation in environmental programs that offer both financial contributions and marketing affiliations to make environmental activities more visible to the public (Rondinelli and London, 2003; Hartman and Dhanda, 2018, Howells et al, 2012).

Within public sector firms the drive for CSC has been instigated due to the need to access new funding and capabilities, in a time of dwindling resources and public austerity measures, to continue to provide public services (Johnston and Finegood, 2015). Within the UK, Cross-Sector Collaborations have focused on building hard infrastructure like roads, water works and hospitals through private-public-partnerships (Von Tulder et al, 2016).However, there is no clear definition of the word collaboration, as collaboration in a public setting could mean co-working to achieve common goals, working across boundaries, in multi-sectors, include multi-actor relationships, includes the public and is based on value of reciprocity (O'Leary and Vij, 2012). Within the world of "big science" collaboration has become a critical component of research, as not every scientist can possess all the knowledge or skills required to make theoretical and application contributions to every area of research (Hara et al, 2003). Within the public sector firms like the NHS and Local Government, the reasons for CSC include providing a joined-up-service, offering clients better coverage, avoiding conflicts of interest, providing specialist groups with support, sharing resources, deploying limited resources more effectively and supporting the voluntary sector (Mayo et al, 2014).

## 15.1 Critical Success Factors in Cross-Sector Collaboration

Within the CSC literature there is a broad spectrum of benefits that a firm can obtain through cooperation, both firms can gain access to information, resources, markets, and technologies (Schuster and Holtbrügge, 2013). CSC can offer partners the ability to reduce uncertainty and solve their own organizational problems. There is a general assumption that partners come together voluntarily, sharing common goals and share power in the partnership (Babiak and Thibault, 2009). For public sector bodies, the benefit of a partnership includes not only access to resources, but increase capability to address complex problems, increased viability of scope and scale of public sector efforts, access to new funding and capabilities during a time of increased limited resources and public austerity measures (Johnston and Finegood, 2015).

From these benefits the author concluded that the motives for partnering can have an impact on the success or failure of the collaboration. Within the CSC literature there are several studies that identify potential critical success factors, critical success factors can be defined as those characteristics, conditions, or variables that when properly managed has a direct impact on the partnership operation and shared vision between partners (Ukalkar, 2000).

Within the CSC and procurement literature the critical success factors include integration of new projects into existing cultures, clear lines of communications between partners, trained cross-functional teams, level of trust between partners, willingness to share, advanced planning, shared values, longevity of partnership and conflict resolution process (Mendel and Brudney, 2018; Mohr and Spekman, 1994; Vernis et al, 2006; Ukalkar, 2000). After reviewing the CSC literature, the author has summarized a list of common factors below in Table 2.20, these factors need to be implemented between the partners for the collaboration to be successful.

**Table 2.20 - Common Factors influencing CSC Collaborations**

| ***Factors*** | ***Activity*** | ***Author*** |
|---|---|---|
| **Context** | All collaborations and partners are influenced by the context of the external environment consisting of market competition. Government policy, legal and tort reforms, management practices, unionization, and organisational culture. All these factors can influence if a collaboration will be successful in one context and not another. | Bryson et al, 2006; Clarke and Fuller, 2010; Hartman and Dhanda, 2018; O'Leary and Vij, 2012; Osborne, 2006; Perkmann et al, 2014 |
| **Collaboration Purpose** | Sharing values, goals and a mission is a key requirement of a successful collaboration. Different partners can have various reasons for collaboration. Potential goals for a private partner collaboration can include interest of the firm's leadership, nature of the firm's business and their firm's organisational approach to corporate social responsibility (CSR). CSR | Austin, 2010; Bryston et al, 2009; Clarke and Fuller, 2010; Johnson and Finegood, 2015; Mayo et al, 2014; O'Leary and Vij; 2012; Ukalkar, 2000 |

| | | |
|---|---|---|
| | extends the firm's interest into social and ethical concerns, which may benefit the firm by creating business through goodwill and extending its external contacts. | |
| **Partner Selection process and capability** | Each partner brings its own skills, knowledge, experience, expertise, and resources to the collaboration. As the collaboration develops both partners begin to learn from each other. Capacity is ability of the partner to bring these resources to the collaboration and this increases the likelihood of the collaboration being successful. For this study, the tender process, will be the method for selecting a collaboration partner to work with the buyer on the new scientific equipment. | O'Leary and Vij, 2012 |
| **Collaboration motivations and commitment** | There are multiple reasons why partners decide to collaborate. Before forming any collaboration, the motivations and commitment to the collaboration should be assessed for suitability. | Clarke and Fuller, 2010; O'Leary and Vij, 2012; Thune, 2011; Ukalkar, 2000 |
| **Collaboration structure and governance** | Within the collaboration the partners face a paradox on providing stability or flexibility in the partnership. Therefore, a centralised structure to managing the collaboration is recommended, as this allows for lines of authority and responsibility to each partner to be defined. Eliminating the potential for conflict in the relationship. | Bryson et al, 2006; Bryson et al, 2009; O'Leary and Vij, 2012. |
| **Power** | Within the collaboration there can be an imbalance of power, due to one partner having more resources than the other. This can lead to mistrust between the partners and lead to failure of the collaboration. One method of reducing possible imbalance in power is for partners to have a legal mandate to share authority and power in the collaboration, this can improve the collaboration's chances for success. | Bryson et al, 2006; Hartman and Dhanda, 2018; O'Leary and Vij, 2012 |
| **Accountability** | Accountability can be a very complex issue to manage in a collaboration, if there are multiple stakeholders involved, they all have their own perspective on the results and outcome for the collaboration. Therefore, to comply with public requirements to be open and transparent about the management and decision making within the collaboration, before forming the collaboration, partners must decide on how the partners involved with be accountable to all stakeholders. Accountability may include a conflict resolution process. | Bryson et al, 2006; Bryson et al, 2009; O'Leary and Vij, 2012 |
| **Communications** | The communication process and channels should be decided before the collaboration process begins and can be incorporated into the governance mechanism for the collaboration. Ideally all forms of communication from brainstorming to conflict resolution must be | Austin, 2010; Austin and Seitanidi, 2014; O'Leary and Vij, 2012; Ukalkar, 2000 |

| | | |
|---|---|---|
| | included to make them inclusive, transparent, and regular. | |
| **Legitimacy** | The collaboration must be perceived as being legitimate, in that the actions of the collaboration are proper, within a system of norms and benefits. | Bryson et al, 2006; O'Leary and Vij, 2012 |
| **Trust** | Trust is developed through the process of personal interaction between the partners in the collaboration. Trust can be built up by individuals in the partnership working on small initiatives, so as time develops, both gain experience and mutual confidence in each other that will lead to trust for larger undertakings. Developing trust between the partners requires clear communication, reciprocity, goal alignment, transparency, information, and knowledge sharing, demonstrated competency, good intentions, and follow-through. In some cases, partners will only collaborate with others that they have a previous history with as the relationship and element of trust is already established. | Austin, 2010; Austin and Seitanidi, 2014; Bryson et al, 2006; Couchman and Fulop, 2009; Forrer et al, 2014; Johnson and Finegood, 2015; O'Leary and Vij, 2012; Osborne, 2006; Perkmann et al, 2014; Ukalkar, 2000 |
| **Information Technology** | As collaboration partners can transgress geographical boarders and many firms move toward being virtual organisations. Partners in a collaboration must understand the role, need and nature of the technology required to fully participate in the collaboration. As well as their own ability to manage the information technology effectively to collaborate | Austin, 2010; O'Leary and Vij, 2012 |

Source: Austin, 2000; Austin, 2010; Austin and Seitanidi, 2014; Bryson et al, 2006; Bryston et al, 2009; Clarke and Fuller, 2010; Crosby and Bryson, 2010; Forrer et al, 2014; Hartman and Dhanda, 2018; Ivascu et al 2016; Jamali and Keshishian 2009; Johnson and Finegood, 2015; O'Leary and Vij, 2012; Osborne, 2006; Malin and Hackmann 2019; Mayo et al, 2014; Mendel and Brudney, 2018; Mohr and Spekman,1994; Perkmann et al, 2014; Seitanidi et al. 2010; Thune, 2011; Von Tuder et al, 2016; Vernis et al, 2006; Ukalkar, 2000.

The only criticism of these factors when forming a CSC, there are six main factors that are missing from the literature. Firstly, the factors do not identify how the collaboration is monitored, evaluated, and continuously improved in the collaboration (Austin, 2000; Jamali and Keshishian, 2009; Johnson and Finegood, 2015; Seitanidi et al, 2010; Von Tuder et al, 2016; Ukalkar, 2000). Secondly, the factors fail to identify who in the partnership will lead the collaboration (Bryson et al, 2009). Thirdly, as the partners develop similar goals, they should adopt an organisational culture that supports the partnership

(Johnson and Finegood, 2015; Ivascu et al, 2016; Mendel and Brudney, 2018; Mohr and Spekman, 1994; Vernis et al, 2006; Ukalkar, 2000).

Fourthly, another factor that may have an impact on the success of a cross-sector collaboration, is the leadership, does the leadership provide the vision and direction for the collaboration to be successful (Bryson et al, 2009; Crosby and Bryson, 2010; Malin and Hackmann, 2019). Fifthly, another factor that may impact on the success of a collaboration if both parties form cross-functional teams to work on problems and the project together (Mendel and Brudney, 2018; Mohr and Spekman, 1994; Vernis et al, 2006; Ukalkar, 2000). Finally, there is no indication if these factors need to be considered for short term collaborations e.g., for a specific project that may last a couple of months or a year. Or for long-term collaboration that could last 20 years (Mendel and Brudney, 2018; Mohr and Spekman, 1994; Vernis et al, 2006; Ukalkar, 2000).

However, collaboration can incur high scanning, coordinating, and learning costs associated with creating and managing collaborative links or networks. For SME's continuing to maintain these collaborative links or networks can pose a heavy burden on the SME's limited resources (Howells et al, 2012). Another factor which may delay the development of any collaboration is the negotiation time required to finalise a contract between the two partners for the collaboration (Ivascu et al, 2016). Possible barriers to a successful collaboration include unwillingness of the firm to change, excessive organisational bureaucracy specifically in a large organisation, lack of financial resources, inability in the firm to learn based on previous experience and fear of risk taking (Canker and Petoskey, 2013). Other barriers to CSC being successful within scientific collaboration's is that different working patterns, expectations, personal beliefs, subject specialist language can make it difficult to collaborate and share knowledge between partners (Hara et al, 2003). Other reasons why a CSC may fail include a conflict of interest and goals of the collaboration between the partners, lack of opportunity, desire to collaborate, or incentive to collaborate between the partners, constricted resources, inflexible organization structure and procedures, mistrust, different organization culture and norms, group attitudes different between partner employees and lack of senior management support for the collaboration (Babiak and Hibault, 2009).

### 15.2 Criticisms of Cross-Sector Collaboration Literature

Unfortunately, there is little empirical research into applying these success factors in CSC partnerships between universities and firms (Esteves et al, 2011, Halseth and Ryser, 2007). Another gap in the CSC literature is research only assesses the success factors from the macro level in a partner-to-partner relationship, it does not include individuals involved in CSC activity or the success factors required for end-user and firm collaboration. For this study, CSC is defined as collaboration taking place at the department level of the university between the buyer and a technical representative of the supplier. Using the CSC factors that make a successful collaboration, this study will examine if the tender process can be used to develop a collaboration to create new scientific equipment. After reviewing all the CSC literature, the author has summarised all cross-sector collaboration factors into a single table in figure 2.21 below. All these cross-sector collaboration factors can have an impact on the success of any collaboration.

**Table 2.21 - Summarised Cross-Sector Collaboration Factors**

| No | Critical Success Factor | Literature reference |
|---|---|---|
| 1. | Collaboration Context | Bryson et al, 2006; Clarke and Fuller, 2010; Hartman and Dhanda, 2018; O'Leary and Vij, 2012; Osborne, 2006; Perkmann et al, 2014 |
| 2. | Purpose of Collaboration | Austin, 2010; Bryston et al, 2009; Clarke and Fuller, 2010; Johnson and Finegood, 2015; Ivascu et al 2016; Mayo et al, 2014; Mendel and Brudney, 2018; Mohr and Spekman, 1994; O'Leary and Vij; 2012; Perkmann et al, 2014; Vernis et al, 2006; Ukalkar, 2000; |
| 3. | Partner Selection Process and Capability | O'Leary and Vij, 2012; |
| 4. | Collaboration Motivation and Commitment | Clarke and Fuller, 2010; O'Leary and Vij, 2012; Mayo et al, 2014; Thune, 2011; Ukalkar, 2000 |

| | | |
|---|---|---|
| 5. | Collaboration Structure and Governance | Bryson et al, 2006; Bryson et al, 2009; O'Leary and Vij, 2012 |
| 6. | Power | Bryson et al, 2006; Hartman and Dhanda, 2018; Mayo et al, 2014; O'Leary and Vij, 2012 |
| 7. | Accountability | Bryson et al, 2006; Bryson et al, 2009; O'Leary and Vij, 2012 |
| 8. | Communications | Austin, 2010; Austin and Seitanidi, 2014; O'Leary and Vij, 2012; Mendel and Brudney, 2018; Mohr and Spekman, 1994; Perkmann et al, 2014; Vernis et al, 2006; Ukalkar, 2000. |
| 9. | Legitimacy | Bryson et al, 2006; O'Leary and Vij, 2012 |
| 10. | Trust | Austin, 2010; Austin and Seitanidi, 2014; Bryson et al, 2006; Couchman and Fulop, 2009; Forrer et al, 2014; Johnson and Finegood, 2015; Mohr and Spekman; O'Leary and Vij, 2012; Osborne, 2006; Perkmann et al, 2014; Vernis et al, 2006; Ukalkar, 2000 |
| 11. | Information Technology | Austin, 2010; O'Leary and Vij, 2012 |
| 12. | Culture | Johnson and Finegood, 2015; Ivascu et al 2016; Mendel and Brudney, 2018; Mohr and Spekman, 1994; Vernis et al, 2006; Ukalkar, 2000. |
| 13. | Collaboration Monitoring | Austin, 2000; Jamali and Keshishian 2009; Johnson and Finegood, 2015; Seitanidi et al. 2010; Von Tuder et al, 2016; Ukalkar, 2000. |
| 14. | Collaboration Evaluation | Austin, 2000; Jamali and Keshishian 2009; Johnson and Finegood, 2015; Seitanidi et al. 2010; Von Tuder et al, 2016; Ukalkar, 2000. |
| 15. | Continuous Improvement | Johnson and Finegood, 2015; Ukalkar, 2000. |
| 16. | Leadership | Bryson et al, 2009; Crosby and Bryson, 2010; Malin and Hackmann 2019. |
| 17. | Partnership Length | Mendel and Brudney, 2018; Mohr and Spekman, 1994; Vernis et al, 2006; Ukalkar, 2000. |
| 18. | Cross-Functional Teams | Mendel and Brudney, 2018; Mohr and Spekman, 1994; Vernis et al, 2006; Ukalkar, 2000. |

Source: Austin, 2010; Austin and Seitanidi, 2014; Bryson et al, 2006; Bryson et al, 2009; Clarke and Fuller, 2010; Couchman and Fulop, 2009; Forrer et al, 2014; Hartman and Dhanda, 2018; Ivascu et al 2016; Jamali and Keshishian 2009; Johnson and Finegood, 2015; Malin and Hackmann 2019; Mayo et al, 2014; Mendel and Brudney, 2018; Mohr and Spekman, 1994; O'Leary and Vij, 2012; Osborne, 2006; Perkmann et al, 2014; Seitanidi et al. 2010; Thune, 2011; Vernis et al, 2006; Von Tuder et al, 2016; Ukalkar, 2000

Although there are several studies that focus on the different factors that influence cross-sector collaboration success. Most of these studies focus on investigating one or two factors and do not focus on incorporating all these success factors into a single research design. This study uses the summarized success factors and incorporates them into the telephone interview and virtual meeting questions. However, this study also identifies other success factors not identified in the literature that are specific to a buyer or supplier during the collaboration.

This research can potentially make a practical contribution in relation to enhancing the procurement tender process by integrating the success factors discerned from both practice and theory. This research will identify the success factors created in cross-sector collaboration leading to new product development (NPD) and enhance our understanding of the motives and value-added factors that drive university academics and scientific manufacturing firms to collaborate which has contributed to both theory and practice. This research will potentially contribute to enhancing the Chesbrough's (et al, 2006) OI model, by providing real world cases where the buyer (university) and supplier (Industry) exchange knowledge and integrate resources within the partnership as part of the inflow process of the OI model in the context of the public sector procurement. This research will potentially provide case examples of how OI can be implemented into the procurement tender process and allow a cross-sector partnership to access and integrate resources and knowledge that it does not possess. This links the tender process as a possible driver of OI within a public sector firm. This study would potentially inform how industry can collaborate better with universities to create a competitive advantage (Christensen, 2001; Porter, 1985; Powell, 2001; Wen-Cheng et al, 2011).

From the gaps identified in the literature, a revised tender process will be created to combine these literature gaps into a single model. To answer the literature review gaps, the author adopted a case study approach, first by selecting a UK research intensive university (known as RIU), that could be used to investigate the tendering process. Then by reviewing the university's tender documents to identify if any tender resulted in collaboration between the buyer (university academic) and supplier (scientific equipment manufacturer).

Once, the tenders had been reviewed and the tenders that had resulted in collaboration identified, the author investigated if the tender documents could answer the research questions. After this analysis, the author concluded, that primary data would have to be collected from the buyer via a telephone interview and a virtual meeting with the supplier, to answer the research questions. The research methods chapter provides a detailed discussion on the research methods adopted to answer the research questions.

As the author has identified the CSC literature factors that may drive successful university – firm collaboration, the author concluded that CSC factors was a critical theory that needs to underpin this study. However, the buyer is not the only person to benefit from the partners collaborating, other academics and students in the department may experience a spill-over in the benefits which can support the department’s teaching and research activities, this is discussed in more detail in section 15.3, 15.4 and 15.5.

## 15.3 University Cross-Sector Collaboration

In contrast Tether and Swann (2003) conducted secondary research of the data collected in the UK version of the 3rd European Community Innovation Survey (CIS-3) to identify what contribution the “public science base” consisting of universities and publicly funded research institutes made to firm innovation. The CIS-3 survey was carried out between 2001 and involving innovation activities between 1998 and 2000 and consisted of firms with 10 or more employees and covering both manufacturing and commercial service firms. The data set comprised of 8,172 responses from firms engaged in “production activities” (extraction, manufacturing, construction, and the utilities) and marketed “service activities” (wholesaling, business service and financial intermediation). From the data Tether and Swann (2003) identified that firms consider UK Universities to be a significant source of information for innovation. The second finding of Tether and Swann (2003) research suggested there are direct links between universities and firms though co-operative agreements where both partners collaborate on joint innovation projects (including R&D).

## 15.4 University – Industry Direct Links Benefits

Another direct link is university agreements where a firm engages with a university (or research institution) to conduct research on their behalf. These firms normally part or fully fund the research being conducted at the university. The benefit of this approach for the firm, is the firm develops closer links with the university and can have privy rights to basic science and research which may be part funded by government or other public bodies (Ahmed and Shepard, 2010). In contrast, Howells et al, (2012) conducted a large-scale questionnaire of firms within the UK between June 2008 and February 2009 to determine if UK firms were collaborating with UK universities. From the sample of 600 UK firms examined, Howells et al, (2012) concluded that firms collaborate with universities in different ways including training and continuing professional development, using research facilities, research projects, student internships and by co-patenting and licensing activities.

Overall, the study found that the most important benefit of working with a university was developing new methods, skills, and techniques. Other benefits of collaboration can include consultancy services, employees serving on university advisory boards, creating, and modifying existing courses to train the firm’s employees and developing new training courses to meet the firm’s objectives (Brandt et al, 2009; Jonbekova et al, 2020; Salminen-Karlisson and Wallgren; 2005).

## 15.5 University – Industry Indirect Links Benefits

An indirect link was the firm employing graduate students from a university who has signed a co-operative agreement (Tether and Swann, 2003). Another indirect link was identified in Tyrrell’s (2015) study that universities and firms at a local departmental level were transferring knowledge by the scientific manufacturing firms offering to fund PhD studentships. However, the CIS-3 data examined by Tether and Swann (2003) their research did not investigate the indirect or direct link between universities and firms in any depth. Other possible benefits for a university in collaboration including increasing student work experience and skill to make students more employable, to create an entrepreneurial mind set within departments, increase knowledge flow across industries and create new knowledge networks (Thune, 2010).

In contrast, a study conducted by Jonbekova et al, (2020) investigated if Kazakhstan universities are engaged in collaboration with industry. As Kazakhstan was formally a soviet run country, a statist triple helix model, was adopted, where the soviet government played the leading role in shaping university and industry interactions. In Kazakhstan, university and firm partnerships have focused on employability rather than research. With universities keen to create a prestigious image through a high level of record students in employment.

With this prestigious image, universities hoped it will attract more students and entice more grant funding from Kazakhstan's government. The research methodology adopted for this study includes a case study of two universities and a one-hour semi-structured interview with the senior leadership team including the provost, vice-provost, deans of departments and faculties. After conducting the interviews, Jonbekova et al (2020) findings indicated that universities are continuing to develop partnerships with firms to enhance student employability, based on previous soviet policy. This has resulted in Kazakhstan's universities to suffer from a poor research environment, top-down management, and difficult working conditions for faculties to operate within. These barriers are influencing the ability of universities to develop research and innovation partnerships. Unfortunately, this study does not identify the critical success factors that lead to a successful collaboration between a university and industry, nor does the research methodology investigate the individual collaboration between an individual academic and a firm.

However, this study did identify the benefits of an education collaboration for students, like providing teaching and learning activities with the firm providing equipment, thesis advice, defining parameters for student projects, embedding internships within university courses, and offering students real life case studies (Jonbekova et al, 2020). The collaboration between the university and firm can offer a bridge between studies and work life skills by offering voluntary internships, apprenticeships, investment, and equipment loans, help through career fairs, and help with other recruitment programs, mentoring and career advice (Harman, 2010, Prigge, 2005; Thune, 2010). Other possible benefits the academic, department or university could be that the supplier provides sponsorship for master students and funding for Master and PhD conferences, poster presentations and providing travel grants. This study aims to map the direct and indirect links between universities and firms by identifying if these can be embedded in the procurement tender process specification. After performing a literature review on the theories and models that underpin this study, the author has summarized the literature gaps in section 16 that can identify area’s this study can provide new insight and extend the existing body of knowledge.

## 16. Literature Gap Summary

### 16.1 Introduction

Within the interdisciplinary literature examined, the author has identified various literature gaps within the theories and models that underpin this study. The author has summarized these below and how this study will close the literature gaps.

## 16.2 Triple Helix Model and the Entrepreneurial University Theory

Although there is extensive theoretical and empirical literature within the Triple Helix model (Etzkowitz, 2003a; Etzkowitz, 2003b; Etzkowitz and Leydesdorff, 2000; Etzkowitz, 2008), focusing on the relationship between industry, universities, and the government to create innovation and the rise of the knowledge-based economy. There are limited studies that focus on the collaboration at the university departmental level between an academic (buyer) and firm (supplier) in creating innovations indicating a literature gap. Additionally, the author concluded that each of the triple helix configurations have implications on the relationship formed and the length of the partnership. Hence, this study aims to investigate the relationship and the length of the partnership during the collaboration.

Within the Triple Helix literature, few studies examine the benefits and reasons for individual universities and firms engaging with each other to create innovation, indicating another gap in Triple Helix literature. Additionally, the literature gaps spill over into the entrepreneurial university literature (Etzkowtiz et al, 2000; Etzkowitz, 2003; Etzkowitz, 2004; Etzkowitz, 2008), a core concept within the Triple Helix paradigm. The author intends to close these literature gaps by designing a study, which investigates if collaboration is taking place between university academic (buyer) and firm (supplier) that results in innovation, the reasons for the partnership, how long these partnerships last and what benefits each party receives from the collaboration. However, the author will need to examine value-added and cross sector collaboration (CSC) factor literature to inform the study design.

After closing the literature gaps, the author will potentially contribute to knowledge and the triple helix literature by providing a theoretical model and cases that express that collaboration is taking place between university and industry at the local departmental level. Interlinked with the value-added and CSC factors present in these collaborations, to identify the reasons why buyers and suppliers engage in collaboration to develop innovation through the value-added literature and identifying the important CSC factors present or not required in the collaboration. As both OI and the Triple Helix Model's share the same objective to find surplus value in bringing industry innovation closer to public Research and Development (R&D) (Leydesdorff and Ivanova, 2016) and as OI is a theory that underpins this study, the author in section 14.3 discusses the OI literature gaps.

## 16.3 Open Innovation Model

Within the Open Innovation literature, the firm is the central driver of innovation (Chesbrough's, 2003a; 2003b; 2004; 2006). Whilst the majority of studies focus on implementing OI in large multinational firms (Chesbrough, 2003; Dodgson et al. 2006; Christensen et al, 2005; Melese et al, 2009) there are limited studies into OI research that identify the processes adopted to effectively implement OI (Giannopoulou et al, 2011; Spithoven et al, 2013; West and Bogers, 2014,) and the OI implementation and processes used in public sector firms like universities, which indicates a literature gap. This literature gap indicates that current empirical research on OI, is general and not applied to specific contexts and organizations (Tidd and Bassant, 2015).

Equally like the Triple Helix Model, the OI model (Chesbrough, 2003a; 2003b; 2004; 2006), does not investigate the benefits and reasons for academic (buyer) and firm (supplier) engaging with each other to create innovation, nor if the supplier has embedded the buyer's knowledge into the firm's OI process. In addition, on the OI model input side, there is a gap in the literature on the integration of lead-users in the model, as previous studies have focused on the firm's interaction with the supplier (Padilla-Meléndez and Garrido-Moreno, 2012; Vanhaverkek and Du, 2010). Indicating limited studies that investigate OI models within universities and the inclusion of the end-user in the creation of innovation.

Within the procurement literature (Bidault et al, 1998; Ellram and Tate, 2015; Grudinschi et al, 2014; Luzzini et al, 2015) there are limited studies that link OI buyer and supplier knowledge exchange within the procurement tender process (Tyrrell, 2015) due to a lack of research in public procurement (Bergman and Lundberg, 2013; Quayle and Quayle, 2000), indicating there is a literature gap. To close the OI literature gap, the author will investigate, knowledge exchange within the tender process, if the supplier is embedding the buyer knowledge into the firms' OI process and if the procurement tender process can be an example of OI within a university setting.

By closing the literature gap, this study data has provided an example of how to implement the open innovation process within a public sector organisation to create new innovations. Through conceptualising Chesbrough's model (2003a; 2003b; 2004; 2006), within the tender process, gives us an example of how buyers and suppliers can access knowledge that creates innovation. The firm then sells these innovations to other HE buyers, which would be a minor contribution to the OI literature. As end-user theory is a theory that underpins this study, the author in the next section discusses the literature gaps.

## 16.4 End-User Innovation

As most end-user literature focuses on the end-user as the sole creator of new innovations (von Hippel, 1976; von Hippel, 1977; von Hippel, 1986; Urban et al, 1988) and on products that do not require major capital investment which include as Franke and von Hippel suggest (2003, p4 ) "printed circuit CAD software (Urban and von Hippel; 1988); Pipe Hanner hardware (Hersate and von Hippel, 1992); Library Information systems (Morrison et al, 2000); Apache software (Franke and von Hippel, 2003); medical/surgical instruments (Lüthje, 2003a); Outdoor consumer products (Lüthje, 2003b); "Extreme" sporting equipment (Franke and Smith, 2003) and mountain biking equipment (Lüthje, 2003)". There are limited studies within the broad literature on end-user innovation that focuses on academics or clinicians being involved in the innovation process with medical or scientific equipment manufacturers (Hippel, 1976; Lüthje's, 2003a; Shaw, 1985; Shaw, 1988; Tyrrell, 2015).

These studies do not investigate the reasons for the collaboration, or the benefits obtained from the collaboration for both parties indicating a literature gap. A further literature gap is limited research has focused on the demographics of the end-user population within UK universities engaged in innovation with scientific manufacturers to create new equipment. Additionally, limited studies have focused on developing the supplier demographics to investigate if these characteristics influence the collaboration, as no dichotomous questions like market characteristics (industry type, size of the firm, market share, location of business, business type and revenue) feature in previous research studies. This study will redefine the PI end-user demographic criteria used by both Ogawa and Pongtanalert (2013), Hippel et al, (2011) and Tyrrell (2015) by adding the additional dimensions of the PI end-users funding provider, level of funding received from the funding bodies, number of research papers produced and whether the PI end-user is female or male. Additionally, the author will explore the supplier demographics to identify if supplier characteristics influences the collaboration with the buyer.

By closing the literature gaps, the author builds on Tyrrell’s (2015) empirical study and the empirical research of von Hippel, 1981; von Hippel, 1986; Urban et al, 1988; von Hippel, 1988; Franke and von Hippel, 2003 by extending the dimensions of the PI end-user by adding to the concept of the lead end-user. This makes a minor contribution to knowledge of the end-user types within universities that engage with firms to create innovation. By using these characteristics to identify the lead-user (buyer), this reduces the cost of the firm’s marketing department trying to engage with buyers that are not the lead-user (buyer) with the supplier customer base, the author discusses this subject in more detail in Chapter 8 recommendations. Furthermore, by investigating the supplier demographics, the author can explore if the demographics has an impact on the value-added and cross-sector collaboration (CSC) factors that are present in the collaboration. In the next section the author examines the literature gaps in the value-added literature, as this theory underpins the study.

## 16.5 Value-Added Factors

After reviewing the interdisciplinary literature on value-added theory, the author concluded that limited research studies have merged all the value-added factors identified in the literature into a single study, indicating a literature gap. Additionally, the literature value-added factors identified have not applied to a university collaboration between a buyer (university) and supplier (firm), indicating there is limited knowledge on the benefits and reasons for the partners to collaborate showing a gap in the current empirical research and literature.

To address, this literature gap, the author created a summary of the value-added factors and split these into four groups, the equipment value-added factors (Table 2.16), the research value-added factors (Table 2.18), the benefit to student's value-added factors (Table 2.17) and the collaboration value-added factors (Table 2.19) which are specific groups that support the buyer's teaching and research activities. The author then triangulates the secondary and primary data, to identify the value-added factors that are present in university-industry collaboration, and those factors not in the literature that are specific to a project for both buyer and supplier. To make the tendering documentation and process more conducive to supplier collaboration, the author will incorporate the value-added factors from the findings into the tender process.

By closing the literature gaps, the author contributes to knowledge by identifying the value-added factors that drive university-industry collaborations, which enhances the value-added literature with cases. Additionally, by identifying all the value-added factors into a matrix format that can apply to science tenders, the procurement professional can make a step change to the tender process and documentation by consulting with the buyer to add value-added factors they lack into the tender process. Thereby enhancing the value, the buyer can obtain from the collaboration by accessing resources and skills the buyer does not possess. This study has implications for the Triple Helix model, as previous studies have never examined including value-added factors into the current model, which requires further research. Finally, as this study identifies the important value-added factors, there is the potential to transfer these to another setting or context. As the study focuses on university-industry collaboration, to understand what make a collaboration a success, the author examines the cross-sector collaboration (CSC) literature to identify the literature gaps to close in this study.

## 16.6. Cross-Sector Collaboration (CSC) Factors

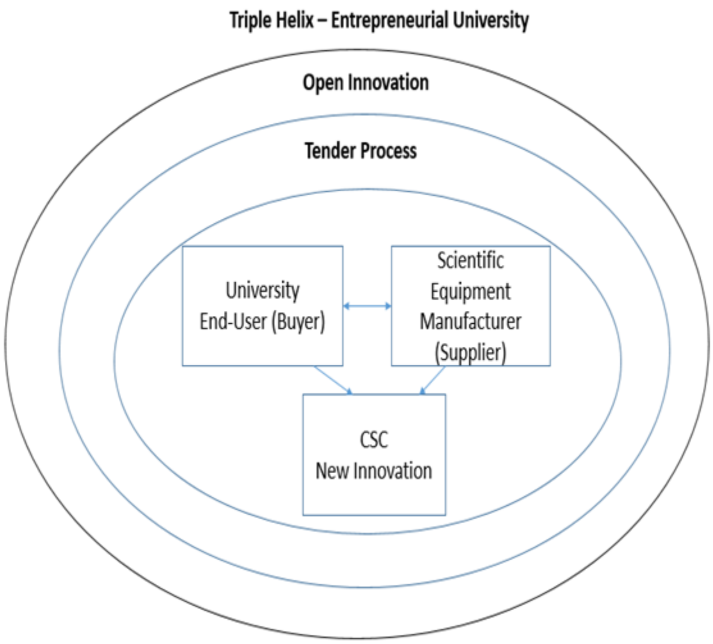
After reviewing the interdisciplinary literature cross-sector collaboration (CSC) theory, the author concluded that few empirical studies focus on university and firm cross-sector collaboration (Esteves et al, 2011, Halseth and Ryser, 2007) and the CSC factors required to make the collaboration a success, indicating a gap in the CSC literature. Additionally, few research studies have merged all the CSC factors identified in the literature into a single study, as most studies have focused on one or two factors investigated in a single study, again indicating a literature gap.

To address these literature gaps the author, first summarized all the CSC factors into Table 2.21, from the CSC factors identified in the literature, the author will examine and identify which CSC factors are present and the CSC factors not adopted in university-industry collaborations. The author concluded this would close the literature gap by identifying CSC factors present in university firm collaboration.

By closing the literature gaps, the author’s potential contribution to knowledge includes, enhancing the CSC literature by identifying important CSC factors that are present and that drive university-industry collaborations to be a success. Plus, the reasons why certain CSC factors are not present in university-industry collaborations. Enhancing the Triple Helix literature by incorporating the CSC factors into the model to illustrate the CSC factors required to make university-industry collaboration as success. This study has implications for the Triple Helix model, as previous studies have never examined including CSC factors into the current model, which requires further research. Finally, as this study identifies the important CSC factors involved in buyer-supplier collaboration, there is the potential to transfer these to another setting or context.

Consequently, this study is bound by the Triple Helix, Entrepreneurial Model of the University, Lead-User Theory, the Concept of Value-Added Factors, the OI Model and CSC Factors, by exploring how knowledge flows in the context of the procurement tender process. Below is a copy of Figure 1.11 showing the conceptual framework for university-industry collaboration.

**Figure 1.2 - Conceptual Framework of University – Industry Collaboration**




Source: Tyrrell (2022)

Chapter 3 will explore the research design by examining the different ontology and epistemology perspectives and why the author has adopted an abductive ontology and pragmatics epistemology. The author will explore the use of a case study design, research methods and data collection tools to assemble the data from the tender specification, supplier tender returns, research collaboration agreement and participant responses to answer the research questions. The author will assess the different methods used for analysing the data and how the findings are credible, transferable, dependable when applied into another university setting.

# Chapter 3: Research Methodology

## 3.1 Introduction

This chapter provides an overview of the research methods and methodology adopted for this research study. This chapter has provided a rational for the research design adopted including the advantages and disadvantages for implementing the research tools applied. The chapter offers a discussion on the sampling strategy and the participants population being studied. Along with a discussion on producing and analysing results to answer the research questions being proposed.

## 3.2 Ontology

As part of the process of designing a research study, the author aims to identify their ontological perspective, as this has an impact on the research design of the study. According to Frost (2011, p195) ontology focuses on “the beliefs and assumptions that individuals hold about what exists in the world that they inhabit. It raises issues about what people believe is real and what they believe exists in the world”. Alternatively, Saunders et al, (2016, p127) suggests ontology “refers to the assumption about the nature of reality. Although this may seem abstract and far removed from your intended research study, your ontological assumptions shape the way in which you see and study your research objects”.

For this research study, the author’s ontology perspective used is relativism. According to Liniluoto, et al (2004, p747) “relativism may be defined as the view that knowledge (and/or truth or justification) is relative - to time, to place, to society, to culture, to historical epoch, to conceptual scheme or framework, or to personal training or conviction – in that what counts as knowledge (or as true or justified) depends upon the value of one or more of these variables. Knowledge is relative in this way, according to the relativist, because different cultures, societies, epochs, etc. accept different sets of background principles, criteria, and/or standards of evaluation for knowledge claims, and there is no neutral way of choosing between these alternative sets of standards. The relativist's basic thesis is that a claim's status as knowledge (and/or the truth or rational justifiability of such knowledge-claims) is relative to the standards used in evaluating such claims; and (further) that such alternative standards cannot themselves be neutrally evaluated in terms of some fair, encompassing meta-standard". The benefit of adopting this ontological position is that the research problem or phenomena can be view from different perspectives and that as researchers we should value each person's differences and accept each other's views. The world is seen through the eye of the subjects and reality has multi perspectives. As this research study explores a new area of research, where there is little empirical data, the author explores the phenomena through the perception of the study participants.

After reviewing previous research studies in business, one of the most common errors in the research design, is the researcher fails to identify the philosophical approach adopted for their study (Banister et al, 2011). As the success or failure of a research study rests on selecting the correct research philosophy, it is important to understand the epistemology adopted for each research study. The author will explore the epistemology for this study in section 3.3.

## 3.3 Epistemology

Epistemology according to Saunders et al, (2012, p132) concerns "what constitutes acceptable knowledge in a field of study". Epistemology involves examining the relationship between the researcher and what is being researched (Collis and Hussey, 2003; Jankowicz,1995; Pole and Lampard, 2002). In contrast, Langdridge (2004, p250) suggests epistemology concerns "those questions we ask about our knowledge of some phenomenon. Or, other words, epistemology is the branch of philosophy concerned with the varieties and validity of our knowledge of aspect of the world". As we need to know the epistemology standpoint, as not all researchers can agree what we know about the world and people within it. The epistemology underpinning this study is pragmatism based on the concept that knowledge is an external reality but considers theoretical frameworks as a fiction which helps solves specific problems. Next the author will discuss the potential philosophy's that could have been selected to conduct the study and the final decision to use pragmatism.

## 3.4 Study Philosophy

As every research study is underpinned by a philosophical approach, which provides a perspective on which the research is situated and can be seen in each step of the research process. Before starting the research process, the researcher investigated several philosophical approaches for the study. The researcher examined if positivism would be a suitable philosophy for this study, positivism according to Quinlan et al, (2018, p57) stated positivism "holds that there is one objective reality, reality is singular and separated from consciousness". Alternatively, McKenzie et al (1997, p3) suggests positivist contains "research emphases determinacy (that there is certain trust that can be known), rationality (no contradictory explanations, convergence on a single explanation), impersonality (the more "objective" and the less "subjective" the better), the ideal knower (that anyone whose senses are not impaired and whose faculty of reason is fully functioning can be a knower), and prediction (that research should aim for generalizations for which predictions can be made and events/phenomena controlled)". Within this perspective the researcher approaches the study without any preconceptions or biases about the phenomena being studied. However, we develop an understanding of the phenomena from our own experience and words used to express our understanding of the phenomena. Therefore, we are never truly free of our biases influencing the phenomena being studied. As this study, investigates university-industry collaboration through both buyer and supplier participant perspectives, the author rejected the use of positivist philosophy to underpin this study.

In contrast, post-positivism was created to resolve the criticism of positivism, post-positivism accepts that both participants and researcher have their own biases and by adopting the correct research design and data collection tools biases can be removed from the research (Grbich, 2007; Eriksson and Kovalainen, 2008; Tyrrell, 2015). A key feature of post-positivism is that the researcher aims to generalise the findings of the study to another population. Generalising requires a large sample size, post-positivists, argue that the more data that is analysed, the more accurate the results of a study (Saunders et al, 2016). As this is an exploratory study, with limited cases that can confirm that the buyer and supplier are engaged in collaboration to develop innovation. The researcher has rejected the use of post-positivism to underpin this study because of the limited sample available for analysis, making it difficult to generalise the result to another population.

For this study, the author has adopted pragmatism, pragmatists do not believe that truth can be objective or absolute and that reality is co-created by working within reality we create. In pragmatism, theory and practice is interlinked not separate entities (Lee and Lings, 2008; Hammond and Wellington, 2012). Alternatively, as Shields (1988, p 197) suggests "pragmatism the philosophy of common sense. Its uses purposeful human inquiry as a focal point. Inquiry is reviewed as a continuing process which acknowledges the qualitative name of human experience as problematic situations emerge and are recognized. Recognition involves the doubt associated questioning existing belief systems. Doubt is resolved through critical reasoning and ultimately tested in action. It is the philosophy of common sense because actions are assessed considering practical consequences. Finally, inquiry is not necessarily limited to individual effort, rather if often incorporates as "Community of inquirers". Epistemologically, pragmatism, steers clear of the meta-physics debate about truth and reality and focuses on practical considerations (Kelly and Cordeiro, 2020). Pragmatists believe that it is possible to use different paradigms to resolve research problems (Sharan and Tisdell, 2016). Pragmatism has been linked with the concept of deduction, which involves the continuous process of generating and testing hypotheses (Hammond and Wellington, 2012). In a pragmatic view of research, the researcher should adopt all necessary approaches to understand the research problem or any methods that result in a practical answer to the phenomenon (Shaw et al, 2010).

Within the pragmatic paradigm, there are different versions of pragmatism, the traditional view of pragmatism focuses on a) holds on to modernist foundations, b) advances a denotative correspondence to theory or truth, c) posits a belief in scientific objectivity (Miller, 2005; Turner, 2000). This version of pragmatism is “American Pragmatism” based on the writings of Peirce, James, Dewey, and Mead among others (Törnudd, 1915; Frega and Carreira da Silva, 2011). A paradigm according to Burns and Burns (2008, p13) concerns a particular way of viewing the world, a framework of assumptions that reflect a shared set of philosophic beliefs about the world which places strict guidelines and principals on how research should be conducted”. At a basic level, according to Hammond and Wellington (2012, p116) a “paradigm has been used to refer to the dominant framework in which research takes place. This framework defines how problems are identified (what is to be studied); the epistemological and methodological assumptions behind the research (how it is to be studied); and what is done with the research (the nature and value of the knowledge generated)”. A benefit of using pragmatism is that the researcher is no longer “held prisoner of a particular research method or technique” (Feilzer, 2010). A pragmatic paradigm allows the researcher the ability to adjust the research design as the study progresses. Pragmatism, allows the researcher to use different research methods, including case studies with interviews, questionnaires, and surveys, which previous procurement studies have employed (Ellegaard and Koch, 2012; Ellram and Tate, 2015; Foerstl et al, 2010; Meehan et al, 2017; Matthyssesn et al, 2016).

An alternative version of pragmatism, including functional pragmatism emphases that knowledge is a basis for actions. Referential pragmatism suggests that actors, actions, action-objectives, activities, and practices become the main emphases on knowledge through actions. Methodological pragmatism is based on how knowledge is created, with the researcher playing a key role in the creation of data and theories (Goldkuhl, 2012). Alternatively, Neopragmatism focuses not on experience but the use of language, words now become a function of how they are used, instead of how people us them to describe an event (Sundin and Johannisson, 2005; Vodonick, 2017). A criticism of pragmatism is most of the social and health care literature presents pragmatism as a philosophical partner to conducting or designing a framework for mixed methods research (Doyle et al, 2009; Florczak, 2014; Johnson and Onwuegbuzie, 2004; Hathcoat and Cara Meixner; 2017). Mixed methods research involves using both qualitative and quantitative approaches and combines this into a single study or related studies (Bishop, 2015; Miller, 2018).

For this study, the author looks to understand the reality perceived by the buyer through the concept of value-added factors and examines the practical results of the tender response from the supplier. From the type of pragmatism identified above, this study adopts a traditional perspective of pragmatism, using abductive reasoning which allows the author to draw conclusions from a series of events based on the best explanation instead of evidence (Mitchell, 2018). As this is an exploratory study with limited data on buyer and supplier engagement in collaboration to develop new innovations, by adopting traditional pragmatism, the author can adjust the research methods and data collection tools to answer the research questions, this gives flexibility to the author when conducting the research study. Additionally, pragmatism allows the author to develop theory to better inform practice, for this study this included making recommendations to make the tender process more conducive to collaboration. As the author has selected pragmatism to underpin this study, this philosophy influences the type of research design the author can employ to collect the primary and secondary data to answer the research questions.

## 3.5 Research Design

Before starting this study, the author investigated the different research designs that could be adopted to answer the research questions. Firstly, the author investigated using a quantitative research design. According to Bell et al (2015, p35) comments that "quantitative research is a research strategy that emphasizes quantification in the collection and analysis of data and that: entails a deductive approach to the relationship between theory and research, in which the emphasis is on the testing of theories; has incorporated the practices and norms of the natural scientific model and positivism in particular; takes a view of social reality as an external, objective reality". A quantitative design involves the researcher using data collection tools (liked questionnaires) to collect data from a large sample and use graphs or statistics to analyse the data. As this study is an explorative study the author is unable to adopt a quantitative design, due to the limited sample available for analysis, making it difficult to generate statistics analysis from the data.

For this study, the author has employed a qualitative research design, which according to Veal, (2005, p125) "is an array of interpretive techniques which seek to describe, decode, translate and otherwise come to terms with the meaning, not the frequency, of certain more of less naturally occurring phenomena in the social world". A qualitative approach is concerned with interpretation and understanding, unlike quantitative approaches that focus on hypothesis testing, explanations, and statistical analysis.

The benefits of the author using a qualitative design in this study, includes the author being able to examine, explain and understand the personal experiences of participants. These personal experiences of the world are variable, personal, self-constructed and meaning can be varied between each person (Miller, 2018). Another benefit is qualitative research works well when there is little knowledge of the phenomenon being studied and the research requires an exploratory, flexible methods to understand the problem (Bell et al, 2019; Cooper and Schindler, 1998; Eriksson and Kovalainen, 2008; Veal, 2005). An integral part of qualitative research is the reflexivity of the researcher and their part in creating new knowledge and this should not be excluded from the research process or research reporting (Eriksson and Kovalainen, 2008). However, there are limitation of using a qualitative research design, firstly that collecting, analysing and interpretating qualitative data can be complex, difficult and time consuming (Rahman, 2017), therefore the author has refined the research questions during the research process, to make sure the research questions are relevant to the study research objectives.

After defining the epistemology and adopting pragmatism as a philosophy for this study, the research design focuses on turning the research questions into a manageable study. For this research study the research questions are:

1) What is the success of cross-sector collaboration (CSC) and value-added factors that drive new product innovation and University-Industry collaboration?
2) What cross-sector collaboration (CSC) and value-added factors do buyers (university) and suppliers (industry) consider important when developing a collaboration and do the study participant’s demographics influence these factors?
3) How can these cross-sector collaboration (CSC) success and value-added factors become integrated into the procurement tender process and documentation to make the process more conducive to cross-sector collaboration for innovation?
4) What model can drive buyer (university) and supplier (industry) collaboration for new product innovation?

This process involves developing research questions to investigate, deciding what data to collect to answer the research questions and how the data is to be collected. Obtaining ethical approval for the research to be conducted. Defining the participant sample size to answer the questions and accessing the participant sample. Then deciding how the data has been analysed and presenting the findings (Hammond and Wellington, 2012). However, any research methods and data collection tools have their own strengths and weaknesses, and the researcher has found it difficult to eliminate all weaknesses from a single study (Beins, 2018). As the author has employed a qualitative research design, this approach influences the type of data collection tools that can be used in the study, the author will next discuss in section 3.6 using a case study to collect the study data for analysis.

## 3.6 Using a Case Study

Before starting the study, the author investigated alternative data collection tools. The author considered adopting action research for this research study. Action research has become increasingly popular within business management research within recent years (Erro-Garces Alfaro-Tanco, 2020).

Action research according to Saunders et al (2016, p189) is defined as "an emergent and iterative process of inquiry that is designed to develop solutions to real organizational problems through a participative and collaborative approach, which uses different forms of knowledge, which will have implications for participants and organizations beyond the research project". Table 3.1 shows the cycle adopted by the author during action research.

**Table 3.1 - Action Research Cycle**

| | |
|---|---|
| 1) | Planning – include preparing a plan and deciding the changes you want to implement. At this stage, the investigator will plan how observations will be measured and how changes will be monitored. |
| 2) | Acting - involves fact finding on the issue or problems being investigated. |
| 3) | Observing - collect the data, conduct analysis and writing a diary of action. Then record the findings to identify if the changes have been successful. |
| 4) | Reflecting – includes reflecting on what has happened by reviewing the observations and diary of actions. At this point, it becomes clear if the changes implemented have been successful, if not then what are the barriers to change and what new changes can be implemented to make the process successful. |

Source: Hartas, 2010

Action research is cyclical process, and these steps may be undertaken several times before a solution to a problem can be reached. Action research works effectively within education, where the practitioner, can review the process in a classroom. For this research study, due to the limited tender data, it is problematic to carry out the cyclical process, as there is not enough data to develop an effective plan to solve the problem. Consequently, the author abandoned the process of using action research during the research methods development phase of the thesis.

The author employed a case study design. By using a case study approach (Collis and Hussey, 2003; Farquhar, 2012; Gillham, 2000; Yin, 2014) the author explores the value-added and CSC factors present in university-industry via the procurement tender process, by allowing us to identify the relationships between individuals involved in specific tenders. A case study can be defined as an intensive investigation into a single case, this can include a person, organisation, a community, or an event (Howitt, 2016: Jankowicz, 1995). In contrast, a case study focuses on a particular unit of analysis, this can be an organization, a city, group, a community, a patient, a school, an intervention, a nation state, or empire (Willig, 2013). Indicating the case studies involve an in-depth, sharp, focused exploration of a person, organization, or process.

Traditionally cases have been used across various academic disciplines including law, medicine, political sciences, anthropology, sociology, social psychology, education, and management. Within business studies, the exploration of case studies has been the mainstream strategy for teaching business to business students (Hammond and Wellington, 2012; Saunders et al, 2016). A case study approach should be used were the boundaries between the phenomenon and context is not very clear. Case studies are adopted when there are multiple evidence sources that require the data to be analysed using a triangulated approach (Vela, 2005).

There are several different versions of a case study, the first type of case study is called an intrinsic study, where the researcher has no desire to generalize beyond a single case or to build theory. The second type of case study is defined as instrumental; in this approach the case is explored to develop insight into a specific situation or to reveal a generalization, with the focus of the research being on something else. Finally, the collective case study investigates several cases to explore a general phenomenon (Silverman, 2013). The criticism of the intrinsic case study design is the case can be laden with theory. As the researcher may have undertaken a literature review and scoped out some possible research questions before adopting a case design.

Alternatively, Yin (1984) suggests the case study can be defined as either exploratory, descriptive, and explanatory case studies. The exploratory case study focus allows the researcher to explore data that holds the phenomena of interest. This type of case study allows the researcher to conduct provisional small scale data collection, permitting the researcher to develop research hypotheses. The benefit of this approach is the researcher has flexibility to adjust their methods during the study (Collis and Hussey, 2003, Yin, 1984). A descriptive case study starts with a theoretical construct, to explore the data to identify patterns and connections that develop theory. The benefit of adopting this approach is that the researcher can define the boundaries of the study and improve the rigor of the case being studied (Collis and Hussey, 2003, Yin, 1984).

Finally, an explanatory case study is used to examine a phenomenon or question on the surface or deep level of the data. The benefit of this approach is the researcher can adopt both quantitative and quality research methods to explore the phenomenon or question (Collis and Hussey, 2003; Yin, 1984). Table 3.2 shows the specific features of a case study design.

**Table 3.2 - Case Study Design Features**

| | |
|---|---|
| 1) | An Idiographic perspective, the research is more concerned with the particularity of the case being studied than the general feature of the case. This contrasts with the nomothetic approach, which focuses on the identification of general laws like human behaviour based on averaging out individual human behaviour. For this research study, an idiographic perspective is adopted. |
| 2) | Attention to contextual data, the case study is explored in its context. Here, the researcher focuses on the various dimensions of the case and the interaction within the environment. The researcher does not study the case in isolation. |
| 3) | Triangulation, to investigate the phenomenon in-depth, the researcher will investigate various resources to explore the phenomenon. The researcher may use a variety of data collection tools and analysis techniques within one specific case. The benefit of adopting a triangulation within in a case study, is the researcher can explore different perceptions within the case. This enriches the case and allows the researcher to |

| | |
|---|---|
| | explore the various social, physical, symbolic, psychology contexts of the phenomenon. |
| 4) | A temporal element, cases are normally occurred within a specific time frame. The researcher will examine the phenomenon with the processes that take place over time. |
| 5) | A concern with theory, using a case study design can help generate theory. When the researcher undertakes an in-depth exploration of a specific case that can generate insight to processes that can be developed into new hypotheses and theory generation. The case study approach can test existing theory or clarify existing theories. |

Source: Willig, 2013

Other benefits of using a case study approach are that it allows the researcher to examine an entire organisational or entity in depth which can undercover details not accessible through other research methodologies (Quinlan, et al 2018). Case studies can be used for a single person, for a single location and even for a single event (Bell et al, 2019; Hammond and Wellington, 2012). In a case study approach, the research questions always related to the understanding and solving of the case (Eriksson and Kovalainen, 2008).

Additional benefits of using a case study approach includes allowing the researcher to adjust their research strategy and data collection methods as the research progresses, when resources are limited, the researcher can use a single case approach (Antoft and Houlberg Salomonsen, 2007; Hudon et al, 2021). Or limit the number of cases to make the data collection and analysis more manageable, allowing the researcher to look at the whole case not the abstract (Veal, 2005). The case study method does not intend to produce findings that can be generalised to a wider population or provide universal representation. The case study approach examines a few cases to support theory in exploratory research or to evaluate policy (Veal, 2005). Another benefit of using a case study approach allows the researcher to combine archival material and documentation as part of the inquiry (Saunders, et al, 2016). This approach helps the researcher us triangulation in the study and examine the phenomena from different perspectives. As pragmatism is the epistemology used for this research study. The case study approach adopted is more focused and starts with a set of research questions that are refined as the study develops. These questions provide a direction on the data collection process, collection tools and the process for data analysis. These propositions can identify key themes of interest for the researcher (Willig, 2013). Table 3.3 provides a summary of the key features of a pragmatic case study.

**Table 3.3 - Key Features of a Pragmatic Case Study**

| | |
|---|---|
| 1) | The researcher develops a broad research question that changes and is refined over the course of the study. |
| 2) | The research question drives the selection of the units of analysis, the research tools adopted for the study and the source of data. |
| 3) | The researcher develops a coding process to relate the data to the research questions. If data does not make the research questions, the researcher may seek to develop new questions. |

Source: Marks and Yardley, 2011

Based on the above key features identified by Marks and Yardley (2011) of a pragmatic case study, this research study has adopted the above key features.

Based on the pragmatic case study literature, the author has employed a pragmatic case study, due to the benefits it gives the author in undertaking this study. Firstly, as there is a limited number of tenders that show that buyer and supplier have engaged in collaboration to create innovations, using a pragmatic case study allows the author to adjust the research questions to incorporate new themes that emerge from the data. Once the data was analysed, the author was able to adjust the research question to identify that buyer and supplier demographic (characteristics) influence the value-added and CSC factors present in university-industry collaborations. Secondly, this approach gives the author more flexibility in conducting the research study, as the author changed the supplier online questionnaire, due to the lack of rich data that was submitted back in the pilot study, to a virtual online meeting, which is like the buyer telephone interview, as these methods provide richer data to answer the research questions. Quantitative research methods and positivism, that requires an objective approach and large population sample size, would not allow these changes to the research epistemology and research design.

Another benefit the author has accessed by using a pragmatic case study approach is the use of a case within a case approach. For this research study, the organisation which is providing the context for this research is a UK research intensive university (known as RIU). According to Njuguna (2020) the purpose of a RIU is where academics undertake a “technology transfer” role and play a part in economic development through collaborations with government bodies and industry. Another key feature of an RIU is that both undergraduate and postgraduate courses have a core component of the curricula allowing students access to the latest knowledge and thinking in their subject (Abtru et al, 2016; Casper, 1998, Russell Group, 2017) This specific UK RIU conforms to the entrepreneur university as defined by Schulte, 2004 and Shattock 2003.

This UK Research-Intensive University is the context in which the cases were studied. All individual university science/engineering tenders (cases), awarded in the past 3 years under the new procurement regulations have been analysed. Just for clarification, the case for this research study is defined as the tender documents, which includes, the tender log, tender specification, Invitation to Tender document, marking and tender award letters. The key document in the case is the specification tender return from the supplier. This confirms if the supplier wishes to collaborate with the buyer and after the marking/award process has been completed, who the final supplier selected is likely to be. As the author has used a qualitative research design and pragmatic case study, these approaches influence the sampling process for selecting the cases, which is discussed in more detail in section 3.7.

## 3.7 Sampling Framework

Sampling is a fundamental part of business research and starts by identifying the population to be analysed. A population is defined as a group of people that share some common set of characteristics for example, students, sales territories, or stores (Quinlan et al, 2018; Zikmund et al, 2013). The main aim of sampling selection is to adopt the methods that provide the best results for the research being conducted. The next steps involved choosing a sampling frame. This involved selecting part of the population that is accessible and obtaining their information to be drawn from the sample. The final step is to choose a sampling technique. Sampling techniques can be divided into probability (random) sampling and non-probability sampling (Bhattacherjee, 2012). The decision to adopt a specific sampling technique depends on the research hypothesis being investigated, the availability of access, getting good data from the sample being investigated and the methods used to collect the data (De Vaus, 2007).

Probability sampling is a technique which select's participants at random from a large population of potential participants (Bell et al, 2019; De Vaus, 2020; Mcneill and Chapman, 2005; Zikmund et al, 2013). The first sampling technique is random sampling which requires the researcher to randomly select participants from a sampling frame. Within the population, a participant has an equal, non-zero chance of being selected to take part in the research (Collis and Hussey, 2003; Quinlan, et al, 2018; Riley et al, 2000). Table. 3.4 provides a summary of the five steps for developing a random sampling process, as suggested by De Vaus (2007).

**Table 3.4 - Five Step Process of Random Sampling**

| | |
|---|---|
| 1) | Obtain a complete sampling frame. |
| 2) | Give each case a unique number starting at one. |
| 3) | Decide on the required sample frame. |
| 4) | Select numbers for the sample size from a table of random numbers. |
| 5) | Select the cases that correspond to the randomly chosen numbers. |

Source: De Vaus (2007, p71)

Random sampling offers the researcher the opportunity to generalise the results across a large population (Jawale, 2012; Kelly et al, 2003) and this technique reduces the risk of sampling bias. A sampling bias is when the sampling selected is different in some way from the population being studied. Sample bias can be divided into two specific categories; participant error, where participants fail to answer survey questions correctly and administration error (Collis and Hussey, 2003; De Vaus, 2002; Quinlan et al, 2018). Other possible source of bias includes inappropriate sampling methods, the novice researcher may find it difficult to choose between using probability sampling and non-probability sampling. As the researcher does not select the correct sampling approach that reflects the objectives of the research. Sample size can also be a problem, as the novice researcher may not select the right sample size, which may be too large or too small for a meaningful sample (Riley et al, 2000). As random sampling has been linked to a quantitative research design, which required a large sample to be investigated, the author rejected random sampling due to the limited number of tenders that had resulted in collaboration.

An alternative to random sampling is systematic sampling which requires the researcher to select units in the sampling frame that are not random (Bell et al, 2019; De Vaus, 2002; McBurney, 1998, Quinlan et al, 2018). The benefit of using systematic sampling is that processing is simpler, more accurate and allows the researcher to adopt a level of process or into selecting participants randomly (Elsayir, 2014). Unfortunately, as there is a limited number of tenders that have resulted in collaboration to create innovation and the systematic sampling requires selecting a sample at intervals, so that this minimizes the potential impact of periodicity (Zikmund et al, 2013), which is not possible due to sample size, the author rejected the use of systematic sampling. Then again, if the researcher is interested in studying a subgroup with a particular set of characteristics within a population, the researcher should adopt a stratified sampling approach (Bell et al, 2019; McBurney, 1998; Mcneil and Chapman, 2005; Quinlan et al, 2018). The benefit to the researcher of using a stratified sample is the researcher does not need to adopt a large sample size for analysis, as the sample is very specific (Ye et al, 2013). However, as specific participants are linked to a tender which results in collaboration, the author rejected the use of a stratified sample, as the sample being studied is not random.

Finally, the researcher could adopt a cluster sampling approach, where units or individuals making up the population are grouped together in clusters. Cluster sampling is normally adopted when the population being studied is geographically spread out (Bell et al, 2019; De Vaus, 2022; McBurney, 1998; Quinlan et al, 2018). The benefit of adopting this approach is the researcher requires less resources to access the population being studied. The author rejected the use of cluster sampling, as this sampling technique requires the cluster to be selected at random, as the study's sample is not random.

Alternatively, the multi-stage cluster technique lets the researcher select and split up people into sub-groups to make the collection of the primary data simpler (Bell et al, 2019; De Vaus, 2007; Riley et al, 2000; Zikmund et al, 2013). This technique does not require the researcher to use a full sampling frame (De Vaus, 2007; Newby, 2010; Mcneill and Chapman, 2005; Riley et al, 2000). The author rejected the use of multi-stage cluster sampling, as this sampling technique involves selecting various participant clusters at random, as the tender participants are not random but linked to specific tenders, this sampling approach is not suitable for this study.

Non-probability sampling consists of convenience sampling, which involves selecting participants or units that are convenient to obtain. For example, the researcher may intercept shoppers at a local shopping centre to conduct interviews (Miller, 2018; Zikmund et al, 2013). An alternative to this approach is snow-ball sampling, where the researcher finds a potential participant for the research study, conducts the research with this participant then asks the participant to recommend another person to invite to take part in the research (Bell et al, 2019; Newby, 2010; Riley et al 2000; Zikmund et al, 2013). The benefit of this approach for the researcher is that it takes less time to implement and reduces the cost of assembling many participants from the target population using traditional recruitment strategies (Sadler et al, 2010). The author rejected the use of snow-ball sampling, as there is a limited sample size of participants, as each participant is linked to a specific tender and the author is unable to obtain additional participant responses from information provided by the initial participant (Zikmund et al, 2013). Another sampling technique is quota sampling, this approach is used predominantly for market research that involve conducting surveys and opinion polls (Newby, 2010). Quota sampling requires the researcher to develop a quota system for identifying potential participants for a research study (De Vaus, 2007; Quinlan et al, 2018; Riley et al, 2000). However, the author rejected the use of a quota sample, as the sample size is fixed based on the tender being examines and the participants in subgroups are identical over all tenders, resulting the sample be distorted.

Another sampling techniques is purposive sampling, this sampling techniques, the authors have employed to collect the data for this study, purposive sampling which according to Patton (2002, p. 230) involves “The logic and power of purposeful sampling lie in selecting information-rich cases for study in-depth. Information-rich cases are those from which one can learn a great deal about issues of central importance to the purpose of the inquiry, thus the term purposeful sampling. Studying information-rich cases yields insights and in-depth understanding rather than empirical generalizations”. The author has made a judgement about who or what the author should include in the sample being studied including if these individuals can contribute to answering the research question (Quinlan et al, 2018). The benefit of adopting a purposive sample is the author can reject the participants that do not meet the profile of the desire characteristics. For this study, the author will not be investigating participants who have undertaken the tender process which has result in a purchase of scientific equipment.

As the author has employed a pragmatic case study approach, the sampling is based on the tender that has resulted in collaboration being examined rather than sampling size (Newby, 2010). The author used a typical case sampling approach based on examining cases which exemplified a specific area of interest (Bell et al, 2019; Frenz et al, 2009). Adopting a typical case sampling approach is used when working with a small sample size that are associated with a case study design, this helps the researcher to select participants that are particularly informative (Saunders et al, 2017). This process identifies the buyer and supplier involved in the tender process and the number of cases to be examined.

The author started by identifying the tenders that had resulted in collaboration by investigating three sections in the tender specification documents entitled “Ongoing Development”, “Collaboration” and the “Goods Performance” completed by the buyer. The ongoing development section, normally referred to development of new software, the “goods performance” section, normally identifies if the equipment had new features and the “collaboration” section discusses the partnership requirements from the buyer’s perspective. This section refers to the buyer requirement for studentship funding, or project funding etc. Once the tender had been selected, they were code based on Tyrrell’s (2015) innovation typology. Tyrrell (2015) defines innovations as; Minor innovation improved functionality in the equipment and Major innovation, equipment characteristics are significantly different compared with previously manufactured products.

The author reviewed the tender log, which contained the name and email address of the buyer who developed the specification and tender number. Then cross referenced the tender award letter with the tender, to identify the supplier’s name and email address of the supplier that had been chosen to collaborate with the buyer. The supplier tender return was then analysed to investigate if the supplier submitted a response under the sections entitled “Ongoing Development”, “Collaboration” and the “Goods Performance”.

From the tenders investigated, only 15 tenders had resulted in a collaboration, the author then cross-referred the questions against the supplier returns to confirm that the research questions could be answered using this secondary data. However, after analysing the secondary data, the author did not find any data that referred to the buyer and supplier demographics (characteristics), that influenced the collaboration or any CSC factors that are present in the documentation. Therefore, the author designed a telephone interview schedule (buyer) and a virtual meeting schedule (supplier) to obtain additional information from tender participants.  However, the author did identify several value-added factors with the buyer specification documents and, in the supplier, tender return, the author discusses how these value-added factors inform the study’s findings in section 3.8.

## 3.8 Reviewing Secondary Data

For this study, the secondary data examined by the author consisted of the pre-tender market engagement (where suppliers are invited to discuss the process and make recommendations), call for bids, winning offer, tender specification, tender returns, clarifications, equipment data, records of meetings and decisions made with the buyer present. The benefit of using secondary data for this study, is the information provided gives context to the tender process and can lead to unforeseen and unexpected new discoveries of potential reasons for buyer and supplier collaboration (Dwyer and Slyman, 2016; Pole and Lampard, 2002; Saunders et al, 2000). However, a drawback of using secondary data comes with some else's rational and assumptions about the importance of the information recorded in the documents, as the author may have been selective or provide a biased view of the event (Dwyer and Slyman, 2016; Jankowicz, 1995; Punch, 2005). Another disadvantage of using secondary data is the data is predetermined, the data may not provide the answers to the research questions or research objectives (Blumberg et al, 2011).

For this study, the secondary data has been used to provide context to the tender process, the name of the participants (both buyer and supplier), the type of equipment that the collaboration has focused on and the value-added factors that have been provided by the supplier in their tender return. Without reviewing and analysing the secondary data, the author is unable to ascertain if the data can answer the research questions or whether the author needs to conduct additional primary data collection. Without this secondary data, the author would be unable to identify the buyer and supplier involved in the collaboration and collect any additional primary data required to answer the research questions. Before using this secondary data, the documents have been analysed to identify if there are any biases present, what assumptions the documents have been created under, how this information has been presented and if it is relevant to the context of this study.

Additionally, the author has examined the secondary data to confirm if any buyer and supplier demographics (characteristics) are recorded that can influence the collaboration. Additionally, the author has examined the secondary data, to identify if any value-added and CSC factors are present in the tender specification, supplier tender return and supplier meeting minutes, that explain the reasons for the partnership and the critical success factors required to make university-industry collaborations successful. Unfortunately, the secondary data did not hold any information that confirmed if the buyer and supplier demographics had influenced the collaboration, nor any CSC factors to confirm which CSC factors are critical to the collaboration success. Although, the tender specification and supplier tender return did indicate which value-added factors are present in university-industry collaboration. However, these may not be all the value-added factors present in the collaboration, therefore the author will triangulate the value-added factors from the secondary data against the participant responses.

## 3.9 Data Collection Methods

One of the biggest challenges for the novice researcher is selecting a data collection method that provides the response rates required to answer the research questions. Many factors can affect the response rate for a study, these include, the studies topic, nature of sample, type of method adopted, implementation and other factors. It is important for the researcher to identify what data collection tools should be used or not used in a particular situation (De Vaus, 2002). As this study is qualitative, several data collection designs were investigated to confirm if they were suitable to answer the research questions.

The first was narrative, narrative can be defined as a story of a sequence of events as seen by the narrator (Langdridge and Hagger-Johnson, 2009; Parker, 2005; Smith, 2015). The main purpose of a narrative is to tell an interesting

story to a reader or a listener. A narrative can contain either a fact or fiction and is always set in a context (Quinlan et al, 2018). Alternatively, Sekarn and Bougie (2016, p352) suggest “narrative is an approach that aims to elicit and scrutinize the stories we tell about ourselves and their implications on our lives. Narrative data are often collected via interviews. These interviews are designed to encourage the participant to describe a certain incident in the context of his or her life history. In this way, narrative analysis differs from other qualitative research methods; it is focused on a process or temporal order, for instance by eliciting information about the antecedents and consequences of a certain incident in order to relate this incident to other incidents”. From these quotations we can conclude that narrative is concerned with the participant telling a story about a particular incident using their history to framework the incident.
For this research study, as the research questions are driven by the tenders resulting in collaboration between a buyer and supplier, the problem of using a narrative approach is the participant may not focus on the tender process as part of their stories. Narrative is designed for participants to identify what is important to them. Consequently, using this approach may not have provided the data to answer the research questions for this study, the author rejected the use of narrative as a research technique.

Another approach investigated to apply to this study was observation, observation concerned as Sekarn and Bougie, (2016, p127) “the planned watching, analysis and interpretation of behaviours, actions, or events. Various approaches of observation have been used in business research. These may be distinguished by four key dimensions that characterize the way observation is conducted; (1) control (are the observations conducted in an artificial or in a natural setting?), (2) whether the observer is a member of the group that is observed or not (participant versus nonparticipant observations), (3) structure (to what extent the observation is focused, predetermined, systematic and quantitative in nature), and (4) concealment of observation (are the members of the social group under study told they are being studied or not?)". Observations, require the researcher to make several decisions, firstly, should the observation be overt or covert in nature, with either researcher advising the participants the reasons for the study or undertaking the observations without their knowledge. It has long been argued that when research is covert, participants will behave differently than when they are being observed (Gill and Johnson, 2010). Secondly, should the researcher lead participants or no participant lead. In non-participant observations, the researcher does not interact with participants (Wilson, 2010). Thirdly, the researcher needs to develop an observation schedule, with times, locations and individual(s) that will be observed during the research study.

As the research study was conducted during the COVID-19 pandemic and during lockdown when it was not possible to meet individuals outside your house or bubble, the author had difficulty in conducting observations. Although the author could originally obtain access to the university site to carry out buyer observations, the buyer participants now had to work from home. Even if the restriction had not been in place, there was several safety considerations for the author by conducting the observations. For the supplier participants, as the process does not identify which supplier is involved in the tender process, until the tender returns have been submitted back to the university. It is not possible to conduct observations on the supplier preparing their tender submission, as the scientific equipment manufacturer is unlikely to grant access due to the confidential nature of the tender return. Consequently, the author rejected the use of participant observations for this research study, due to COVID-19 restrictions and the confidential nature of the supplier completing the tender returns.

## 3.10 Semi-Structured Telephone Interview (Academic Buyer)

Semi-structured telephone interviews were arranged with 5-15 buyers (end-users) identified in the case studies (tenders). The author did not select the buyers for this research study, the name of the buyer (who instigated the tender process) was listed in the tender log. The author sent an invite to this named person to attend a semi-structured telephone interview as participants are likely to reveal sensitive topics which may not be discussed in a face-to-face interview (Block and Erskine, 2012; Farooq, 2015; Vogl, 2013). However, a research interview is different from a day-to-day conversation, as firstly the interview is structured around a theme chosen by the researcher. Secondly that the accounts shared by the participants are recorded or notes taken to later be transcribed. Finally, these transcripts are then analysed and disseminated (Banister et al, 2011).

The author selected to use semi-structured interviews for this study as using a semi-structured telephone interview strategy to collect the case specific data, the author can access people's perceptions, meaning of a situation and construction of reality more quickly (Farooq, 2015; May, 2011; Punch, 2005). Furthermore, semi-structured telephone interviews are easy to schedule and can be re-scheduled more quickly than face-to-face interviews (Rahman, 2015) and allows the author access to participants without the need to endure time consuming travel to different locations (Block and Erskine, 2012; Cavana et al, 2000). This medium of data collection tool allows for author access to a more exhaustive sample of participants and the process is less labour intensive than undertaking face-to-face interviews (Wellington, 1996). Semi-structured telephone interviews offer participants control over the interview process, fewer distractions for the interviewee, provides more focused information and offers better anonymity (Vogl, 2013), compared to using focus groups were participants dynamics may inhibit the group situation, some participants agree in public but privately disagree, produce a group consensus and can be dominated by one powerful participant (Stokes and Bergin, 2006; Sapsford and Jupp, 1996; Zikmund et al, 2013). Consequently, the author rejected the use of focus groups, to allow freedom of speech to obtain the rich data to answer the research questions.

Due to COVID-19 and the restrictions on face-to-face meetings, the author has employed telephone interviewing for the buyer participants. Telephone interviewing reduces interview bias caused by the interviewer giving non-verbal or facial expressions that can influence the participant's answers (Zikmund et al, 2013) and allows the author to go off schedule, then follow up participant's answers with new questions (Bell et al, 2019). Another benefit for the author is that unlike face-to-face interviews, there is very little risk for the interview being overheard, feeling uncomfortable, interrupted and removes the potential risk to the researcher's safety (Pole and Lampard, 2002). However, telephone interviews have traditionally been viewed with a considerable amount of suspicion by researchers within the academic community, (Block and Erskine, 2012; Farooq, 2015). The criticisms of using telephone interviews, is that visual clues and body language cannot be detected during a telephone interview. This can lead to a loss of contextual and nonverbal data that can impact on the rapport, probing and interpretation of participant's answers (Novick, 2008; Quinlan, 2011). One method of accessing non-verbal data is to undertake the telephone interview on Microsoft teams, this would allow access to the body language of the participants. However, this would depend on if the participant is willing to undertake the interview through this medium, as the choice of setting chosen by the participant to undertake the call may influence the data that is produced during the interview (Hartas, 2010).

Another benefit the author obtains from using a telephone interview for the buyer participants, is the ability to probe questions further. According to Cavana et al (2000, p144) probing involved "the funnel sequence of questions with paraphrasing and allows the interviewer to delve into the memories of the interviews". Probing questions allow the author to clarify participant answers and probe the new areas identified in the interview that are of interest to the researcher". As this study used open-ended questions during the buyer telephone interview, probing questions have been used to dig deeper into answers related to the buyer's concept of added-value and the success factors the buyer considers important in developing cross-sector collaborations with the supplier.

The format selected by the author for the buyer (end-users) telephone interviews is semi-structured in design with the structured part of the telephone interview transcript based on the PI end-user demographic criteria modified from Ogawa and Pongtanalert (2013), Hippel et al (2011) and Tyrrell (2015) by adding the additional dimensions of PI end-users funding provider name, level of funding received from the funding bodies, number of research papers produced and whether the PI end-user is female or male. The unstructured part of the telephone interview has focus on the buyer's reasons for collaborating, which included access to technology, access to knowledge, funding for PhD Studentships (Tyrrell, 2015), funding for their research and employment of their students when they graduate (Tether and Swan, 2003). A copy of the buyer telephone interview schedule can be found in Appendix 1.

## 3.11 Adoption of Online Semi-Structured Questionnaire (Supplier)

Because the supplies are located around the world and in different time zones, an online semi-structured questionnaire has been selected to collect the supplier's data to answer the research questions. One of the biggest challenges for the researcher is developing a questionnaire that fulfils the research objectives of the study and that avoids bias in the research design (Bajpai, 2018). For this study, an online semi-structured questionnaire has been adopted for the 5-15 suppliers involved in the tender process.

A questionnaire is a formal set of pre-defined questions that are presented to potential participants to answer, these questions reflect the research questions being investigated (Bajpai, 2018). The semi-structure part of the online questionnaire has focused on the demographics of the supplier, e.g., location, type of equipment manufactured, firm's turnover, number of employees etc. The unstructured part of the online questionnaire has focused on the supplier's reasons for collaboration which include access to lead buyer knowledge, access to potential sales markets, access to employees (graduate students) and access to IP. Additional questions have been based on the CSC factors identified in the literature (Mendel and Brudney, 2018; Mohr and Spekman, 1994; Vernis et al, 2006). The benefit of using a semi-structured format for the supplier questionnaire is the overall structure and direction is flexible enough to include unstructured questions, allowing the researcher to probe more details on area's that are of interest (Hair et al, 2003).

As the majority of the scientific equipment firms have their production facilities scattered across the globe, once the questionnaire has been created, it can be distributed to participants with little effort (Stoke and Wall, 2014; Adams and Cox, 2008). Web-based questionnaire invites potential participants by email to complete the questionnaire by visiting a website which host the questionnaire format (Bell et al, 2019). Furthermore, an online semi-structured questionnaire can be visually interactive and offer flexibility for busy people who do not have time to schedule a telephone interview (Szolnok and Hoffmann, 2013). An online semi-structured questionnaire offers immediate storage of data into a database ready for processing (May, 2011) and does not require the researcher to travel, nor work in an unsafe environment (Vogl, 2013). Web-based questionnaires offer the researcher the ability to design questions with filters like "Yes" and "No" questions. Once the answer is completed the web-based software skips automatically to the next question on the questionnaire. Web-based questionnaires can be preformatted so that participants can see only one question on the screen at a time and allow participants to view all the questions in advance (Bell et al, 2019).

A potential problem of using an online questionnaire is self-administrated, is that there are no researchers available to help participants, with any misconception they may have about the wording of a question. From the researcher perspective, the question may seem reasonable but in the participant's mind there is a misconception on the question which results in a foolish answer (Berry, 1957). Another problem is the email with the link to the online questionnaire gets lost in the spam filter of the participant's email and the participant is not aware they have been invited to participate in the study. For this study, to improve the response rates for potential supplier participants, after issuing the first invite to participate in the study, should the supplier participant not undertake the online questionnaire within a month, a follow-up email was sent to remind the supplier to complete the online questionnaire.

### 3.12 Supplier Data Collection Method Change – Online Virtual Meetings

After sending out the invites to the online questionnaire and getting the first online questionnaire response back to review, it was clear that the data provided would not offer enough insight to answer the research questions. After discussion with the author's supervisory team, it was decided the data tool should change to online virtual meetings (interviews), this would allow for more richer data to be collected. While removing the risk of participant and author contracting COVID through a face-to-face interview. After reviewing the online questionnaire structure and questions design, the author decided that the original online questionnaire format could be changed into an online interview schedule, without any changing to the wording and structure. The original online questionnaire has been renamed virtual meeting (interview schedule) and remains in a semi-structured format with a mixture of open and closed questions for the participants to answer.

There are two types of online interview designs, these are asynchronous and synchronous interview types. Asynchronous interviews are conducted online between the researcher and participant but through the chat function or email. Neither the researcher nor the participant needs to be online at the same time. Alternatively, a synchronous online interview involves the researcher and participant holding an interview online at the same time, this can be a mixture of face-to-face and chat function (Fielding et al, 2008; Janghorban et al, 2014; Jowett et al, 2011). For this study, the author has adopted synchronous online interviews to complement the buyer telephone interviews. The benefit of holding synchronous online interviews include: many participants can be interviewed without little trouble (arrange a location and time), it is very convenient for participants, there a no time limits, participants have more time to respond, no access issues if the population has a computer (Quinlan, 2015; Roksana et al, 2014). Other benefits for a virtual meeting (interview), include participants do not need to travel and waste time attending a face-to-face interview. Virtual meetings can be administered quickly to participants that are geographically dispersed and would otherwise be difficult to contact (Gruber et al, 2008: Quinlan et al, 2015).

Additional benefits of adopting virtual meetings are by holding the interview online this allows the participant and interviewer to create rapport more easily during individual online interviews. During the interview both participant and interviewer have equal status, this can allow the participant to open-up during the online interview.  The interviewer no longer needs to write up a transcript of the interview, as online virtual meeting platforms offer the interviewer the option of recording the interview via the online chat function, which can provide an interview transcript, allowing the researcher to analyse the data quicker (Gruber et al, 2008; Jowett et al, 2011; Quinlan et al, 2015). Another benefit to the researcher is there are no welfare or safety issues for the researcher to consider for both the researcher and participant. As the researcher and participant can hold the interview either at home, work, or another location of their choosing without having to worry about the safety of the location or person they are meeting. Online interviews offer the same advantages as face-to-face interviews that the researcher can asked probing questions, allows for natural dialogue of the interview, allows the researcher to see and understand the perspective of the participant to obtain a better understanding of the phenomena (Coiro et al, 2008).

Other potential benefits of using a virtual interview to collect data from participant's is that participant's that are unable to attend a face-to-face interview due to commitments, like caring for a disabled person or having to arrange childcare or the expense of travel to the interview. Now no longer needs to arrange childcare, caring support or incur costs travel to an interview, as the interview can now be held online at a time that is convenient to the participant (Feld and Shah, 2021). From an ethical perspective, online interviews offer the ability to withdraw from the interview process at a click of a button. This allows participants if they wish to use the video function or not, use email or chart function instead of face-to-face interactions (Fielding et al, 2008). However, there are several criticisms of using online interviews, firstly, using an online platform for the face-to-face interview does not give the researcher full access to the participant's full body language, therefore some of the participant's feelings may not be shared with the researcher. Another problem is the use of technology and the internet, some participant groups may not undertake the online interview, as they lack the technology or experience to operate the technology to take part in the online interview (Jowett et al, 2011; Quinlan et al, 2015). As the participant group consist of representatives from the scientific equipment manufacturers, many of the participants work in the field, consequently they have the technology and skills to undertake an online interview. For this research study, the online video function has not been used, to protect the anonymity of the participant. A copy of the virtual meeting interview schedule can be found in Appendix 2.

## 3.13 Data Collection Method Design

Both the telephone interview and online virtual meeting uses a mixture of open and dichotomous questions. Dichotomous questions can be used to understand the demographics of the participants engaged in the study. The strength of using dichotomous questions is the researcher does not need expertise to develop the questions, as constructing, coding, and analysing the questions is simple (Bajpai, 2018; Clover and Balsley, 1984; Fraenkel and Wallen; 1993). Traditionally, dichotomous questions include providing a profile of individuals or firms through describing their personal, social-demographic background including age, gender, material status income, education, ethnic minority, nationality, religion, language ability, location, occupation, family size, social class etc. For a firm this could include market characteristics (industry type, size of the firm, market share, location of business, business type, revenue) etc and so on (Ekinci, 2015).

In contrast, open-ended questions allow the researcher to ask participants about their views, perceptions, and explanations on a specific topic. Open-ended questions must be designed clearly to express the key themes being researched, so participants can develop their own answer to these themes

(Cameron and Price, 2009; Collis and Hussey, 2003; Hair et al, 2003; Howitt, 2016). The benefit of using open-ended questions is this type of questions can be used to explore a research topic in more depth (Ekinci, 2015). However, open-ended questions can be demoralising for the participant, which may reflect in the answers given being the first thing that comes into the participant's head (Pole and Lampard, 2002). As the data is normally very rich from using open-ended questions, the data is normally collected from a small sample and used in qualitative research (Ekinci, 2015).

Once the data has been collected and analysed from the buyer telephone interviews and supplier virtual meetings, the author will used verbatim extracts to illustrate the participant's perspectives, the author has used verbatim extracts (as evidence and context) from buyer telephone interviews and supplier virtual meetings transcripts to demonstrate participant characteristics. The benefits of using verbatim in qualitive research, is quotations can be illustrative, succinct, and representative of overall participant's sentiments related to study themes (Brinkmann and Kvale, 2015; Gillham, 2005; Lingard, 2019, Thorne 2020). However, the participant's verbatim may not be grammatically correct, as several of the participants have expressed their ideas in their own manner and others their first language is not English. All verbatim quotes have not been grammatically corrected by the author as this would remove the authenticity of the verbal material presented (Clark et al, 2016; Thorne, 2020).

Consequently, the author decided a pilot study to check word length, question meanings and length are acceptable to participants, the next section discusses the benefit of conducting the pilot study.

## 3.14 Conducting a Pilot Study

As it can be difficult for the researcher to predict how participants have interpreted the questions being asked. Before issuing both data collection tools, a pilot study was conducted. There are several benefits of conducting a pilot study, by trialling a draft copy of the questionnaire with potential participants you can identify if the design has any glaring errors (Collis and Hussey, 2003; Hair et al, 2003; Riley et al, 2000; Veal, 2005). A pilot study allows for the author to explore the correct length of the interview or questionnaire design, as too long a length design may result in missed answers due to participant fatigue and/or uniform responses (Berry et al, 2014; Collis and Hussey, 2003; Fitzpatrick. 1991; Hair et al, 2003; Riley et al, 2000; Veal, 2005). The question wording is another important part of the design that must be tested. If negative wording or the question is double barrelled, this can lead to participants answering the question in a way that would bias their response (Collis and Hussey, 2003; Hair et al, 2003; Riley et al, 2000; Veal, 2006). Another factor to consider is the grouping of questions and order of the questions on the data collection tools. As to improve responses, it is best to start with questions that are not contentious and then move to more complex questions later in the interview and/or questionnaire design. As participants may answer “no” to end the interview or questionnaire quickly (Marshall, 2004).

After undertaking the pilot, it is advisable to redraft the interview and questionnaire schedule, before starting the main phase of the data collection process (Stone, 1993). Alternatively, a pilot study can be used to test frame questions, collect background information, or develop a research approach (Sampson, 2004). After redrafting both the data collection tools, the main phase of the data collection process begins with both buyer (end-user) and supplier (manufacturer) being invited to take part in the study by emailing the potential participants directly. Potential participants received a copy of either the telephone interview questions or online questionnaire and a copy of the Worcester University Consent Form (to be signed off by the participant). An email provided a brief overview of the study to provide assurance and create curiosity for the participant to take part in the study. To confirm the study legitimacy, the contact details of my supervisor has been added to the email, allowing the participant opportunity to discuss this study with the author’s supervisor (Jankowicz, 1995). The buyer (end-user) has been offered a specific time and date for the telephone interview to take place, if the buyer wishes to participate in the study, the buyer is required to complete an online consent form. The author then sent the potential participant confirmation of the telephone number and details for the telephone interview. The supplier (manufacturer) was sent an email with a link to the online questionnaire. The supplier was asked if they can complete the online consent form and be encouraged to complete the online questionnaire.

## 3.15 Pilot Study Results

Before starting the main data collection stage of the study, a pilot was conducted with one of the confocal manufacturers on the supplier online questionnaire schedule to clarify the wording, language, question layout and check for errors on the schedule. After reviewing the questionnaire, the supplier made the following recommendations in Table 3.5 below.

**Table 3.5 - Study Changes After Pilot Study Review**

| | |
|---|---|
| 1. | A section should be added for the supplier to state any professional qualification or institutional memberships. (This section, has been added to develop the demographics of the supplier and buyer to compliment von Hippel's research). |
| 2. | Within the section on Scientific Equipment use: the supplier suggested the question be more specific. By changing the answers into research collaboration (with another university), research collaboration (with a firm), for commercial use (spin off activity). |
| 3. | The supplier stated that some of the questions where a duplicate or sound like another question on the questionnaire. These duplicated questions have been removed from the online questionnaire design. |
| 4. | The supplier suggested that the length of the online survey was of an acceptable length, making it likely participants would complete the whole questionnaire. |
| 5. | Apart from a couple of errors which need to be corrected the format for the questions was acceptable. |

Source: Tyrrell (2022)

In addition, the supplier suggested that a table of the value-added factors could be presented to both groups of participants, allowing them to comment on the added-value factors they had used in the specification. The pilot for the telephone interview questions, was undertaken with one of the buyers identified in the tender log. The pilot study was an opportunity to identify if any changes needed to clarify the wording, language, question layout and to check the documents for errors. The pilot offered an additional opportunity to investigate the time it takes to complete one telephone interview. After sending out the invite to the buyer to participate, the first problem that the buyer encountered was being unable to access the consent form through the University of Worcester link to the OneDrive. After making some changes to the setting on my access to the OneDrive, the buyer was able to complete the consent form before scheduling the telephone interview. The telephone interview was conducted using a voice call via Microsoft teams.

After conducting the telephone interview, the demographics questions have been redesigned to add more clarity to the questions being asked. For example, the question entitled "What is the scientific equipment mainly used for?" a new answer "Core Facilities" was added to the schedule.

### 3.16 Triangulating the Data

Within the research methods literature, there are different versions of triangulation that include: 1) Triangulation of methodologies focusing on combining both qualitative and quantitative materials in the same research design. 2) Triangulation of methods which involved using several different approaches to analysis which is used to validate the research findings. 3) Triangulation of theories, which used several theories to explain and interpret the case. 4) Triangulation of researcher which involves several researchers examining the empirical material and cross-checking the interpretations and conclusions of the research study. 5) Triangulation of data (Eriksson and Kovalainen, 2008).

By using a triangulated approach to data collection (Brown and Hale, 2014; Myer, 2013; Stokes and Wall, 2014) we can explore the cross-sector partnerships goals within a specific tender process in the tender specification, supplier questionnaire and buyer telephone interview responses. The benefit of triangulation is this approach allows the researcher to use different data collection methods in the same study to confirm their theory or question is correct across all data sources (Ghauri and Grønhaug, 2010; Jankowicz, 1995; Pole and Lampard. 2002; Saunders et al, 2000). However, triangulation can be problematic for inexperienced researchers, as using different data collection tools can be complex, time consuming and difficult for the researcher to administer (Cohen et al 2000).

For this study, the author triangulated the buyer and supplier responses in the primary data and has summarized the findings in Chapter 5, 6, 7 and 8. As part of the analysis, the author examined the secondary data, unfortunately, there was no information that supports the concept that both buyer and supplier demographics influenced the collaboration, nor of the CSC factors that are required to make the collaboration a success. However, the secondary data from the tender specification and supplier tender returns, did identify value-added factors that are present in university-industry collaboration. To confirm the findings, the author, triangulated the value-added factors identified in the secondary data against those identified in the participant responses.

## 3.17 Data Analysis Techniques

During the methodology section process, the author investigated if the study should adopt either a deductive or inductive approach, the two different techniques are discussed more in detail in this paragraph. The author rejected the idea of adopting using just deduction in the research study, as the research is exploratory, only a small sample size can be collected from participants, making it difficult for the author to generalise from the data collected and analysed. The author also investigated if the study should adopt only an inductive approach, however the author was reluctant to use only an inductive approach because of the risk this would not develop theory. Therefore, the author rejected the use of an inductive approach and decided to employ abduction in this study.

As the data has been analysed using abduction, according to Haack (2006, p25) abduction consists of “forming a hypothesis that, if true would explain some puzzling phenomenon; deduction of the consequences of that hypothesis; and inductive testing to those consequences to determine how likely the hypothesis is true”. Deduction starts with the assumption that theory is the first source of knowledge, and the researcher can deduct from this knowledge the hypotheses that are investigated in the study. Deduction is a linear process, and the research process starts with deduction and finishes with empirical evidence to support the research hypotheses (Bell et al, 2019; Collis and Hussey, 2003 Eriksson and Kovalainen, 2016; May, 2011; Saunders et al, 2000). The criticism of using deduction is can the research really comply with scientific rigor, as the researcher brings to the research their own biases and experiences while working on the study. Another criticism of a deductive approach is the ability to generalise, as the researcher needs a suitable successful numerical size of sample to be able to generalise across a population (Saunders et al, 2000). An additional criticism of deduction is that the approach is very rigid.

Within the qualitative research methods literature induction is the core approach adopted for qualitive studies. Induction is the opposite of deduction and starts by collecting data and developing theory. The main aim of inductive research is to develop theory through the scrutinising of the hypotheses designed (Bell et al, 2019; Collis and Hussey, 2003; Eriksson and Kovalainen, 2016; May, 2011; Saunders et al, 2000). In contrast, induction begins in an empirical setting and focuses on generating context-sensitive theory with the aim to broaden the concept of the phenomena and the individual being studied in the larger social environment (Gummesson, 2000; Maylor et al, 2017; Polsa, 2013).

Alternatively, Schindler (2019, p17) suggests “in induction, you start by drawing an inclusion from one or more particular facts or pieces of evidence. The conclusions explain the facts, and the facts support the conclusions”. One of the greatest strengths of using induction is its flexibility, as this approach does not require the researcher to establish theory or hypotheses before starting their research. Induction also allows the researcher flexibility in the research design by allowing flexibility in the sample size and types of data that can be collected and analysed (Lancaster, 2005). The criticism of using induction in a research study is the approach can create empirical results that do not develop into interesting theory (Polsa, 2013). Lincoln and Guba (1985, p 204) argue "Induction data analysis is often attacked as inadequate on several grounds. The first of these is that data are theory-laden that is "facts" cannot exist without a theory that defines them as facts. Hence the hope that one can collect "raw" (theory-free) data and base a theory-free analysis upon them is vain". Alternatively, the collection and categorizing of data can be conducted in various ways, therefore inductive data analysis can be highly subjective, and any data may make a legitimate claim to be included in any write up by the researcher (Lincoln and Guba, 1985).

An alternative to deduction and induction is abduction. The author has selected abduction because of the benefit this can offer to the study design. Abductive reasoning allows the author to collect data and explore the phenomenon by identify the patterns in the phenomena, exploring themes to create new theory or modify an existing theory with the aim of collecting additional data to develop theory (Anderson et al, 2015). According to Eriksson and Kovalainen, (2016, p24) abduction, proposes "a way of overcoming the limitations associated with deductive and inductive positions. The weakness with deductive reasoning is its reliance on a strict logic of theory testing and falsifying hypotheses, but a problem arises because it is not clear how to select the theory to be tested. The difficulty with induction reasoning arises from the criticism that no amount of empirical data will necessarily enable theory-building. Abductive logic is prosed as a third way which overcomes these limitations. It is based on the pragmatist perspective (in particular the work of philosopher Charles Pierce)". As abduction reasoning is interlinked with a pragmatic epistemology, which allows the author the flexibility to develop the research questions, conducting the literature review, develop the research design, data collection, data analysis and thesis write up has been adopted (Sans Pinillos, 2022). In section 3.18, the author discussed the different methods of data analysis that can be used to examine phenomena being studied.

## 3.18 Thematic Analysis of the Data

Before starting this study, the author investigated the different data analysis techniques that could be adopted to answer the research questions. The author investigated using content analysis, which aims to be able to convert the text into numerical variables that can be used for statistical analysis (Saunders et al, 2019; Wilson, 2010). Content analysis according to Riley et al, (2000, p104) “involved identifying and counting certain key words or phrases in a piece of writing or in the recording of an interview, conversation or surveys which include unstructured responses”. From this quote the author concluded that content analysis requires a step-by-step process for counting the text and developing variables to be used to answer the research questions. Table 3.6 below is a summary of the steps required to carry out content analyses.

**Table 3.6 - Content Analysis Steps**

| | |
|---|---|
| 1) | Identify the unit of analysis – recording unit, sentence, or paragraph. |
| 2) | Choose categories that are relevant to the issues being studied. They must be reliable, so that if another researcher repeated the analysis, they would find the same information (increased reliability). |
| 3) | Once you have chosen your categories, read through the material and apply these codes to units of text. |
| 4) | Tabulate the material. Present categories and list the assertions under them. |

Source, (Wilson, 2010, p267)

However, content analysis has several issues that are associated with quantitative analysis. The author needs to reflect on the sample size and collect a large amount of data to answer the research questions. This data must be representative of the population being studied so that it can be generalised

(Pole and Lampard, 2002). Unfortunately, as the primary and secondary data for this research study is limited to a few cases and content analysis uses a positivist approach, the author rejected using content analysis for analysing the data.

Once the data has been collected, the primary and secondary data has been analysed using Thematic Analysis, one of the most common tools for analysing data within qualitative research. Thematic analysis is a method of identifying, analysing, and reporting patterns (themes) within data (Braun and Clarke, 2006; Mcneil and Chapman. 2005; Quinlan et al, 2018; Vaismoradi et al, 2013). The challenge for the author is the ability to identify and understand what constitutes a theme in the research. Themes are patterns across the different data sets that are important to the description of a phenomenon and are associated to a specific research question (Maguire and Delahunt, 2017; Nowell et al, 2017).

Alternatively, according to Bell et al, (2019, p519) a theme "is a category identified by the analyst through his/her data; relates to the analyst's research focus (and quite possible the research questions); builds on codes identified in transcripts and/or field notes; provides the researcher with the basis for a theoretical understanding of his or her data that can make a theoretical contribution to the literature related to the research focus". The author has employed thematic analysis as it offers several benefits to conducting the study, according to Howitt (2016) these benefits are listed in table 3.7 below.

**Table 3.7- Benefits of Thematic Analysis**

| | |
|---|---|
| 1) | Compared with other forms of qualitative analysis, thematic analysis makes fewer demands in terms of data collection and few constraints in terms of data analysis. |
| 2) | Thematic analysis is relatively easy to learn and understand compared with other qualitative methods. Consequently, it may be used by a novice researcher with little difficulty. |
| 3) | Thematic analysis findings are easily understood by intelligent and educated members of the community. |
| 4) | Its accessibility to the public means that it can be used for participatory studies involving particular groups and the researcher. For example, it is unlikely that a thematic analysis of interviews with staff in a casualty unit will produce findings which they will fail to understand. |
| 5) | Thematic analysis summarises large amounts of data by offering descriptive themes which can be rich in information. |

| | |
|---|---|
| 6) | Thematic analysis can be useful in qualitative research which may inform policy development because of its accessibility and use of data produced by involved individuals. |

Source: Howitt (2016, p182)

Using thematic analysis allows the author the ability to examine the perspectives of different research participants, highlighting similarities and differences, and generating unanticipated insights (Braun and Clarke, 2006 and King, 2004). However, within the research methods literature, there is a general lack of example of the use of thematic analysis in practical application in contrast to the extensive literature of using grounded theory, ethnography, and phenomenology analysis (Nowell et al, 2017).

After reviewing the tenders, the author contrasted the content with the literature on value-added and CSC success factors, the data has been collected case by case. The data is being collected from each tender (case), by reviewing the tender, identifying the buyer which procured the equipment, the supplier that submitted a return and offered to form a collaboration.  To identify the themes in the data, the author developed a coding process for analysing the primary and secondary data.

Table 3.8 below provides a summary of the coding process and analysis of the data in a step-by-step process.

**Table 3.8 - Coding Process and Data Analysis Step-by-Step Process**

| **Stage** | **Action** |
|---|---|
| 1. | From the CSC and value-added literature, develop a theme-based coding system. |
| 2. | Review the tender specification and identify the themes used based on the coding system. |
| 3. | Develop the telephone interview/online questionnaire questions based on these themes. |
| 4 | And identify new themes that are discussed in the telephone interviews and questionnaires. |
| 5. | Read and become familiar with the themes. |
| 6. | Collect the first data set from the first tender, buyer, and supplier. |

| | |
|---|---|
| 7. | Analyse the collected data against themes. |
| 8. | Review telephone interview/online questionnaire and add new themes to questions. |
| 9. | Read the data collected and reread to become familiar with the themes. |
| 10. | Collect the second data set from tender, buyer, and supplier. |
| 11. | Repeat stages 4-7 for each of the 5-15 cases being studied. |
| 12. | Compare code themes across the buyer data set. |
| 13. | Write up the buyer data using quotes and compare the themes across the buyer data set. |
| 14. | Compare code themes across supplier data set. |
| 15. | Write up the supplier data using quotes and compare the themes across the supplier data set. |
| 16. | Compare the themes between buyer and supplier transcripts. |
| 17. | Write up the themes that are not common to each project. |
| 18. | Write up combined data set using quotes and summarising differences and similarities in motives and value-added factors. |

Source: Tyrrell (2022)

Using Thematic Analysis, the buyer and supplier data from each specific case (based on scientific equipment type) was analysed to highlight the common and difference themes in the data collection tools. Each case was summarized and contrasted against the research questions. Each case was analysed using this format and a final summary of each of the cases was identify if there are common themes across all cases and difference specific to each equipment type.

## 3.19 Study Participant Inclusion and Exclusion

After the author had selected the RIU cases (tenders) by the buyer completing the sections in the tender specification entitled “Ongoing Development”, “Collaboration” and the “Goods Performance”, that had resulted in a collaboration to create innovation. The author now drafted the selection criteria for participants to provide responses to the study’s research questions. The author reviewed the RIU tender log, to identify the buyer involved in the collaboration. In Table 3.9 the author provides a summary of the selection criteria for the buyer participants.

**Table 3.9 - Buyer Selection Criteria**

| ***No*** | ***Selection Criteria*** |
|---|---|
| 1. | The buyer is identified in the RIU tender log. |
| 2. | The tender has resulted in the development of new equipment and/or software. |
| 3. | The tender resulted in collaboration between buyer and supplier. |
| 4. | The tender involved a specific buyer and supplier. |
| 5. | The buyer had developed the specification with the new equipment functionality and/or software. |
| 6. | The buyer had added additional value-added factors to the specification template to access resources or skills, the buyer lacks. |
| 7. | The partnership lasts a minimum of 3 to 5 years. |
| 8. | The buyer was the main point of contact for the supplier during the collaboration and manage the project at the RIU. |
| 9. | The buyer was the owner of the large grant that had been awarded by the external funders. |
| 10. | The buyer either managed a shared facility (used by other academics and students) or used the equipment themselves to conduct teaching and research activities. |
| 11. | The buyer complied with von Hippel (1986), Shaw (1985,1998) and Tyrrell (2015) buyer typology. |
| 12. | The buyer and supplier are a matching pair of dyads. |

Source: Tyrrell (2022)

As the supplier’s name is not listed in the tender log, the author examined the specific case (tender) and identified the supplier named in the tender award letter. This is the supplier awarded the contract to develop the new scientific equipment and/or software for the buyer.  In table 3.10 the author provides a summary of the supplier selection criteria for the study.

**Table 3.10 - Supplier Selection Criteria**

| ***No*** | ***Selection Criteria*** |
|---|---|
| 1. | The supplier is named in the tender award letter. |
| 2. | The supplier works with the buyer identified in the tender log. |
| 3. | The partnership lasts a minimum of 3 to 5 years. |
| 4. | The supplier develops and sells the new scientific equipment and/or software to the external market. |
| 5. | The supplier provides the value-added factors requested by the buyer in the tender specification. |
| 6. | The supplier manages the relationship between the buyer and the scientific firm. |
| 7. | The buyer and supplier are a matching pair of dyads. |

Source: Tyrrell (2022)

The author used these criteria to select the match paired dyads to invite to the buyer telephone interviews and supplier virtual meetings. After reviewing over 300 tenders during a 3-year period at the RIU, the author identified the criteria for rejecting potential participants to the primary data collection stage. Table 3.11 provides a summary of the criteria to reject potential participants from the study.

**Table 3.11 - Potential Participants Rejection Criteria**

| ***No*** | ***Rejection Selection Criteria*** |
|---|---|
| 1. | The buyer and supplier were not involved in a collaboration. |
| 2. | The buyer purchased goods, services and software already release to the market. |
| 3. | The supplier offered to the buyer, goods, services and software already manufactured. |
| 4. | The tender process was transactional (order raised and goods supplied). |

| | |
|---|---|
| 5. | The relationship between the buyer and supplier was short term (12 months only based on a standard warranty issued). |
| 6. | No new goods, services or software was created from the tender process. |
| 7. | No value-added factors had been added to the tender specification template. |

Source: Tyrrell (2022)

In section 3.20 the author discusses the participant response rates and the limitations of the participant responses on the study's credibility, transferability, dependability and conformability framework (Lincoln and Guba's, 1985) had on influencing the study design and findings.

## 3.20 Participant Responses to Telephone Interviews and Virtual Meetings

For this study, the participants being studied to answer the research questions are the University Principal Investigators (PI end-user) known as Buyers and from the Scientific Equipment Manufacturers known as Suppliers. The original plan had been to collect between 5 to 15 telephone interviews from the buyer and another 5 to 15 online questionnaires from the suppliers. As the suppliers maybe out in the field working during the working week, the online questionnaire would allow the suppliers freedom to complete the questionnaire round their work schedule.

Due to the COVID 19 pandemic, most of the representatives from the Scientific Equipment Manufacturers decided to put their representatives out to furlough. At the time of write up only one online supplier questionnaire had been completed by a sales manager for the fit-out of new Co2 Incubators, Ultra Low Freezers and Bench Top Centrifuges for a new joint University and NHS building. This supplier requested the online questionnaire format before completing the online questionnaire. This supplier signed the consent form on the University of Worcester OneDrive.

As the British Chancellors furlough scheme was due to finish at the end of September 2021, the next step was to contact the supplier representatives to complete the online questionnaire. However, after discussion with my supervisory team, it was decided that the data collection tool for the supplier should be adjusted to obtain richer insight from the supplier participants. The data collection tool was changed from online questionnaire, that can have a low response rate, to a virtual meeting (Arnfalke and Kogg, 2003; Hill et al, 2021; Jones et al, 2020; Riley et al, 2023) with the supplier participants.

A virtual meeting allows the researcher to obtain rich data without the safety issues for the researcher while conducting a face-to-face interview. Before completing the telephone interview and virtual meeting, both the buyer and supplier participants are required to sign a consent form confirming that they consent to take part in this research study. The completed consent forms are hosted on the University of Worcester OneDrive (which is password protected).

All buyer and supplier participants that have undertaken the telephone interview or virtual meeting have signed their consent form. As the supplier invites have been issued during COVID 19, several scientific equipment manufacturers either restructured their workforce or put their staff out to furlough. Consequently, several supplier participant’s that had been involved in the tender process and formed the collaboration with the buyer had either retired or left the organization during the COVID-19 pandemic. Therefore, the author was unable to conduct telephone interviews with buyer participants P4, P6, P7, P8 and P11. In contrast, the author did not receive a response from supplier S2, S5, S8, S9, S10, S11 and S12 who had either left the organisation during covid or had retired.

This has implications for the study, although the author was able to identify all value-added factors present in the 15 tenders examined and obtain a saturation point (Bryman, 2011; Glaser and Strauss,1967) in the secondary data where no new themes had emerged from the cases (tenders). The author was unable to triangulate (Ghauri and Grønhaug, 2010; Jankowicz,1995; Pole and Lampard, 2002; Saunders et al, 2000) these value-added factors with all 15 buyer and supplier participants, due to some participants declining to engage in the study. Consequently, this limits the ability to generalise (Rahman, 2017; Veal, 2005) the findings to another setting, as the author cannot verify if all participant responses agree with the value-added factors found in the secondary data (Dwyer and Slyman, 2016; Pole and Lampard, 2002; Saunders et al, 2000) or if there were any new themes that would have been generated from additional participant responses. Additionally, the secondary data did not hold any participant demographics or CSC factor data, the author used the participant responses from the buyer telephone interview and supplier virtual meeting transcripts to identify what influences the participant's demographics have on the collaboration and what CSC factors are important during the partnership. As the response rate is low due to COVID19, once again the author cannot generalise to another setting, or if any new themes would have been generated from additional participant responses.

However, to mitigate these limitations, the author intended to make the findings transferable using Lincoln and Guba's (1985) framework. By using a thick contextual description of university-industry collaboration, the author has provided readers the methods to transfer the findings to another setting or context (Anney, 2014; Lincoln and Guba, 1985; Korstjens and Moser, 2018; McInnes et al, 2017; Miyata and Kai, 2009: Morse et al, 2002; Shenton, 2003) Supported by the author using verbatim extracts to illustrate the participant's perspectives, as evidence and context to support the study's findings and a representation of all the participant's sentiments related to study themes (Brinkmann and Kvale, 2015; Gillham, 2005; Lingard, 2019, Thorne 2020).

Additionally, by providing a breakdown of the research methods used for this study, including copies of the buyer telephone interview schedule, supplier virtual meeting interview schedule, participant information sheet and example consent form, the author has ensured that the study has dependability and the findings are stable over time (Anney, 2014; Lincoln and Guba, 1985; Korstjens and Moser, 2018; McInnes et al, 2017; Miyata and Kai, 2009: Morse et al, 2002; Shenton, 2003).

**Table 3.12 - Participant Response Rates**

| Tender Name | Buyer No | Participated | Supplier No | Participated |
|---|---|---|---|---|
| C02 Incubators | P1 | Yes | S1 | Yes |
| Ultra-Low Freezers | P1 | Yes | S1 | Yes |
| Range of Centrifuges | P1 | Yes | S1 | Yes |
| A New Engineering Platform | P2 | Yes | S2 | No – left organisation |
| New MRI Scanner Software | P3 | Yes | S3 | Yes |
| 3T MRI Scanner | P4 | No | P13 | Yes |
| BEAM System | P5 | Yes | S5 | No - retired |
| Two Confocal Microscopes | P6 | No | S6 | Yes |
| Inverted Confocal Microscope | P7 | No | S6 | Yes |
| Turnkey Super-Resolution Microscopy | P10 | Yes | S10 | No |
| Raman Microscope | P12 | Yes | S12 | No |
| Research MRI Scanner | P13 | Yes | S13 | Yes |

Source: Tyrrell (2022)

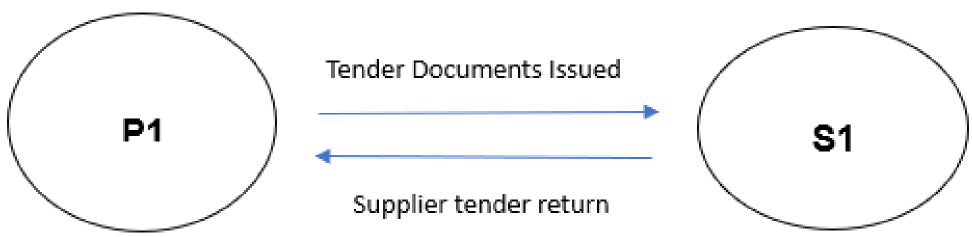
After sending out the email invites to participants, the participants contacted the author to request a time and date to hold the buyer telephone interview and supplier virtual meetings. The table 3.12 above provides a summary of those participants that responded to the author's invite to participate in the study.

The participant's identified in table 3.12 have been selected after investigating the RIU tender process and the author examining those tenders that have resulted in collaboration to create innovation. For clarity, each tender has a matching dyad of a buyer and supplier involved in the tendering process (Choi and Wu, 2009; Sundtoft Hald et al, 2009; Tanskanan and Aminoff, 2015). In the next section the author will illustrate each of the buyer and supplier dyads.

## 3.21 Study Buyer and Supplier Dyads

As each tender has a matching dyad of buyer and supplier involved in the tender process, where the buyer develops the specification and confirms the value-added factors required and the supplier completes a tender return, to meet the requirement of the buyer's specification. The author has illustrated each matched dyad pair, for each collaborative tender in the figures below. The author has added the context of the procurement, the buyer and supplier involved in the collaboration, details of the buyer telephone interview and supplier virtual meeting to provide a thicker description of the collaboration to make the findings transferable to another setting using the Lincoln and Guba (1985) naturalist framework.

**Figure 3.1 - Ultra Low Freezers (Buyer and Supplier Dyad)**




A telephone interview was held with the Medical Institute Building Operations Manager. The telephone interview lasted for around 1 hour and during the interview process to protect the anonymity of the participant, the Building

Operations Manager was code named, P1. During the telephone interview, the author asked the interview questions to P1. The author conducted the telephone interview from their home and the participant answered at their place of residence.

The Institute Building Operation Manager's role is to ensure that research and teaching labs are run to the standards required by the Health and Safety Legislation. To provide advice and guidance to other Principal Investigators (PI's) on the operation, purchase, and repair of all medical/scientific equipment within the Institute. This person is a technical adviser to the Institute and has a scientific background, as the manager originally used to teach lab techniques to undergraduate and postgraduate students. For this project, the Institute was working with the local NHS Trust to develop a new research and diagnostics building to treat rare medical diseases.

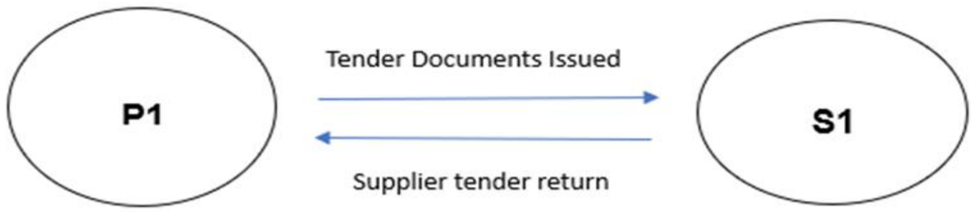
As part of the new building infrastructure, the Operations Manager was required to purchase multiple general lab equipment to fit out the new building. The main aim was to as P1 suggested "replicate existing facilities and equipment to one of our new research facilities". The scientific equipment purchased included, Biological Safety Cabinets, C02 Incubators, Ultra Low Freezers, a range of Bench Top Centrifuges, a range of peripheral equipment, Safety Based items (flammable storage cabinets) and Ultra and Cell Sorter Centrifuges.

Only the Ultra Low Freezers, CO2 Incubators and the Cell Sorter Centrifuges resulted in new software being created (via collaboration). The equipment had a range of costs, from low value equipment (£100 to £3,000) to capital equipment (100K to 180K). All the items purchased had to be delivered, installed, and commissioned before the end of July 2018, in preparation for the benefactors to officially open the building. P1's tenders are interlinked with S1 virtual meeting responses and supplier tender returns.

A virtual meeting was held with the Account Manager for the supplier that manufactures these products, the Account Manager governed the development and collaboration with P1. The virtual meeting lasted for around 1 hour and during the meeting process to protect the anonymity of the participant, the

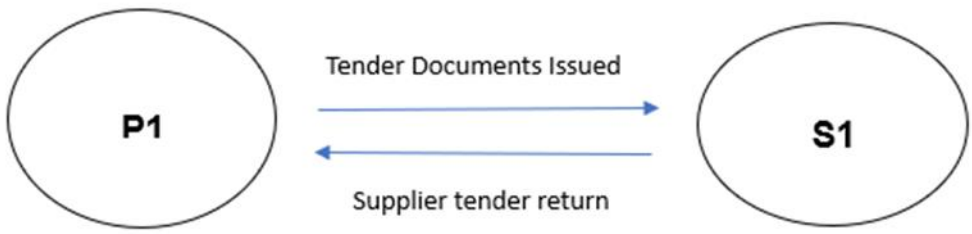
Account Manager was given code name S1. During the virtual meeting, the author asked the virtual meeting questions to the S1 participant. The author conducted the virtual meeting from their home and the participant answered at their place of residence.

**Figure 3.2 - Cell Sorter Centrifuges (Buyer and Supplier Dyad)**



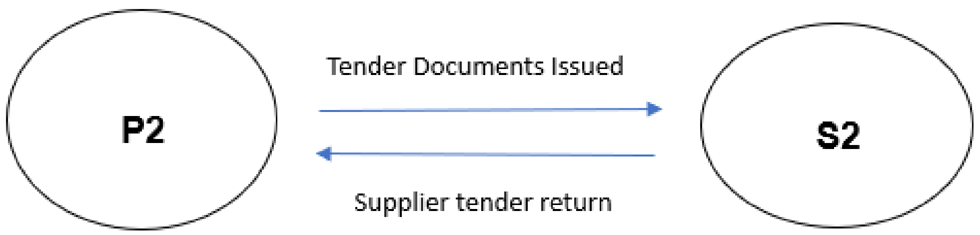

This is the second tender that resulted in a collaboration between P1 and S1, the Institute Building Operation Manager conducted this tender process at the same time as the tender for the Ultra Low Freezers tender.  The context of the procurement, buyer telephone interview and supplier virtual meeting are the same as figure 3.1 above.

**Figure 3.3 - CO2 Incubators (Buyer and Supplier Dyad)**



This is the third tender that resulted in a collaboration between P1 and S1, the Institute Building Operation Manager conducted this tender process at the same time as the tender for the Ultra Low Freezers and Cell Centrifuge tenders. The context of the procurement, buyer telephone interview and supplier virtual meeting are the same as figure 3.1 above.

**Figure 3.4 - A New Engineering Platform (Buyer and Supplier Dyad)**



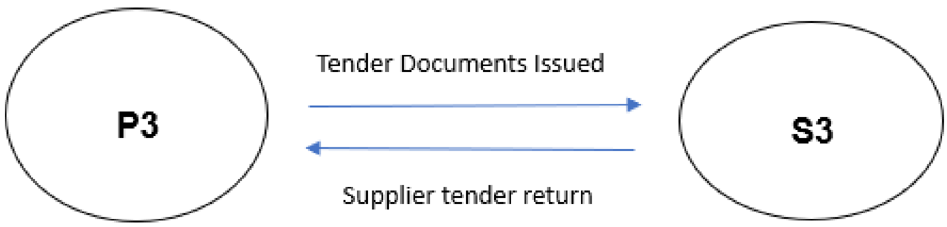

A telephone interview was held with the Principal Investigator (PI) who purchased a new platform system. The telephone interview with the buyer lasted for 1 hour, during the telephone interview, the buyer was referred to as P2. By using this code name, the buyer's anonymity was protected during the telephone interview. During the telephone interview, the author asked the interview questions to P2. The author conducted the telephone interview from their home and the participant answered at their place of residence.

As part of a 15-million-pound grant funded project from the Engineering and Physical Sciences and Research Council (EPSRC), one of the Engineering departments plan to purchase a new platform to develop a core facility to deepen the Principal Investigators (P1) knowledge of the interactions between pedestrians and their immediate environment. The platform allows for the physical reconfiguration on the surface of the platform to change surface material, topography, and disposition of lateral and vertical obstacles.

The platform has a variable lighting system that provides wide range lighting conditions and ambient sound system. This new platform complements the existing two other platforms used by this PI within engineering. Previous platforms have been used by researchers in Italy, France, Japan, Latin America, and the USA.

The new platform is designed to increase capacity to allow for public engagement and research. With the increase in the configurable floor, research can be divided into sections and have its own sound, lighting, and access, allowing multiple projects to run at the same time. Unfortunately, the author was unable to arrange a virtual meeting with S2 as they had left the employment of the platform manufacturer.

**Figure 3.5 – New MRI Scanner Software (Buyer and Supplier Dyad)**




A telephone interview was held with the Program Manager (who runs a shared service for other PI's) who purchased a new MRI scanner and upgrading replacement coils for existing machines. The telephone interview with the buyer lasted for 1 hour. During the telephone interview, the buyer was referred to as P3. By using this code name, the buyer's anonymity was protected during the telephone interview. During the telephone interview, the author asked the interview questions to P3. The author conducted the telephone interview from their home and the participant answered the questions from her medical school location within a hospital.

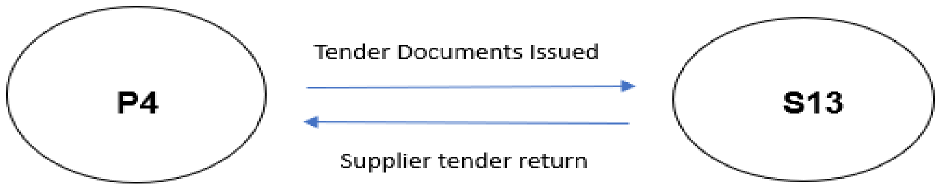
The new MRI scanner is used for both research and clinical work within both the University and Hospital setting, the coils have been used to upgrade existing MRI scanners within the department. P3 is not a natural born English speaker, the quotations used reflect the language used by the participant, even if the grammar is incorrect.

This procurement was part of an upgrade to a suite of MRI scanners which are managed and used by the different academic groups working on cancer treatment, clinical trials, and research. The cost of the MRI was 520K and the new MRI has been installed and used by several academic groups, this funding came from Cancer Research UK (CRUK). The aim of the equipment is to provide tailored planning, monitoring and control delivery of thermal therapy with real-time MRI visualization and temperature feedback. This new MRI designed offers a specific technique to identify and treat a specific cancer (which cannot be named as this would identify the supplier).

As part of the upgrade process a couple of magnetic coils for the existing MRI scanners have been installed within the facility. As part of the collaboration, the supplier wanted RIU to help provide information that would allow the supplier to continue to develop the new MRI scanner and help obtain a CE mark. The CE mark would allow the supplier to access the NHS market, as the NHS will not purchase MRI scanners unless they have been CE marked, as it is not authorised for diagnostic work. The PI confirmed that the supplier required support from the department to obtain the CE marking. However, new software was created from the collaboration, as this did not need a CE mark to be sold to other, HE buyers.

A virtual meeting was held with the Senior Clinical Scientist for the MRI equipment manufacturer, the supplier manufacturers different MRI scanners and supporting equipment, the supplier organized the development and collaboration with P3. The virtual meeting lasted for around 1 hour and during the meeting process to protect the anonymity of the participant, the Senior Clinical Scientist was given code name S3. During the virtual meeting, the author asked the questions to the S3 participant. The author conducted the virtual meeting from their home and the participant answered at their place of residence.

**Figure 3.6 - 3T MRI Scanner (Buyer and Supplier Dyad)**




This tender involved delivery, installation, and commission of a new 3T MRI into a building belonging to the University Faculty of Medicine. The budget for this new 3T MRI was estimated to be around 2.5 million and would provide additional capacity to conduct research and clinical diagnostic work on patients. This was a major procurement, as the PI had added into the specification documents that the “Successful implementation and operation of the proposed 3T scanner will be largely contingent upon the rapid implementation of the optimized techniques for data acquisition and analysis that have been developed by these (groups named) and above all by the physicists”.

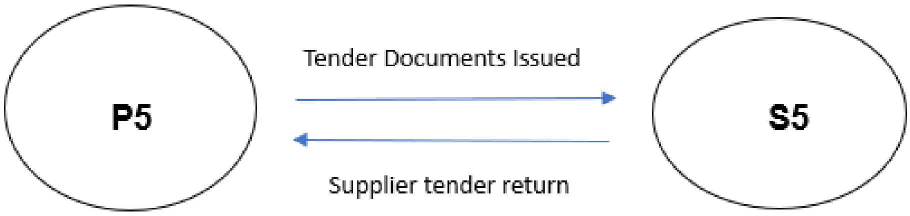
The winning bidder needs to “collaborate closely with the R&D scientists to improve imaging procedures and analytic techniques. These concerns require a high degree of software compatibility between existing scanners, and the scanner to be purchased and installed in the faculty of medicine. It is imperative that the pulse sequences and imaging techniques developed at the RIU be easily portable to the proposed scanner, and that the resident pulse sequences be modifiable by Group physicists without first having to engage in complicated and lengthy legal negotiations with the winning bidder”.

The PI was invited to arrange a telephone interview to investigate the reason for collaboration, what value added factors they considered important and what CSC factors lead to a successful collaboration. However, after provisionally agreeing to undertake a telephone interview, the author was unable to arrange an interview date with the PI involved in this project. S13, the supplier that was involved in this tender did provide a virtual meeting to discuss the project in more detail.

A virtual meeting was held with the Head of Imaging Sales for an MRI manufacturer, who had been the supplier lead in developing and managing the collaboration between Principal Investigators P4 and P13. The virtual meeting with the supplier lasted for 1 hour. As the Head of Imaging Sales was travelling between two different customers via train, the call was via a phone. An unfortunate side-effect of him travelling via train, was the audio recording for this virtual meeting was inaudible due to the noise of the trains.

As a back up to the audio recording of the virtual meeting with S13, the author had written hand notes on the virtual meeting schedule, the author used this information to write up the S13 data analysis. As the write up may not be accurate or information has been missed in the write up, a copy of S13's virtual meeting transcript was submitted for review to S13. The benefit of this approach is the participant can confirm if the quotations and information presented in the write up is factually accurate. During the virtual meeting, the supplier (Head of Imaging Sales) was referred to as S13. By using this code name, the supplier's anonymity was protected during the virtual meeting. During the virtual meeting, the author asked the virtual meeting questions to the S13 participant. The author conducted the virtual meeting from their home, which had no background noise.

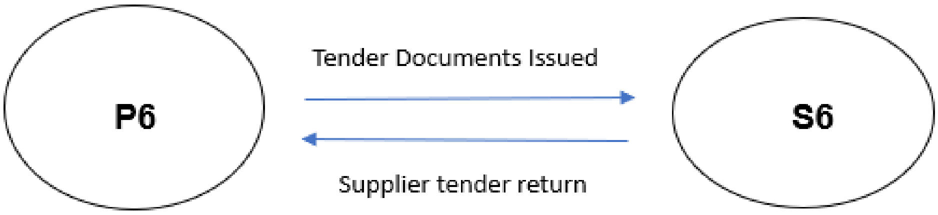
**Figure 3.7 - BEAM System (Buyer and Supplier Dyad)**




A telephone interview with the Principal Investigator (PI) who wished to purchase the BEAM system was completed. The telephone interview lasted for around 1 hour and during the interview process to protect the anonymity of the participant, the Principal Investigator (PI) was coded with the name P5. During the telephone interview, the author asked the interview questions to P5. The author conducted the telephone interview from their home and the participant answered at their place of residence. The BEAM system has been installed and is being used in day-to-day research and is used as a core facility, with other PI's using the equipment. P5 only speaks English as a second language, therefore some of the grammar and wording may be incorrect, as this is transcribed directly from the responses made during the telephone interview.

This tender involved the purchase of another BEAM system to increase capacity for research conducted by the Principal Investigator (PI) in the University Department of Engineering. The BEAM is an ultra-high-vacuum facility used to make compounds semiconductor materials with great precision and purity. The cost of this procurement was around 660K and was provided by a grant from the Engineering and Physical Sciences and Research Council (EPSRC). Unfortunately, the author was unable to arrange a virtual meeting with the supplier as the supplier's representative had retired from the scientific manufacturer and had originally manage the collaboration on behalf of the scientific manufacturer.

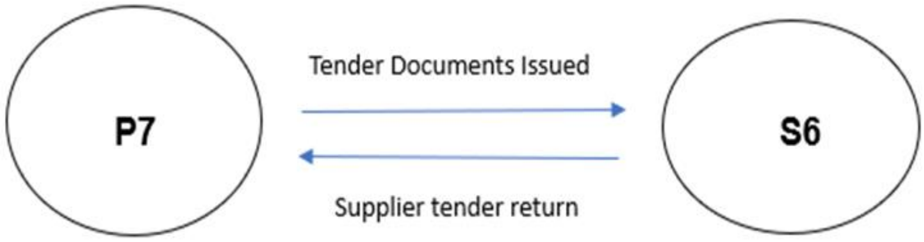
**Figure 3.8 -Two Confocal Microscopes (Buyer and Supplier Dyad)**




This tender involved delivery, installation, and commissioning of two confocal microscopes at a core facility at the RIU Medical Faculty. The facility offers internal microscope service to the rest of the university academics community, PI’s can send their sample to the facility for staff to image and analyse samples. The budget for these new two microscopes was estimated to be around 500K and would provide additional capacity to conduct research on samples. The funding for this facility is provided by the Medical Research Council (MRC). This was a minor procurement, as the PI (who is head of the facility), wanted a new software package that would improve the visibility of tissue cells.

The PI was invited to arrange a telephone interview, however, after sending the first reminder invite to participate in the study, the PI did not consent to take part in the study. However, the supplier S6 did respond to a request for a virtual meeting. The virtual meeting lasted for around 1 hour and during the meeting process to protect the anonymity of the participant, the Sales Manager was coded name S6. During the virtual meeting, the author asked the questions to the S6 participant. The author conducted the virtual meeting from their home and the participant answered at their place of residence. The supplier organised in developing and managing the collaboration between Principal Investigators P6 and P7.

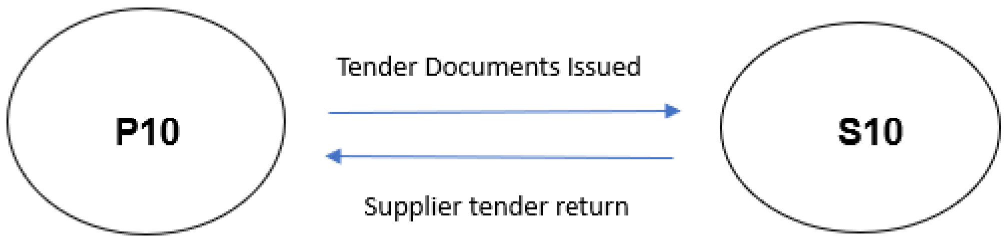
**Figure 3.9 - Inverted Confocal Microscope (Buyer and Supplier Dyad)**




This tender involved delivery, installation, and commissioning of an inverted confocal microscope belonging to a core facility (microscopy) to the University's Biosciences Faculty. The budget for this microscope was estimated to be around 400K and would provide additional capacity to conduct research on samples. The funding for this facility is provided by the UK Research and Innovation funder (UKRI). This was a major procurement, as the PI required new equipment functionality to conduct research into cell imaging.

The PI was invited to arrange a telephone interview, however, after sending the first reminder invite to participate in the study, the PI did not consent to take part in the study. However, the supplier did respond to a request for a virtual meeting, the virtual meeting was conducted in the same way as S6, as S6 provides various microscope models for clinical, research, teaching and has also collaborated with buyer P6.

**Figure 3.10 - Turnkey Super-Resolution Microscopy (Buyer and Supplier Dyad)**

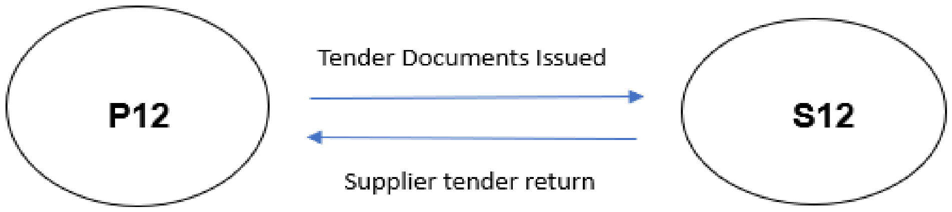



A telephone interview with the Principal Investigator (PI) who wished to purchase the Turnkey Super-Resolution Microscope was completed. The telephone interview lasted for around 1 hour and during the interview process to protect the anonymity of the participant, the Principal Investigator (PI) was coded name P10. During the telephone interview, the author asked the questions to the P10 participant. The author conducted the telephone interview from their home and the participant answered questions at their place of residence.

This tender involved delivery, installation, and commissioning of a Turnkey Super-Resolution Microscope for the PI in the Physics Department. The budget for this microscope was estimated to be around 258K and would provide additional capacity to conduct research on samples. The funding for this facility is provided by the Engineering and Physical Sciences Research Council (EPSRC). This was a major procurement, as the PI required new equipment functionality to conduct research into biology, biophysics, and biotechnology samples.

The supplier was invited to arrange a virtual meeting, however, after sending the first reminder invite to participate in the study, the supplier did not consent to take part in the study.

**Figure 3.11 - Raman Microscope (Buyer and Supplier Dyad)**

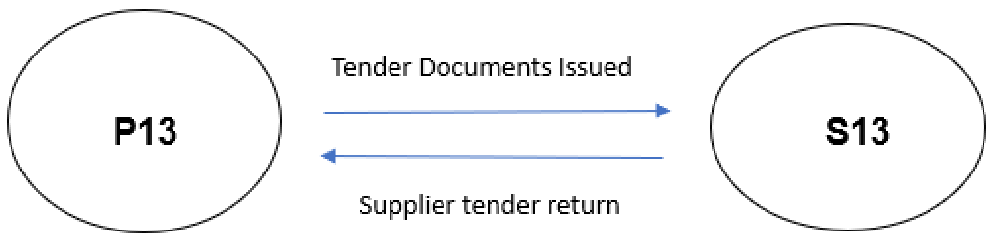



A telephone interview with the Principal Investigator (PI) who wished to purchase the Raman Microscope was completed. The telephone interview lasted for around 1 hour and during the interview process to protect the anonymity of the participant, the Principal Investigator (PI) was given code name P12. During the telephone interview, the author asked the interview questions to the P12 participant. The author conducted the telephone interview from their home and the participant answered at their place of residence.

This tender involved delivery, installation, and commissioning of a Raman Microscope for the PI in Medicine. The budget for this microscope was estimated to be around 350K and would provide additional capacity to conduct research on biological samples. The funding for this facility is provided by Biotechnology and Biological Sciences Research Council (BBSRC). This was a major procurement, as the PI required new equipment functionality to conduct research into cell biology and used as a shared facility with another PI in the department.

The supplier was invited to arrange a virtual meeting, however after provisionally agreeing to undertake a virtual meeting, the author was unable to arrange a virtual meeting date with the supplier.

**Figure 3.12 - Research MRI Scanner (Buyer and Supplier Dyad)**




A telephone interview was held with the PI who purchased a new Research MRI scanner and associated equipment. The telephone interview with the buyer lasted for 1 hour. During the telephone interview, the buyer was referred to as P13. By using this code name, the buyer’s anonymity was protected during the telephone interview. During the telephone Interview, the author asked the interview questions to the P13 participant. The author conducted the telephone interview from their home and the participant answered the questions from her medical school location within a hospital. The new MRI scanner is used for both research and clinical work within both the RIU and Hospital setting.

The purchased of a new MRI scanner was required to provide additional capacity to carry out research dedicated to brain imaging, with a particular focus on developmental, perceptual, and cognitive neuroscience. This is a shared facility that offers full body scans and other services to the hospital, other academics within the RIU and external academics from other universities. The tender required the supplier to undertake the building work to deliver, install and commission a new MRI scanner (and shield). The funding for the new MRI scanner came from the Welcome Trust to support a school within the Faculty of Medicine develop its MRI capabilities. The grant for the new MRI scanner was 7 million pounds.

In the tender specification document under “Collaboration” it stated that “The winning bidder will need to collaborate closely with the R&D scientists to improve imaging procedures and analytic techniques. These concerns require a high degree of software compatibility between existing facility scanners. It is imperative that the pulse sequences and imaging techniques developed at the facility be easily portable to the proposed scanner, and that the resident pulse sequences be modifiable by group physicists without first having to engage in complicated and lengthy legal negotiations with the Vendor”. This collaboration was major as it looks to enhance the equipment functionality and software capability.

A virtual meeting was held with the Head of Imaging Sales for an MRI scanner manufacturer. The virtual meeting with the supplier lasted for 1 hour. As the Head of Imaging Sales was travelling between two different customers via train, the call was on a phone. An unfortunate side-effect of him travelling via train, was the audio recording for this virtual meeting was inaudible due to the noise of the trains. As a back up to the audio recording of the virtual meeting with S13, the author had written hand notes on the virtual meeting schedule, the author used this information to write up the S13 audio transcript. As the write up may not be accurate or information has been missed in the write up, a copy of S13’s virtual meeting transcript was submitted for review to S13. The benefit of this approach is the participant can confirm if the quotations and information presented in the write up is factually accurate.

During the virtual meeting, the Head of Imaging Sales was referred to as S13. By using this code name, the supplier’s anonymity was protected during the virtual meeting. During the virtual meeting, the author asked the virtual meeting questions to S13. The author conducted the virtual meeting from their home which had no background noise. Finally, S13 organised the development and collaboration between Principal Investigators P4 and P13. Unfortunately, P4 did not participate in this study, therefore we cannot triangulate that data provided by the Head of Imaging with P4’s telephone interview transcript.

As the university procurement professional managing all the Science tendering processes had left the RIU to take up another role, the author was unable to apply triad diagrams (Choi and W, 2009; Sundtoft Hald et al, 2009; Tanskanan and Aminoff, 2015) for each procurement to show the relationship between the buyer, supplier and RIU procurement professional. Additionally, this limits the perspective on the important value-added and CSC factors involved in university-industry collaboration, as the procurement professional cannot give their viewpoint on the buyer-supplier interaction and tender outcomes.

## 3.22 Credibility, Transferability, Dependability and Confirmability

Within both quantitative and qualitive research there has been an increased focus by researchers on conducting research that is rigorous, methodical and produces results that are meaningful (Nowell et al, 2017). There are several different perspectives on what constitutes meaningful research, within the positivist and post-positivist perspective, the researcher aims to be objective and adopt neutrality when conducting a research study, within this paradigm the researcher uses quantitative techniques including generalization and precise statistics. At the other end of the spectrum, an interpretivist study, the research aims to identify participant’s perceptions, beliefs and feelings to a specific action or phenomenon.  To adopt this approach the researcher uses qualitative techniques including observing individual’s experiences and actions with different contexts (Amin et al, 2019).

Unfortunately, qualitative data analysis techniques have been reviewed by positivist researchers as being less rigorous and half-formulated art compared to conducting research using a positivist approach. As the quantitative concepts of reliability, validity, generalisability, and objectivity are deemed not appropriate measures in a qualitative research design, qualitive researchers are focused on establishing “trustworthiness” in their research (Sinkovics et al, 2008).

For this study, the author has employed Lincoln and Guba (1985) naturalist framework which offers an alternative to the positivist concept of reliability, validity, generalisability, and objectivity in their seminal work "Naturalistic Inquiry". According to Bowen (2008, p138) "Naturalistic inquiry is characterized by research in natural settings (rather than in laboratories), qualitative methods, purposive sampling, inductive analysis, a grounded theory approach, a case study reporting mode, the tentative application of findings, and special criteria of “trustworthiness". Within the naturalist perspective the researcher accepts that there are different and valid other alternatives to reality (Porter, 2007). Lincoln and Guba (1985) propose four main characteristics under a naturalist approach, that give rigor to qualitative research studies, these aspects are: credibility, transferability, dependability, and confirmability (Lincoln and Guba, 1985; Morse et al, 2002; Porter, 2007). By adopting these four characteristics in the research study, the researcher aims to demonstrate accuracy in the study's finding and convince external readers that the study is trustworthy. Next the author will discuss the principles of making research findings credible in the next paragraph.

### 3.22.1 Credibility in Qualitative Research

A characteristic of Lincoln Guba (1985) framework is credibility. Credibility is the equivalent to the positivist approach of internal validity, with qualitive studies credibility centred on the researcher's confidence that the research finds are accurate and truthful. Credibility is achieved through the researcher correctly interpreting the participants original point of view and participant data which leads to the research findings being believable (Anney, 2014; Lincoln and Guba, 1985; Korstjens and Moser, 2018; McInnes et al, 2017; Miyata and Kai, 2009: Morse et al, 2002; Shenton; 2003). There are several techniques that can be used that can increase the credibility of a qualitative study, these techniques are prolonged engagement and persistent observation, referential adequacy, member checking, triangulation, negative case analysis, thick contextual description, external audit/audit trail and reflexivity and transparency (Amin et al, 2019). However, depending on the research methods and type of data collected, some of the techniques may not be appropriate to use for all qualitative studies.

For this study negative case involvement has been adopted. Negative case analysis involves reviewing the existing analysed data and identify if any case (themes) is contradictory to the evidence in the data. If no negative case is confirmed then the analysis is considered complete and the boundaries of the phenomenon has been defined (Bowen, 2008; Lincoln and Guba, 1985;

Krefting; 1991). For this study, cases have been selected using tenders based on the buyer completing three sections in the tender specification documents entitled “Ongoing Development”, “Collaboration” and the “Goods Performance” which complies with Tyrrell’s (2015) innovation typology. Tyrrell (2015) defines innovations as; Minor innovation improved functionality in the equipment and Major innovation, equipment characteristics are significantly different compared with previously manufactured products. The supplier tender return was then analysed to investigate if the supplier submitted a response to the buyer sections in the specification document. These are tenders (cases) that have resulted in collaboration. Once the transcripts have been translated into summary of both buyer (telephone interviews) and supplier (virtual meeting) participant’s data has been checked against the individual audio recordings to confirm the data is correct and the author translation is accurate.

For this study member checking has been adopted. Membership checking involves getting the study participant to review the study data, data interpretation, coding systems and conclusions of the study, The benefit of adopting membership checking is that the data’s credibility is strengthened through this process (Amin et al, 2020; Guba and Lincoln, 1981; Lincoln and Guba, 1985; Porter, 2007). Once the transcripts for both the buyer (telephone interview) and supplier (virtual meeting) have been completed, they are returned to participants to comment on the data and study findings that have been interpreted from the audio recordings. Participants then make comments about the transcript summaries and study results, the author then reviewed the comments and made corrections (subject to complying with the ethics for this study).

Another approach is referential adequacy, this requires the author as Anney (2014, p277) comments to test “the analysis and interpretation against the documents that were used during data collection before producing the final document”. For this study, the author has double checked the secondary data, against the buyer (telephone interview) and supplier (virtual meeting) transcripts and audio recordings. Before forwarding the transcript summaries and study results to the participants for review. Additionally, this research study has adopted triangulation, triangulation offers the researcher credibility of the research findings, as triangulation offer conclusions that are more stable than from a single viewpoint (Guba and Lincoln, 1981). This study has adopted a triangulated approach to data collection and analysis which has been discussed in more details in paragraph 3.16.

For this study, thick contextual description has been adopted. Thick contextual data requires the researcher to describe the background to the phenomena, research setting, subjects and persons involved in the phenomena, research participant's quotes, and other data that have provided information for the researcher to transfer the findings to another context (Amin et al, 2020; Lincoln and Guba, 1985). One method of obtaining thick description, is to provide the participants experiences and attitudes (Bowen, 2008). For this study, the author has obtained a summary of the tender process, background to the university being studied, background for both buyer and supplier reasons for collaboration, participant's demographics and provided a detailed description of both buyer (telephone interview) and supplier (virtual meeting) transcripts. Thick contextual description can increase the transferability of the research findings. In the next paragraph the author, will discuss the requirements to make qualitative research findings transferable (to another setting) and dependable (the research findings are reliable).

### 3.22.2 Transferability, Dependability and Confirmability in Qualitative Research

Transferability is another characteristic of Lincoln and Guba's (1985) framework. Transferability is the equivalent to the positivist approach of generalization, transferability concerns how the qualitative research findings can be transferred to another setting or context with other participants. For the findings to be transferable the researcher needs to provide a thick description of the findings, so that other researchers can use their judgement to identify if these findings could be applied in another context or setting (Anney, 2014;

Lincoln and Guba, 1985; Korstjens and Moser, 2018; McInnes et al, 2017; Miyata and Kai, 2009: Morse et al, 2002; Shenton, 2003).

Another method for deciding if a study is trustworthy is undertaking an audit process (trail). An audit trail involves the researcher arranging for an external auditor to review the process of how the study has been carried out, this allows the auditor to confirm the dependability of the study (Amin et al, 2020; Lincoln and Guba, 1985). Dependability is another characteristic of Lincoln and Guba (1985) framework. Dependability is the equivalent to the positivist approach of reliability, within a qualitative study, dependability refers to the stability of the findings over time. Or that the research is conducted in a controlled and stable manner (Hamburg et al, 1994), by providing study readers with an audit trail of the research methods used to support the study's findings. Dependability can involve study participant's checking and making recommendations related to the study findings, so that they match the original data provided by the participant's during the data collection stage of the study (Anney, 2014; Lincoln and Guba, 1985; Korstjens and Moser, 2018; McInnes et al, 2017; Miyata and Kai, 2009: Morse et al, 2002; Shenton, 2003).

An external audit allows the researcher to increase the trustworthiness using confirmability. Within a qualitative study, confirmability refers to external researchers reviewing the study, examining the data and research findings, to confirm they are stem from the data (Anney, 2014; Lincoln and Guba, 1985; Korstjens and Moser, 2018; McInnes et al, 2017; Miyata and Kai, 2009: Morse et al, 2002; Shenton: 2003).

This is the final characteristics of Guba and Lincoln's 1985 framework. Confirmability is the equivalent to the positivist approach of objectivity. The author has provided an audit trail by providing copies of the buyer (telephone interview) and supplier (virtual meeting), questions schedule and audio recording (on the OneDrive). Plus, copies of the consent forms, participant information sheet, through to the findings and emerging theory to an external academic for review. The external academic has supported the author, by advising on inconsistences, missing information, and advice to strengthen the study. In the next paragraph the author discusses the importance of using transparency while conducting qualitative research and analysing the findings.

### 3.22.3 Transparency and Reflexivity in Qualitative Research

Although not part of the Lincoln and Guba (1985) framework. Applying a transparent approach will enhance the credibility for the study for the researcher. Being transparent in a study involved being honest about the research process and allow the author's peers to review all stages of study. By carrying out an audit of the study steps, the author can increase the transparency of the study (Amin et al, 2020). To make the study transparent, the author should disclose any challenges the author had during the research process. Identify any unexpected issues and how the author resolved these issues. Plus, any changes that have been made to the research methodology as the study progressed. Other factors to incorporate into a research study to make it more transparent is acknowledging participants, other authors, research assistants and any other support from colleagues (Tracy, 2010). For this study, the author has acknowledged participant's and support of colleagues for this research study. The author during the write up of this thesis has provided an audit trail of the documents and data that has been collected to support the findings. This allows external readers to make their own minds up on the transparency of this research study.

Again, not part of the Lincoln and Guba (1985) "trustworthy" framework. Implementing a reflexivity approach can improve the credibility of the research being conducted. Reflexivity requires the researcher to examine their own biases and motives for engaging in the study and if they are well suited to examine this specific topic at this point in time (Tracy, 2010). One method of achieving this is to keep a reflexive journal of the research process, which records the daily logic of the research design, mythological decision, and the researcher's insight, personal beliefs, and values (Amin et al, 2020; Nowell et al, 2017; McInnes et al, 2017; Lincoln and Guba, 1985). For this study, the author acknowledges that they bring to this study, an understanding of the UK

Higher Education Sector and knowledge of public sector procurement processes including tendering. However, the author does not know the reasons for collaboration for the specific tenders selected for study. During the study, the author has written a summary of decisions made, methodologies changed and the linkages between buyer and supplier tenders. This provides context and thick description (Amin et al, 2020; Lincoln and Guba, 1985) to enhance the trustworthiness of this study.

Unfortunately, the author was unable to adopt persistent observation and prolonged engagement for this study. Persistent observation refers to the elements or characteristics within the phenomena that are relevant to the problem and examine them in detail. In contrast prolonged engagement refers to the multiplate factors (contextual factors) that influence the phenomenon (Amin et al, 2020; Lincoln and Guba, 1985). As the tenders are based in a fixed point in time (in the past), we are unable to examine these factors, as not every tender resulted in collaboration between the buyer and supplier.

## 3.23 Summary of this Study's Research Design

### 3.23.1 Study Ontology and Epistemology

The author has employed a relativist perspective, as it allowed the author to examine university-industry collaboration through the perspectives of the buyer and supplier involved in the tender process (Liniluoto, et al, 2004). Additionally, by using relativism, the author explored the important value-added and CSC factors present in buyer (university) and supplier (firm) collaborations.

After exploring the epistemology options the author has employed a pragmatic philosophy, as relativist ontology complements pragmatism, as pragmatists, believe that human action is not separate to a person's actions or beliefs. The author employed pragmatism as it gives flexibility to adjust the supplier data collection tool, from online questionnaires which provided very limited data to online supplier virtual meetings, that offer richer, thicker textural data that will answer the study research questions, pragmatism allowed the author to undertake this change (Ellegaard and Koch, 2012; Ellram and Tate, 2015; Feilzer, 2010; Foerstl et al, 2010; Meehan et al, 2017; Matthyssesn et al, 2016; Shaw et al, 2010). Additionally, pragmatism allowed the author to develop theory to better inform practice (Goldkuhl, 2012), by using the findings the author constructed recommendations to make the tender process more conducive to collaboration. This balanced out the disadvantage of how long it can take to conduct the study using a pragmatic approach. By choosing relativism and pragmatism, the ontology and epistemology approaches have driven the research design for this study, which is qualitative in nature.

### 3.23.2 Adopting a Qualitative Research Design

As there are limited cases (tenders) the author used a qualitative design to explore participants concepts of the value-added and CSC factors through rich thick contextual description to identify the important factors in a successful university-industry collaboration (Bell et al, 2019; Cooper and Schindler, 1998; Eriksson and Kovalainen, 2008; Veal, 2005).

Additionally, a qualitative design allowed the author to refine the research questions during the study, to ensure the research questions are relevant to the study research objectives. As a qualitative design has been implemented by the author, this approach influences the data collection tools to answer the research questions, consequently, the author chose to use a pragmatic case study approach.

### 3.23.3 Sampling Framework - Purposive Sampling

As each case (tender) has a corresponding dyad of buyer and supplier that engaged in the tender process, and there is a limited number of tenders that have resulted in collaboration to create innovation, the author is unable to select any other sample selection process apart from purposive sampling. The author did not investigate buyers who had engaged in a purchase of equipment already on the external marketplace. Consequently, over 300 tenders were rejected from the sampling frame, as these tenders did not result in collaboration but a purchase of current market equipment.

The strength of purposive sampling is the author had flexibility to reject participants that do not conform to the study's parameters (Patton, 2002; Quinlan et al, 2018). The author instead focused on tenders that had resulted in collaboration and selected buyer participants from these tenders to undertake the study. The author selected the corresponding supplier through identifying the supplier's name within the tender award letter, as this is the supplier that was awarded the contract to engage in a collaboration with the buyer. Consequently, the sample size for this study is small and focuses on obtaining rich contextual descriptive data, through analysis of secondary and primary data. If the author wishes to generalise the findings, another option would have been to increase the sample size by holding telephone interviews with the PhD students and PI's research group to obtain their perspective on the value-added factors and CSC factors required to make the collaboration a success.

For these telephone interviews to be conducted, the author would use a snowball sampling process (Bell et al, 2019; Newby, 2010; Riley et al, 2000; Zikmund et al, 2013), where the buyer invited to the telephone interview provides the names of other buyers, research staff and PhD students that used the equipment during the collaboration. By triangulating this primary data from this different data source, the author could corroborate the findings, against the other data sets. Allowing the author, to confirm that no new themes are present in the value-added factors and CSC factors present in the collaboration, indicating the primary and secondary data had reached saturation point (Bryman, 2011; Glaser and Strauss,1967). For the author, this increases the credibility of the findings (Anney, 2014; Lincoln and Guba, 1985; Korstjens and Moser, 2018; McInnes et al, 2017; Miyata and Kai, 2009: Morse et al, 2002; Shenton; 2003).

However, as this study was conducted during the COVID-19 pandemic, accessing the buyer's research staff, other buyers, and PhD students to obtain primary data via telephone interviews may have been problematic, as the buyers that did not respond to the invite request, would provide the names of the research staff and PhD students to take part in primary data collection process.

### 3.23.4 Using a Pragmatic Case Study Approach

To complement the epistemology and ontology approaches chosen, the author employed a pragmatic case study design. The strength of using a pragmatic case study is the author was able to adjust the research questions to identify the buyer and supplier demographics (characteristics) influencing the value-added and CSC factors present in university-industry collaborations (Marks and Yardley, 2011). A pragmatic case study gave the author more flexibility in conducting the research study, as the author changed the supplier online questionnaire, due to the lack of rich data that was submitted back in the pilot study, to a virtual online meeting, which is similar to the buyer telephone interview, as these methods provide richer data to answer the research questions (Antoft and Houlberg Salomonsen, 2007; Hudon et al, 2021). Another strength was the author can examine multiple evidence sources that require the data to be analysed using a triangulated approach (Vela, 2005).

As this study, triangulates the data from the buyer specification document, supplier tender returns, buyer telephone interview responses, supplier virtual meeting responses, one research and development agreement, adopting another research design would not allow the author to examine value-added and CSC factors present in university-industry collaboration. However, a case study does not allow the findings to be generalised to a wider population or provide universal representation (Rahman, 2017; Veal, 2005). The author does not intend the study's findings to be widely generalised, however using Lincoln and Guba's (1985) transferability criteria using thick description, the author confirms the findings are transferable to another UK university and/or NHS Trust.

The quickest way for a university and/or NHS trust to obtain additional value from the supplier is to add the equipment value-added factors in table 6.2, (Chapter 6) into the specification template, which would not require a procedural change. However, as all NHS trusts and some universities are classed as contracting authority's and subject to PCR 2015 regulations, the contracting authority would need to operate an open procedure to conduct the tendering process to develop a collaboration with a supplier, as this is the quickest of the tenders. However, the contracting authority is unable to negotiate with the supplier, there is still a risk of legal challenge, and the timescale is longer than running a procurement under the study's tender process recommendations. Using a pragmatic case study, the author selected a UK Research-Intensive University (RIU) to examine 5-15 individual university science/engineering tenders (cases), awarded in the past 3 years. The case (tender) consists of the tendering documents including, the tender log, tender specification, invitation to tender document, marking sheet, tender award letters and any correspondence. After examining the cases, the author was able to identify the buyer and supplier involved in each specific tender, as using a pragmatic case study influences the selection process for examining the participants involved in the cases (tenders).

Conversely, the author examined the secondary data and triangulated (Vela, 2005) this data with the participant responses to corroborate the important value-added factors. The author discusses the examination of the secondary data in the next paragraph.

### 3.23.5 Reviewing Secondary Data and using Triangulation

To strengthen the study's credibility (Anney, 2014; Lincoln and Guba, 1985; Korstjens and Moser, 2018; McInnes et al, 2017; Miyata and Kai, 2009: Morse et al, 2002; Shenton; 2003), the author probed the secondary data for the context of the tender process and the potential reasons for buyer and supplier collaboration (Dwyer and Slyman, 2016; Pole and Lampard, 2002; Saunders et al, 2000). The secondary data provided the name of the participants (both buyer and supplier), the type of equipment that the collaboration has focused on and the value-added factors that have been provided by the supplier in their tender return. Without reviewing and analysing the secondary data, the author was unable to ascertain if the secondary data could answer the research questions and identify if any primary data collection was required to complete the gaps in the data.

The author has examined the secondary data to confirm if any buyer and supplier demographics (characteristics) influence the collaboration. Additionally, the author has examined the secondary data, to identify if any value-added and CSC factors are present in the tender specification, supplier tender return and supplier meeting minutes, explaining the reasons for the partnership and the critical success factors required to make university-industry collaborations successful.

Unfortunately, the secondary data did not hold any information that confirming if the buyer and supplier demographics had influenced the collaboration, nor any CSC factors to confirm which CSC factors are critical to the collaboration's success. Although, the tender specification and supplier tender return did indicate which value-added factors are present in university-industry collaboration. However, these may not be all the value-added factors present, therefore the author triangulated the value-added factors from the secondary data against the participant responses.

For this study, the author triangulated (Ghauri and Grønhaug, 2010; Jankowicz, 1995; Pole and Lampard. 2002; Saunders et al, 2000), the buyer and supplier responses in the primary data are summarized in the findings within Chapter 5, 6, 7 and 8. As part of the analysis, the author examined the secondary data, unfortunately, there was no information that supports the concept that both buyer and supplier demographics influenced the collaboration, nor the CSC factors that are required to make the collaboration a success. However, the secondary data from the tender specification and supplier tender returns, did verify the value-added factors that are present in university-industry collaboration. To confirm the findings, the author, triangulated the value-added factors identified in the secondary data against those identified in the participant responses. As the secondary data did not provide any evidence of the buyer and supplier demographics influencing the collaboration, nor the CSC factors that are required to make the collaboration a success, the author developed a buyer telephone interview and supplier virtual meeting (interview) to collect the data to answer the research questions.

### 3.23.5 Buyer Telephone Interview and Supplier Virtual Meeting

As the study's data collection stage was conducted during the COVID-19 pandemic and lockdown, all the primary data collection was conducted remotely, as it was not possible to meet individuals outside your house or bubble due to UK government legislation. The author used semi-structured interviews to access the buyer participant's personal demographics that had influenced the partnership, investigated the participant perspectives on the important value-added and CSC factors required for the collaboration to be a success (Farooq, 2015; May, 2011; Punch, 2005).

The buyer semi-structured interviews were conducted by telephone, as it removed any potential interview biased between the interviewer and interviewee (Zikmund et al, 2013), removed the risk of the interview being overheard by other people, the participant feeling uncomfortable, both interviewer and interviewee being interrupted and removes the potential risk to the author's safety (Pole and Lampard, 2002). Semi-structured interviews allow the author to go off schedule, then follow up participant's answers with new questions (Bell et al, 2019) by using probing questions, to confirm or ask clarification to a specific answer (Cavana et al, 2000). By using open-ended questions (Ekinci, 2015) during both the buyer telephone interview and supplier virtual meeting, the author explored the concept of value-added factors and what CSC factors are consider important when developing collaborations between buyer and supplier. The author used dichotomous questions to examine the participant's demographics and identify if these demographics have influenced the collaboration, influenced the value-added factors offered and CSC factors present in the partnership. (Bajpai, 2018; Clover and Balsley, 1984; Fraenkel and Wallen; 1993).

Originally, the author had intended to use online semi-structured questionnaires (Stoke and Wall, 2014; Adams and Cox, 2008) via survey monkey to collect the supplier participant responses. After undertaking a pilot study, the author redrafted the interview and questionnaire schedule, before starting the main phase of the data collection process (Stone, 1993). As the pilot study identified changes to the telephone interview and online questionnaire to clarify the wording, language, question layout and correct errors in the format (Berry et al, 2014; Collis and Hussey, 2003; Fitzpatrick. 1991; Hair et al, 2003; Riley et al, 2000; Veal, 2005). After sending out the invites to the online questionnaire (Adams and Cox, 2008; Stoke and Wall, 2014) and getting the first online questionnaire response back to review, it was clear that the data provided would not offer enough insight to answer the research questions. After discussion with the author's supervisory team, it was decided the data tool should change to online virtual meetings (interviews), this would allow for more richer data to be collected and comply with COVID-19 lockdown rules.

By using online virtual meetings, the author removed the problems of arranging a location and time to collect the supplier responses, online virtual meetings are very convenient for participants, there a no time limits for meeting length, participants had more time to respond to questions and it is easier to access supplier participants who are geographically dispersed around the globe and otherwise would be difficult to contact (Gruber et al, 2008: Quinlan, 2015; Roksana et al, 2014). Both the buyer telephone interview and supplier virtual meetings, lasted for around 1 hour, and the author recorded the participant responses using a voice recorder. The author also transcribed the responses on a blank telephone interview/ and supplier virtual meeting schedule. As the open-ended questions in the buyer telephone interview and supplier virtual meeting transcripts create rich data, the author used verbatim extracts to illustrate the participant's perspectives, as evidence and context to support the study's findings and a representation of all the participant's sentiments related to study themes (Brinkmann and Kvale, 2015; Gillham, 2005; Lingard, 2019, Thorne, 2020). After examining the participant transcripts, the author adopted abductive reasoning and thematic analysis to examine the themes present in the primary and secondary data sets.

### 3.23.6 Data Analysis - Abductive Reasoning and Thematic Analysis

Using abductive reasoning, the author collected primary data and explore university-industry collaboration by identifying the patterns in the participant demographic data, important value-added factors exchanged during the partnership and the important CSC factors present in the collaboration. The major advantage of abductive reasoning was the author created the new Mirco Triple Helix model based on themes identified in the data sets (Anderson et al, 2015). By using abductive reasoning, the author complemented the study' epistemology of pragmatism by using abductive reasoning for analysis and to develop new theory (Sans Pinillos, 2022).

Abductive reasoning is interlinked with thematic analysis, which aims to develop a framework for analysing patterns and themes in the data sets (Braun and Clarke, 2006; Mcneil and Chapman, 2005; Quinlan et al, 2018; Vaismoradi et al, 2013). After reviewing the secondary data consisting of each tender specification template, supplier tender returns and one R&D contract, the author contrasted the content with the literature on value-added and CSC success factors to develop a coding process for analysing the primary and secondary data. Table 3.8 in Chapter 3 provides a step-by-step process for coding and analysing the primary and secondary data sets.

Using the coding process stated in table 3.8, the author analysed each case (tender) and summarized all the cases (tenders) together to identify the common themes across the data sets. The author summarized similarities and differences between the participant demographic data, value-added and CSC factors to support the study's findings in Chapter 5, 6 and 7.

### 3.23.7 Participant Selection, Buyer and Supplier Dyad's, Participant Response Rates

In section 3.19 the author provided table 3.9, 3.10, 3.11, to explain the selection criteria for choosing the buyer and supplier participants and the rejection criteria for potential participants to the study. Each buyer and supplier participant are a matching dyad pair. In section 3.21 the author has summarized the buyer and supplier dyad's by providing the context of the procurement, the buyer and supplier involved in the collaboration, details of the buyer telephone interview and supplier virtual meeting to provide a thicker description of the collaboration to make the findings transferable to another setting using the Lincoln and Guba (1985) naturalist framework. A full breakdown of each tender and match dyad pair can be found in section 3.21.

As the data collection stage was conducted during the COVID-19 pandemic, several scientific equipment manufacturers either restructured their workforce or put their staff out to furlough. Consequently, several supplier participant's that had been involved in the tender process and formed the collaboration with the buyer had either retired or left the organization during the COVID-19 pandemic. Therefore, the author was unable to conduct telephone interviews with buyer participants P4, P6, P7, P8 and P11. In contrast, the author did not receive a response from supplier S2, S5, S8, S9, S10, S11 and S12 who had either left the organisation during covid or had retired.

### 3.23.8 Credibility, Transferability, Dependability and Confirmability

To ensure this study is rigorous, methodical and produces results that are meaningful (Nowell et al, 2017), the author has employed the Lincoln and Guba (1985) naturalist framework which offers an alternative to the positivist concept of reliability, validity, generalisation, and objectivity, by adopting a naturalistic approach to enhance "trustworthiness" in this study. (Sinkovics et al, 2008) through credibility, transferability, dependability, and confirmability.

Credibility is achieved by the author correctly interpreting the participants point of view within the primary data which leads to the study's findings being credible (Anney, 2014; Lincoln and Guba, 1985; Korstjens and Moser, 2018; McInnes et al, 2017; Miyata and Kai, 2009: Morse et al, 2002; Shenton; 2003). To enhance the study's credibility, the author employed negative case analysis, membership checking, thick description, triangulation, and referential adequacy. The author completed negative case checking by examining all the RIU scientific tenders and selected 15 tenders, that had resulted in collaboration. As part of the analysis, the author examined each of these cases, identifying which value-added factors had been exchanged between the partners during the collaboration. The author rejected cases (tenders) that has resulted in existing goods been purchased from the scientific equipment market. As the author did not find any new cases (tenders), except for the 15 tenders identified for study, the author concluded that the boundaries of university-industry collaboration had been defined (Bowen, 2008; Lincoln and Guba, 1985; Krefting; 1991).

The data's credibility was strengthened by the author employing membership checking (Amin et al, 2020; Guba and Lincoln, 1981; Lincoln and Guba, 1985; Porter, 2007) by the transcripts for both the buyer (telephone interview) and supplier (virtual meeting) being returned to participants to comment on the data and study findings that have been interpreted from the audio recordings. Participants made comments about the transcript summaries and study results, the author then reviewed the comments and made corrections (subject to complying with the ethics for this study). Additionally, the author used referential adequacy (Anney, 2014) by double checking the secondary data, against the buyer (telephone interview) and supplier (virtual meeting) transcripts and audio recordings. Before forwarding the transcript summaries and study results to the participants for review. By conducting membership checking and referential adequacy, the author indicates the study's findings are dependable (Anney, 2014; Lincoln and Guba, 1985; Korstjens and Moser, 2018; McInnes et al, 2017; Miyata and Kai, 2009: Morse et al, 2002; Shenton, 2003).

Another method for increasing the credibility of this study, was the author used thick contextual description of university-industry collaboration (Amin et al, 2020; Lincoln and Guba, 1985). By the author providing in the study, a summary of the tender process, background to the university being studied, background to each of tenders being analysed, the buyer and supplier reasons for collaboration, participant's demographics that influenced the value-added and CSC factors present in the collaboration and a detailed description of both buyer (telephone interview) and supplier (virtual meeting) transcripts. Thick contextual description can increase the transferability of the research findings. By using a thick contextual description of university-industry collaboration, the author has provided readers the methods to transfer the findings to another setting or context (Anney, 2014; Lincoln and Guba, 1985; Korstjens and Moser, 2018; McInnes et al, 2017; Miyata and Kai, 2009: Morse et al, 2002; Shenton, 2003). By providing a breakdown of the research methods used for this study, the author has ensured that the study has dependability, and the findings are stable over time (Anney, 2014; Lincoln and Guba, 1985; Korstjens and Moser, 2018; McInnes et al, 2017; Miyata and Kai, 2009: Morse et al, 2002; Shenton, 2003).

To ensure the study's confirmability the author kept an audit trail by providing copies of the buyer (telephone interview) and supplier (virtual meeting), questions schedule and audio recordings (on the OneDrive). Plus, copies of the consent forms, participant information sheet, through to the findings and emerging theory to an external academic undertaking a final review. The external academic has supported the author, by advising on inconsistences, missing information, and advice to strengthen the study.

### 3.23.9 Transparency and Reflexivity in Qualitative Research

Although not part of the Lincoln and Guba (1985) framework, to increase the "trustworthiness" of this study, the author has used transparency and reflexibility when conducting this study. Transparency (Amin et al, 2020, Tracy, 2010) involves the author acknowledging participant's and colleagues support during the study process. The author provides an audit trail of the documents, data and findings allowing external readers to make their own minds up on the transparency of this study. Alternatively, reflexibility focuses on the author's personal bias during the study process (Tracy, 2010), the author acknowledges she has knowledge of HE Sector operation, PCR 2015 regulations and public procurement tender processes. However, the author does not know the reasons for collaboration for the specific tenders selected for study. During the study, the author has written a summary of decisions made, methodologies changed and the linkages between buyer and supplier tenders. This provides thick contextual description to enhance the trustworthiness of this study (Amin et al, 2020; Lincoln and Guba, 1985). Finally, the author chose this research design as if would offer flexibility to adjust the study design and research questions as the study unfolded.

The author examines in Chapter 4, the study's research ethics and the author's decision to ensure that participants are not harm during the data collection, analysis and write up phase of this study. Chapter 4 concludes with a discussion on the ethical considerations, problems and processes adopted to make sure the research study complies with principles of confidentiality, anonymity, and informed consent.

# Chapter 4: Ethical Considerations and Data Management Plan

## 4.1 Defining Ethics and Avoiding Harm

A core principle of conducting research is that the research activity is carried out in an ethical way (Dawson, 2013). Ethics can be defined as the norm and standards of behaviour that people (including researchers) adopt to guide moral choices about our behaviour and our relationships with others (Cooper and Schinder, 1998). The most important principle within ethics is that the researcher or research study aims to ensure that no one is harmed during the study or harm is minimized (Cooper and Schindler, 1998; Hennink et al, 2011; Saunders et al, 2000).

Harm can be defined as both physical, emotional (psychological), social, economic and include making study participants feel ashamed, embarrassed, and how an individual feels or is treated by those in the community via social media (Berg, 2009; Hair et al, 2003; Hennink et al, 2011). Other forms of harm can include wasting the time of the participants, wasting scarce resources, breaking of confidentiality, causing distress and offence, failing to publish the results, or producing a publication that casts an individual, group, or organisation in a bad light (Berg, 2009; Collis and Hussey, 2003; Hennink et al, 2011; Zikmund et al, 2013). Another core principle of conducting ethical research is the study is free of deception.

## 4.2 Adopting Informed Consent

This study aims to ensure no one is harmed during the study, by adopting an “informed consent” approach were participants involved in the research process know they are being researched, the nature of that research and how they can withdraw from the research process at any time (Collis and Hussey, 2003; Saunders et al, 2000; Silverman, 2011). Informed consent according to May (2011, p60) “refers to a freely given agreement on the part of the researched to become a subject of the research process. However, this is not only based on a complete understanding of the aims and processes of the research itself, but also may assume to encompass any consequences that follow from its publication in the public domain”. Informed consent normally cannot take place until the study has been ethically approved, at which point the researcher may start the data collection process and gain consent from the participant to take part.

The concept of informed consent implies that the participant is a capable adult (in the UK, this is an individual that is over the age of 16), that is not mentally incapacitated to be unable to understand the research study’s aims fully to participate (Kvale, 2007; Ray et al, 2016). However, can consent really be informed, as vulnerable groups like the elderly or children may feel pressured to take part in a research study and feel they are unable to with-draw from the research process (Letherby and Bywaters, 2007; Kavle, 2007). Consequently, the Society for Research into children has developed a specific set of guidelines to deal with child participants, a copy of these can be found in Appendix 7 (Salkind, 2012). Another consideration with informed consent, is what information should the researcher give to potential participants? As there is a fine line between over-information and providing information that is relevant to the participants (Kvale, 2007). For this study, participants are over the age of 16 and are likely to be mentally competent as the work they undertake day-to-day is technical in nature. As part of the ethical approval process at the University of Worcester, a summary of the study aims, and objectives have been given to potential participants in a study information sheet.

For the university academic buyer that are involved in a specific tender, the buyer has been contacted first by email and asked if they wish to take part in the study. The email invite included a copy of the University of Worcester’s Participant Information Sheet explaining the reasons for the research and how the participant can withdraw from the study (see Appendix 5). Further, a link to the Buyer Consent Form, has been provided in the email invite, which was hosted on the University of Worcester OneDrive, which is password protected. If the buyer wishes to take part in the study, the buyer needs to click on the link and agree to the statements included in the Buyer Consent Form and sign the form off to take part in the study. Each link leads to an individual consent form created for each of the participants. All the signed consent forms were stored on a password protected OneDrive folder. The researcher arranged a telephone interview with those participants who agreed to take part in the research and have completed a consent form. Although the telephone interview asked participants to suggest a suitable time and date to undertake a telephone interview, this study aims to offer the telephone interview between 8.30 am and 5.30 pm Monday to Friday. It is anticipated that the telephone interviews take around 1 hour to complete with participants.

Consent to take part in the study from the supplier (identified in the tender return), was obtained through sending an email invite with a copy of the University of Worcester's Participant Information Sheet explaining the reasons for the research and how the participant can withdraw from the study (see Appendix 6). Further, a link to the Supplier Consent Form, was provided in the email invite, which was hosted on the University of Worcester OneDrive, which is password protected.  If the supplier wishes to take part in the study, the supplier needs to click on the link and agree to the statements included in the Supplier Consent Form to take part in the study. Each link leads to an individual consent form created for each of the participants. All the signed consent forms have been stored on the password protected OneDrive folder. If the participants wish to take part in the study, the email has an embedded link to the online questionnaire that the participant can complete at their leisure.

The supplier has a reminder on the landing page of the questionnaire that they can withdraw 14 days after completing the online questionnaire and the process for the participant to withdraw from the study completely. As suppliers maybe out in the field working during the working week, the online questionnaire allows the supplier freedom to complete the questionnaire round this schedule. The online questionnaire was available to participants online 24 hours during the data collection process and take around 30 minutes to complete. It has taken around 3 months to complete the buyer telephone interviews and online supplier questionnaires. By adopting these data collection tools, the risk to the personal safety of the researcher undertaking this study is minimal, as the researcher does not need to leave their office or home to undertake the interviews directly with participants.

From a participant's point of view, the right to withdraw needs to be differentiated between the data-collection part of the study and withdrawing from the study completely (Sullivan and Forrester, 2019). In the consent form participants need to be aware they can withdraw from the process at any time without any consequences or without explaining their decision. To make the withdraw process clear to potential participant's the following should be stated in the information sheet and be referred to in the consent form:

1) The participant will email the researcher Linda Tyrrell at TYRL1_17@uni.worc.ac.uk asking to withdraw from the study.

2) Participants do not need to give a reason for withdrawing from the study. However, the participant should state their code number which will allow the study office to identify the participant's telephone interview transcript, online questionnaire, consent form, tender log details and audio recording.

3) The study office will then delete any telephone interview, online questionnaire, consent forms and any audio recording (deleted from the recording device), within 14 days of receiving the request.

At some point in the study there is normally a point where it is no longer possible for a participant's data to be withdrawn entirely from the study (Sullivan and Forrester, 2019). Guidelines needs to be provided to the participants on the point when the data has been anonymised and amalgamated and cannot then be excluded. The participants consent form should give a date after which participants can no longer withdraw consent or ask for data to be destroyed. For this study, the point where participants no longer can withdraw from the study, is during the final write up of the thesis and when the thesis has been submitted for publication.

A copy of the consent form for the buyer telephone interview can be found in Appendix 3 and the supplier virtual meeting consent form in Appendix 4. The buyer participant information sheet form can be found in Appendix 5 and the supplier information sheet in Appendix 6.

## 4.3 Participant Confidentiality and Anonymity

One of the biggest challenges in qualitative research is ensuring confidentiality and anonymity to participants. Confidentiality can be defined as protecting the identity of those providing the research data and not reporting this information (Braun and Clarke, 2013; Kvale, 2007; Mann and Stewart, 2000; Mcneill and Chapman, 2005; O'Leary, 2010; Pole and Lampard, 2002; Saunders et al, 2000). For the researcher, this means giving potential organisations and individuals reassurances of confidentiality to gain their co-operation to take part in the study, as this is likely to create trust between the participant and researcher increasing the reliability of the data provided for the study (De Vaus, 2020; Mcneill and Chapman, 2005: Riley et al, 2000). One method of reassuring either the organisation or participant that their identity was kept confidential is to offer them a copy of the data obtained for review. The researcher can also offer a copy of the main study results or provide a short meeting to discuss the results with participants (Eriksson and Kovalainen, 2008).

Anonymity refers to protecting the participant's identity during the study (Collis and Hussey, 2003; Frey and Oishi, 1995; Saunders et al, 2000; Riley et al, 2000). Adopting anonymity in a research study has several implications, firstly removing any quotes of information from the telephone transcripts that provide a clue to the identity of the participant. Nor writing the name of the participant on any data files or telephone interview audio recordings. If names are used, they should be replaced with identification number or pseudonyms and stored away in a secure location like a safe. When writing up the report of the research findings, the researcher must be careful not to describe the findings that identify a participant (Brinkmann and Kvale, 2015; Hennink et al, 2011; Mann and Stewart, 2000).

At the start of the data collection stage, the buyer names identified in the tender log has been allocated with an identifying number to link the buyer with the telephone interview transcript (Sullivan and Forrester, 2019). To keep the buyer identity confidential, the buyer was referred to using the code number P1 onwards for each buyer for each telephone interview. During the telephone interview to protect the anonymity of the participants taking part, the buyer has been advised before the start of the telephone interview that they are referred to by this code throughout the telephone interview. During the telephone interview analysis and thesis write up any quotes used refer to the buyer's identification code, to keep the buyer's identity anonymous.

As the online supplier questionnaire is being administered via survey monkey, the supplier and buyer number with be linked together for example supplier S1 questionnaire has a linked to P1 buyer telephone interview. This unique identify number was provided on any supplier transcripts downloaded from the data base. This may cause problem triangulating the data between the buyer telephone interview and the supplier online questionnaire. Using the tender log, the supplier was issued with a code number S1 onwards for each supplier for each online questionnaire. In the email invite to the supplier, they have been asked to quote this code when completing the online survey.

There are no safety risks for the author during this study, as the author does not have direct physical contact with the participants. There are no safety risks for participants, only a potential risk in protecting their anonymity when participating in the study. If the author refers to both the buyer and supplier participants using their code names during the data collection, transcript write up, data analysis, thesis write up and final journal publication. The anonymity of participants taking part in this study with ensure that no participants suffer physical, practical, psychological, and emotional consequences of this study. As part of the transcript write up process for the buyer, the recorded telephone interview has been transcribed using dragon software. By using computer aided software that automatically transcribes voice recording into MP3 files, the author can save time and remove errors created by manual transcribing recordings (Matheson, 2007). Once the buyer telephone interview has been transcribed using Dragon, any copies of the original audio file and MP3 files on the computer are deleted.

To keep the data confidential, all data collected has been stored on the University of Worcester OneDrive until the study has been completed and the thesis has been published. After which point any electronic copies of the buyer telephone interview transcripts, online questionnaire transcripts and participant consent forms has been deleted from the University of Worcester OneDrive. The physical copy of the tender log, that has been stored in a safe has been shredded.

Any audio recording on the buyer’s telephone interviews (MP3 files) stored on the University of Worcester OneDrive has been deleted. Any email correspondence from both buyer and supplier has been deleted from the University of Worcester email account. As the study is based in the past and is designed to improve the tender process to make it more conducive to developing new products. There are no confidentiality issues that would affect the reputations of both RIU and the suppliers taking part in this study.

## 4.4 Using Incentives in Research

Although most data collection tools, like interviews, surveys and questionnaires cannot offer direct benefits to participants, there has been a trend for marketing research companies to off a small incentive to take part in a study including money, gifts, lottery chances, reports of the study, newsletters to the survey organisations and contributions to charity (Groves, 1989; Hanson et al, 2012). Within research ethics there has been much debate between researchers on giving incentives to participants if the risk of harm is minimal to encourage more individuals to partake in research studies (Sullian and Forrester, 2019; Zutlevics, 2016).

Within medical research, it has become common practice to offer incentives, however, in matters related to transplant organs, transfusion blood and the creation of blood related products, there has been controversy over using incentives (Grant and Sugarman, 2004). As using incentives to get participants to participate in a study, leaves the researcher unsure if it was the incentive that coerced the participant to join the study (Bentley and Thacker, 2004; Halpern et al, 2009). For this study, the author has not used incentives to persuade participants to join this study. The author has persuaded potential participants of the future benefits of collaboration between academic buyer and scientific manufacturers by taking part in this research.

## 4.5 Ethical approval application

Before starting the data collection stage of this research study, ethical approval (including GDPR requirements) was obtained from the University of Worcester's (UoW) ethics committee, as this research focuses on confidential university documents, academics, and supplier participants within RIU. The ethical application for this study includes copies of the documents used to inform participants of the study, these include information sheets, consent forms, academic buyer telephone interview and supplier virtual meeting schedule. Only documents that have had ethical approval may be used for data collection.

Within research the role of the gate keeper has been identified as an individual or institution that has the power to grant or withhold access to a specific research population and/or secondary data (Crow Hurst and Kennedy-Malfoy; 2013; Wanat: 2008; Sigh and Wassenaar, 2016). A criticism of the gatekeeper's role is this individual or organisation may give access to the research population, but it is up to the participants to decide if they wish to take part in the study.

Before undertaking a literature review to developing a hypothesis to conceptualise into a research proposal, the author contacted the University

Director of Procurement to obtain some advice on the procurement tender process. After an initial telephone discussion with the University Procurement Director, the author was granted access to the University Procurement Department to review several Scientific and Engineering tenders. After reviewing over 300 tenders and supporting documents with the University Director of Procurement. The author identified several tenders that may have led to collaboration between an academic and scientific equipment manufacturer.

Due to the confidential nature of the tender documents, the author was unable to take any photocopies or photos of the tender documents away from the University Procurement Department. Instead, the University Director of Procurement provided the author with a copy of the tender log, which identifies the equipment type purchased, name and contact details of the buyer and winning supplier for this specific tender. To protect the anonymity of potential participants, the copy of the tender log is stored in a locked safe. After the study has been completed and the thesis published the tender log has been destroyed (shredded).

The University Director of Procurement has provided a letter confirming access to the site to start the next stage of the study, including the telephone interviews and an online questionnaire for those stakeholders involved in the specific tenders identified in the tender log.

## 4.6 Storage and Management of Data

The online supplier questionnaire is managed, coded, stored and responses anonymised using Survey Monkey. Access to Survey Monkey is restricted to Linda Tyrrell, downloaded data for analysis can be converted into a transcript and stored on the University of Worcester OneDrive (which is password protected) along with the buyers’ telephone interviews transcripts, and participant consent form. The tender log contract details which are in paper is stored in a locked safe (Collis and Hussey, 2003).

The audio recordings of the buyer telephone interviews have been converted into an MP3 file and uploaded to the University of Worcester OneDrive. The original audio recordings of the telephone interviews on the recording equipment have been deleted from the device. This should remove the risk of the data being stolen and the author failing to provide a duty of care to the participants.

Once the study has been completed and the thesis has been published, any buyer telephone interview transcripts, participants consent forms and personal information stored on the University of Worcester OneDrive have been deleted. Any audio recordings (MP3 files) of the buyer telephone interviews on the University of Worcester OneDrive are deleted. Any participant email correspondence is deleted from the Worcester University email account. Any buyer personal information in the tender logs has been shredded.

For the supplier, questionnaire transcripts stored on the University of Worcester OneDrive has been deleted. Any data stored within the Survey Monkey database has been deleted and the account closed. Any supplier personal information in the tender log has been shredded.

## 4.7 Change to Ethical Approach – Supplier Online Virtual Meetings (Interviews)

After sending out the invites to the online questionnaire and getting the first online questionnaire response back to review, it was clear that the data provided would not offer enough insight to answer the research questions. After discussion with the author’s supervisory team, it was decided the data tool should change to online virtual meetings (interviews), this would allow for more richer data to be collected. While removing the risk of participant and author contracting COVID-19 through a face-to-face interview. After seeking ethical approval from the University of Worcester Ethical Committee to change the data collection tool from online questionnaire to online virtual meeting (interviews) for supplier participants. The next steps were to run the online virtual meetings (interviews) with supplier participants.

Although the new online virtual meetings (interview schedule) are based on the principles of causing no harms to the participants in section 4.1 (above). The change in data collection tool has implication for the ethical approval process for this study, how the supplier consent forms are collected, changes to the study participant information sheet, participant's confidentiality, anonymity and storage and data management processes.

As the supplier data collection tool for has changed from online questionnaire administered via survey monkey to online virtual meetings (interviews). The first step was to download the one online questionnaire that had been collected and delete the survey monkey account. The next steps were to change the participant information sheet and consent form to reflect the change to online virtual meetings (interviews).

For the most part the collection of the consent form remains the same. The supplier participant (identified in the tender return) consent was obtained through sending an email invite with a copy of the University of Worcester's Participant Information Sheet explaining the reasons for the research and how the participant can withdraw from the study (see Participant Information Sheet). Further, a link to the Supplier Consent Form, was provided in the email invite, which was hosted on the University of Worcester OneDrive, which is password protected. If the supplier wishes to take part in the study, the supplier needs to click on the link and agree to the statements included in the Supplier Consent Form to take part in the study. Each link leads to an individual consent form created for each of the participants. All the signed consent forms were stored on the password protected University of Worcester, OneDrive.

However, the author now arranged an online virtual meeting (interview) with those participants who agreed to take part in the research and have completed a consent form. Although the online virtual meeting asked participants to suggest a suitable time and date to undertake an online meeting, this study aims to offer the virtual meeting between 8.30 am and 5.30 pm Monday to Friday. It is anticipated that the online meeting takes around 1 hour to complete with participants. The withdraw process for supplier participants remains the same as the buyer participants.

During the online meeting (interview) to protect the anonymity of the participant during the interview, the supplier's name identified in the tender log is allocated with an identifying number to link the supplier participant with the virtual meeting transcript (Sullivan and Forrester, 2019). To keep the supplier's identity anonymised, the supplier is referred to using the code number S1 onwards for each supplier for each virtual meeting (interview). During the virtual meeting (interview) to protect the anonymity of the participants taking part, the supplier has been advised before the start of the virtual meeting (interview) that they are referred to by this code throughout the virtual meeting. During the virtual meeting (interview) transcript write up and thesis write up any quotes used refer to the supplier's identification code to keep the supplier identity anonymous.

As there is no direct physical contact between the author and participant's therefore there is no potential safety risk for either party. The only risk to participant's is protecting their anonymity during the study, if the author refers to the participant using the code names during the data collection, transcript write up, data analysis, thesis write up and final journal publication, this risk is removed.

An audio recording of the supplier virtual meetings (interview) has been taped. The audio recordings of the supplier virtual meeting were converted into an MP3 file and uploaded to the University of Worcester OneDrive. The original audio recording of the virtual meeting on the recording equipment has been deleted from the device. This should remove the risk of the data being stolen and the author failing to provide a duty of care to the participants.

Once the study has been completed and the thesis has been published, any supplier virtual meeting transcripts, participants consent forms and personal information stored on the University of Worcester OneDrive was deleted. Any audio recordings (MP3 files) of the supplier virtual meetings (interviews) on the

University of Worcester OneDrive has been deleted. Any participant email correspondence has been deleted from the Worcester University email account. Any supplier personal information in the tender logs is shredded. This process is identical to the buyer telephone interview process.

The next chapter focuses on the data analysis and findings from the tender specification, supplier tender returns, one research contract and the participant responses from the buyer telephone interview and supplier virtual meeting questions. Chapter 5 explores the buyer and supplier characteristics that influences the value-added and CSC factors present in university-industry collaboration and provides new theoretical models. Chapter 6 identifies the important value-added factors present in university-industry collaborations and provides new theoretical models. Chapter 7, identifies and examines the important CSC factors present in university-industry collaboration, those CSC factors not required for university-industry collaboration and provides new theoretical models.

# Chapter 5: Buyer and Supplier Characteristics Impacting on Value-Added and CSC Factors

## 5.1 Introduction

This chapter provides the data analysis and findings from the characteristics (demographics) section of the buyer telephone interview and supplier virtual meeting questions. As a qualitative approach has been adopted for this research study on university-industry collaboration, the author has reflected on the participant's characteristics as these are likely to have influenced data collection, value-added and CSC factors being investigated in this research study.

## 5.2 Buyer Demographics – Data Analysis and Findings

A quantitative table 5.1 below, has been adopted to provide a summary of the buyer participant responses to the demographic questions in the buyer telephone interviews. Although this type of quantitative table, aims to provide sample representation, the ability to generalise, replicate and detecting bias (Morse, 2008), for this qualitative study, this table, has been used to illustrate the common characteristics of the participant population being investigated (Quinlan et al, 2018). To protect the anonymity of the buyer (Collis and Hussey, 2003; Frey and Oishi, 1995; Saunders et al, 2000; Riley et al, 2000), the author has used the buyer reference code identified in the telephone interviews, to construct the table below. If any of the verbatim quotes contain the buyer's name, supplier name or equipment models that can be identified with the participant's these will be modified to buyer code, supplier code and scientific equipment to protect the anonymity of study participants.

During the writing up, data analysis, and findings in Chapters 5, 6, 7 and 8, the author has used thematic analysis, a method of identifying, analysing, and reporting patterns (themes) within data (Braun and Clarke, 2006; Mcneil and

Chapman. 2005; Quinlan et al, 2018; Vaismoradi et al, 2013) these themes have been cross reference to identify if the impact on the study's value-added and CSC factors against the supplier virtual meeting responses. Table 5.1 provides a summary of the buyer's characteristics (demographics).

**Table 5.1 Buyer Characteristics (Demographics) Summary**

| Participant No and Demographic | P1 | P2 | P3 | P5 | P10 | P12 | P13 |
|---|---|---|---|---|---|---|---|
| **Age** | 55-64 Years | 65-74 Years | 35-44 Years | 45-54 Years | 45-54 Years | 55-62 Years | 35-44 Years |
| **Faculty/ Division** | Med | Eng. | Med | Eng. | Physics | Life | Med/ Life |
| **Role** | Building Ops Manager | Prof | Program Manager | Prof | Prof | Prof | Prof |
| **Qualification Level** | BSc Hons | PhD | PhD | PhD | PhD | PhD | PhD |
| **Gender** | Male | Male | Female | Male | Male | Male | Female |
| **Scientific Equipment Funder** | NHS | EPSRC | CRUK | EPSRC | EPSRC | BBSRC | Wel |
| **Funding Level (£)** | 180K 72K 120K | 15 million | 1 million | 600K | 258K | 350K | 7 million |
| **Scientific Equipment Use** | Res /Core | Teach/ Res/ Coll | Res /Core | Res /Core | Res | Res /Core | Res /Core |
| **Teaching Activity** | No | Yes | Yes | Yes | Yes | Yes | Yes |
| **PhD Supervision** | No | Yes | No | Yes | Yes | Yes | Yes |
| **Journal Publications** | No | Over 100 | Under 10 | Over 100 | Over 75 | Over 50 | Over 50 |
| **Book Publications** | No | 3 | No | 5 | No | No | No |
| **Conference Publications** | No | Yes | Yes | Yes | Yes | Yes | Yes |
| **Supplier Relationship Years** | 25+ years | 17 Years | 2 years | 15 years | 0 years | 4 years | 12 years |
| **Innovation type** | Minor | Major | Minor | Major | Major | Major | Major |

Key: BSc Hons: Bachelor of Science with Honours, BBSRC: Biotechnology and Biological Sciences Research Council, Core: Core Facilities, Coll: Collaboration, CRUK: Cancer Research United Kingdom, Eng: Engineering, EPSRC:

Engineering and Physical Sciences Research Council, Life: Life Sciences, Med: Medicine, NHS: National Health Service, Ops: Operations. PhD: Doctor of Philosophy, Prof: Professor, Res: Research, Teach: Teaching, Wel: Welcome Trust.

As stated in the end-user literature review, the author has continued to develop the end-user demographics of Ogawa and Pongtanalert (2013), von Hippel et al (2011), Tyrrell (2015), Shaw (1985) and Shaw (1988) by adding new sections in the buyer telephone interview questions to collect data on the buyer's named funder, amount funded for the project, number of research paper's published, number of books published, conference papers presented, the buyer's gender and if they have collaborated before with the same supplier. These questions have expanded our understanding of the characteristics of the end-user population within UK universities engaged in collaboration with industry. From the perspective of a marketing practitioner within industry, understanding the buyer's demographics can help the firm understand customer needs, income levels, buying habits to be able to plan the products and services to meet these demands (Kotler et al, 2020; Keegan and Green, 2013; Lee and Hwag, 2011; McDonald and Wilson, 2016). Industry can use this demographic information, to identify lead buyers that can provide knowledge to develop their product range. The author additionally updated the supplier characteristics (demographics) by adding dichotomous questions like market characteristics (industry type, size of the firm, market share, location of business, business type, and revenue) and so on. As this would allow buyer's and the author to identify if the supplier had the resources and skills required to support a university-industry collaboration.

Within the innovation literature, Eric Von Hippel pioneered the concept of the end-user being a source of innovation. Von Hippel's empirical research theorized that lead-users have two distinct characteristics. Firstly, this end-user is at the cutting edge of new trends, and they are likely to experience a need for new goods or services a month or years ahead of the rest of the user community. Secondly, the lead-user is likely to obtain a significant benefit by obtaining a solution to their needs (von Hippel, 1981; von Hippel, 1986; Urban et al 1988; von Hippel, 1988; Franke and von Hippel, 2003). Tyrrell's (2015) empirical study developed von Hippel's lead-user concept by developing a new end-user characteristics typology, the PI end-user was defined as being a Professor, Doctoral Fellow, Research Fellow, or Reader, who receives a large publicly awarded grant to carry out medical or life science research. This PI end-user also receives a large publicly awarded grant to carry out medical or life science research and benefits by obtaining the equipment 6 to 12 months before market release, thereby speeding up and improving their research output.

From the participant responses and the data in table 5.1 above, this study builds on Tyrrell's (2015) empirical study and the empirical research of von Hippel, 1981; von Hippel, 1986; Urban et al 1988; von Hippel, 1988; Franke and von Hippel, 2003 by extending the dimensions of the PI end-user by adding the concept of the lead buyer type. For this study's findings the lead buyer is an individual academic, who is engaged in research but does not share their equipment with other academics. The next buyer is an academic that not only engages in research and teaching activities but also manages the equipment as a core facility for the university. A core facility is equipment that can be rented out to other academics, departments, and external collaborators. When the equipment is not in use by the main buyer, other academics internally or external to the university may hire the equipment at a cost for conducting research (Haley 2009; Hockberger et al, 2018; Zwick, 2021). This allows academics with limited funds to generate additional revenue for their research or teaching activities. This is a surprise finding, as neither von Hippel, 1981; von Hippel, 1986; Urban et al 1988; von Hippel, 1988; Franke and von Hippel, 2003; Tyrrell. 2015, Shaw 1985 and Shaw 1988 included this designation in their lead-user typology. Therefore, this study makes a minor contribution to the characteristics of the lead end-user within university-industry collaborations.

From the demographics data, most of the buyers are engaged in teaching and research activities including teaching PhD students and disseminating their research via books, journal publications and conference papers. Indicating that these buyers are actively formally and informally promoting their knowledge to the external world (Adhikari, 2010; Mansor et al, 2015; Wilkins et al, 2021). An exception to this is P1, who in not engaged in these activities, as his main role during and after the tender was to set up a new core facility in a new research building, for other academics in the medical school to access the latest equipment. Other buyer characteristics include all buyer's participant's having a PhD apart from P1, who has a bachelor's degree.  P1 does not have a PhD, as he no longer teaches undergraduate students but works as an Operation's Manager trouble shooting issues with other academic's scientific equipment. All the scientific equipment is used for research and core facility purposes, only P10 does not use the equipment as a core facility.

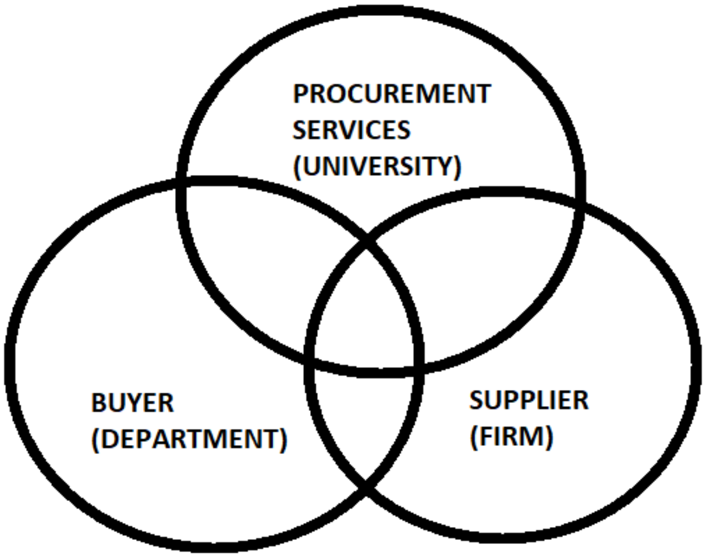
An interesting finding from the buyer transcripts is that all the buyers apart from P10 already have working relationships with the suppliers before undertaking the tender process, as each buyer has existing equipment or alternative equipment from the same manufacturer in their laboratory (Crespin-Mazet et al, 2015; Hodge and Greve, 2007; Gulati et al, 2009). As the P1 responded to the question "do you have similar equipment in your lab from the same manufacturer" P1 responded "Yes". P1 confirmed that he has similar types of equipment in the lab from the supplier. P1 commented "that the equipment has come directly from the manufacturer but also through the resellers, as the mode of operating is mainly via the reseller network". This demonstrates that the buyer's may not be selecting suppliers for collaboration based on only the tender response but on their existing relationship with the supplier. This relationship may be influencing the buyer selection process during the tender marking stage, as the buyer may prefer to select scientific equipment manufacturers that they already have a relationship with on other projects. The only reason why P10 has not engaged in a collaboration with this supplier before, is as this was the first time the buyer had purchased this type of goods and therefore the collaboration was in its infancy. As P10 commented "we have never worked with this supplier before, only time will tell if it is successful".

As buyers have previously collaborated with the same supplier before the tender, this indicates that most of the participants are serial innovators, who are individuals within both SME's, medium, large, and global firms that who repeatedly create new innovations that meet customer's needs and deliver long-term value for their firms (Corradini et al, 2015; Griffin et al, 2014; Tuzovic et al, 2018; Vojak et al, 2012). This finding is a minor contribution to the serial innovator's literature, by providing cases that indicated that university academics can also undertake the role of serial innovators. As there is limited literature on serial innovators within universities as the current literature focuses on the entrepreneurial university (Etzkowtiz et al, 2000; Etzkowitz, 2003; Etzkowitz, 2004; Etzkowitz, 2008) focused on universities obtaining economic returns from generating knowledge and technology transfer from non-key activities of teaching and research, which is a macro view of innovation at a national level.

With buyer participants previously collaborating with the supplier's identified in the award letters, this indicates that innovation is taking place at the local departmental level of the university which is contrary to the triple helix model, that conceptualizes the university at the heart of any national innovation system (Santoen et al, 2014), each institution: university, government and industry takes on the role of the other within the model (Etzkowitz and Ledydesorff, 2000; Leydesdorff and Meyer, 2006). There are several versions of the triple helix model, with the main perspectives being: the neo institutional perspective, the neo evolutionary perspective, entrepreneurial university, and the Quadruple Helix, which adds another dimension to the model: that of community as an institution (Etzkowitz, 2003; Etzkowitz and Leydesdorff, 2000; Demawan, 2016).

None of these models investigate or identify that innovation is taking place at the university department level between an academic and a firm. This study makes a major contribution to knowledge and the triple helix literature by providing a theoretical model and cases that express that collaboration is taking place between university and industry which can be visualized in the below model in Figure 5.1.

**Figure 5.1 - The Micro Triple Helix of University-Industry Collaboration**




Source: Tyrrell (2022)

In this new model, the university procurement department replaces the role of government in the Triple Helix Model (Etzkowitz and Leydesdorft 1997; Etzkowitz, 2003a; Etzkowitz, 2003b; Etzkowitz and Leydesdorff, 2000 and Etzkowitz, 2008) but using the tendering document and process, as the legal framework for undertaking the selection and management of the collaboration. The university becomes the academic (buyer) who provides the knowledge to develop the innovation. Industry becomes the firm (supplier) that provides the resources to develop the new scientific equipment or scientific service. Once the buyer has tested the equipment, the supplier then transforms the prototype into a mass production model to market to new and current university buyers within the HE Sector.

This is demonstrated by supplier S6/7 statement “we have a collaboration with (buyer name), uhm we have two of our newest products (scientific equipment names) both use a technology license from (buyer name) and we now sell tens and tens and tens of these, so uhm, you know but if someone comes up and says I want to do this, if it's only a niche thing, if that all they want to do it's not going to happen". To put this quotation in context, the supplier was referring to a collaboration with an American university, in this situation, the university is obtaining a percentage of revenue from licensing the new scientific equipment and the supplier obtains the revenue from the mass-produced equipment (Bray and Lee, 2000; Conti and Gaule, 2011; Markman et al, 2015; Powers and McDougall, 2005).

Finally, from the table 5.1 above, most of the major innovations (5 participants agreed) have been linked to very high-level grant funding from three specific suppliers. P4 and P13 are MRI scanners and have been funded by Cancer Research UK or the Welcome Trust. P2, P5 and P10 have been funded by the Engineering and Physical Sciences Research Council. Funding for P1 is very low as this is for development of general laboratory equipment and new software functionality. From the buyer characteristics (demographics) we can see there are no similarities between the age, gender, length of relationships with the supplier nor the innovation type that impacts on collaboration formation.

## 5.3 Secondary Data Use in Buyer and Supplier Demographics

As part of the data analysis process, the author examined the secondary data which included the tender specification, supplier tender returns and meeting minutes to identify if any demographic information was present in the secondary data. Unfortunately, the secondary data did not have any buyer and supplier demographic data present to contribute to the findings in this chapter. Therefore, the author, used the primary data from the buyer telephone interviews and supplier virtual meetings to develop the findings for this study.

## 5.4 Supplier Demographics – Data Analysis and Findings

Adopting a quantitative table approach like the buyer characteristics (demographics) table, the author has summarized the supplier participant's responses to the characteristics (demographic) questions in the supplier virtual meeting transcripts. With the aim of identify the characteristics (demographic) factors that influence the value-added and CSC factors provided by the supplier during the collaboration. To protect the anonymity of the supplier (Collis and Hussey, 2003; Frey and Oishi, 1995; Saunders et al, 2000; Riley et al, 2000), the author has used the supplier reference code identified in the virtual meetings, to construct the table 5.2.

**Table 5.2 - Supplier Characteristics (Demographics) Summary**

| **Participant No and Demographic** | S1 | S3 | S6/S7 | S13 |
|---|---|---|---|---|
| **Age** | 55-86 years | 45-54 years | 35-44 years | 45-54 years |
| **Role** | Account Manager | Senior Clinical Scientist | Sales Manager | Head of Imaging Sales |
| **Gender** | Male | Male | Male | Male |
| **Qualification Level** | Diploma – Life Sciences | PhD | PhD | BA/BSC Honours<br>HND Electrical Engineering<br>HND Electrical Manufacturing |
| **Scientific Equipment Type** | Ultra-Low Freezer Storage, Centrifuges, cell culture Incubators | MR Scanners Health Equipment | High Value Microscopes | MRI Scanners Other Imaging Equipment |
| **Scientific Equipment Use** | Research, Teaching, Core Facilities | Research, Teaching, Health Care | Research | Research |
| **Turnover** | £950,000,000 per annum (UK) | Global company 17 billion | UK 78 million Worldwide-<br>6 billion | UK - 5 million Worldwide -<br>15 billion |
| **No Employees** | 4500 staff in 26 countries | 80,000 Globally | UK 300 Globally, 28,000 | UK 1,000 staff Worldwide – 60,000 |
| **Manufacturing Location (s)** | UK, Germany, USA | Globally – India/China/ Netherlands | Germany | Europe (UK, Ireland, Germany) |

| | | | | |
|---|---|---|---|---|
| | | | | China/USA |
| **Technical Support Location (s)** | UK and Global | UK and Global | UK/Global | UK<br>Germany<br>Global |
| **Engineers Based** | UK and Global | UK and Global | UK and around the Globe | UK,<br>German,<br>Global |
| **Innovation Type** | P1, Minor changes to equipment software/design | P3, Minor Innovation | P6 – Minor innovation<br>P7 – Major Innovation | P3 Major Innovation<br>P13 Major Innovation |

Source: Tyrrell (2022)

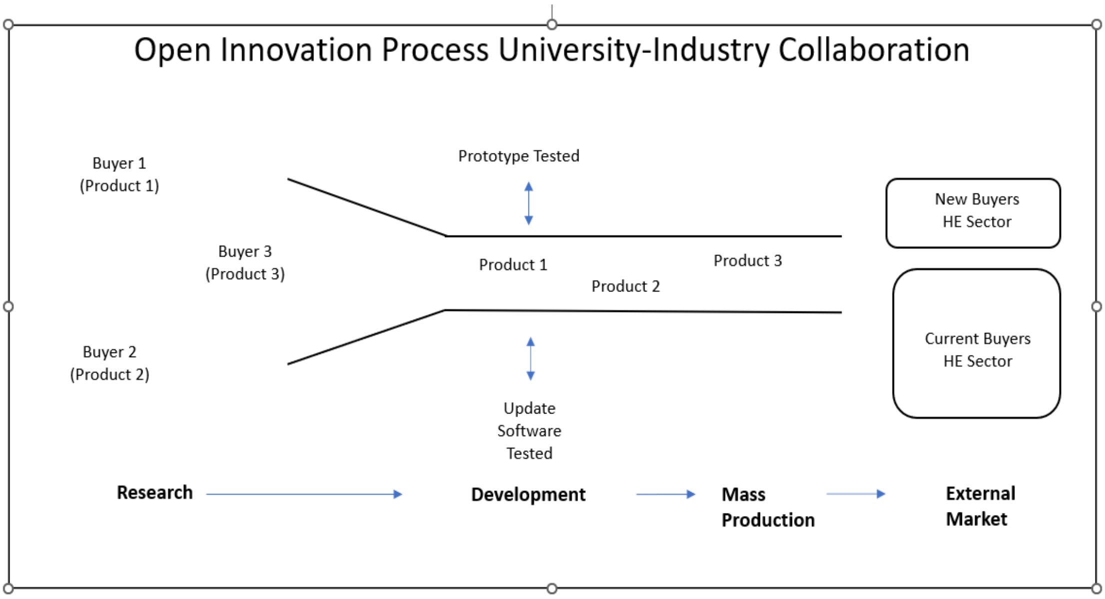
From the supplier characteristics (demographics) the author concluded there are no similarities between the role, qualification level, turnover, number of employees, and type of equipment being manufactured between the suppliers. However, all four suppliers have a similar global structure for production in the UK, Germany and/or the USA. By manufacturing the equipment in these countries, the supplier not only accesses the local market to sell their goods, but it removes any transaction costs to their operations of import or/and export duties while adjusting the equipment to local market needs (Brikinshaw et al, 1998; Mesquitay, 2016; Yaprak et al, 2018). All four suppliers have a similar structure for their manufacturing location and technical support provision. Technical Support is normally either an email, telephone call, chat function or virtual call with the scientific equipment manufacturer to discuss issues the buyer has with the equipment, including the research protocols being adopted for the samples and/or participants being studied (Bailey et al, 2015; Benton W. C. Jr, 2010; Lysons,1993; Lysons and Farrington, 2016).

By implementing this organisation structure, the supplier can deliver value-added factors to the buyer in the local market at no extra costs (Alfaro, 2016; Casson, 2009; Lin et al, 2009). As the technical support services can offer a first-line assessment of any problem, this reduces the cost of sending the supplier’s engineer into the field unless the equipment needs repair. This interlinks with the structure of engineering support to the buyer, as all three suppliers offer engineers based in the country of the equipment purchased. This is beneficial to the buyer as the supplier can provide an engineer onsite to resolve any issue with the equipment within a 24-hour period of a call out by the buyer. Another surprising finding from the supplier virtual meeting transcripts is three suppliers have engaged in several collaborations with different buyers over the three-year period. Firstly, S1 has engaged in collaboration with P1, on three separate occasions, which has resulted in new software being developed for Ultra-Low Freezers, Centrifuges, and Cell Culture Incubators. Secondly, the MRI supplier S13, has engaged with two separate buyers P4 in the development of software for one specific MRI Model (minor innovation) and P13 for the development of a new MRI Scanner (major innovation).

Finally, the supplier of high value microscopes has engaged in two collaborations with P6 which resulted in new software for existing equipment and P7 which resulted in a new microscope being created. Only S3 has engaged with only one buyer, which is P3 in a collaboration that resulted in the development of new software for a clinical MRI scanner. However, S3 has not engaged in collaboration with the buyer before this tender, as their equipment is related to clinical work, therefore any new equipment would need to be certified before use (Lam and Chen, 2019). This finding suggests that the suppliers are serial innovators by working with different buyers or buyer to develop innovations on different product ranges (Corradini et al, 2015; Griffin et al, 2014; Tuzovic et al, 2018; Vojak et al, 2012).

Within the open innovation literature, the OI model aims to open the innovation process up to other firms, individuals, research labs, universities, customers, and suppliers. To allow the smooth flow of ideas from both inside and outside the organisation which allows the firm to gain an advantage by exploiting both internal and external resources (Lichtenthealer, 2011; Rangus et al, 2017; Tidd and Bassant, 2015). As all the suppliers have been engaged in collaboration, this indicates all suppliers have adopted an open innovation process by using lead-user knowledge in the creation of new scientific equipment and services (software development). By university-industry collaborations taking place through the tender process, this study data has provided an example of how to implement the open innovation process within a public sector organisation to create new innovations.  This is a minor contribution to our knowledge on the open innovation model conceptualised by Chesbrough's (2003a; 2003b; 2004; 2006) studies. As this study's tender process provides an example of how buyers and suppliers can access knowledge and resources to create new products and/or services, which the supplier can market to new customers. Figure 5.2 below shows how buyer knowledge is embedded in the innovation process to generate new technology and services.

**Figure 5.2 - Open Innovation Process in University-Industry Collaborations**




Source: Tyrrell (2022)

In the university-industry OI model, the supplier focuses on embedding each lead buyer into the research stage of the open innovation process, the supplier obtains knowledge from each buyer for different products in their portfolio. The supplier then develops the prototype and issues it to the buyer to test. The buyer then tests the equipment and detects/reports any faults with the equipment; the supplier then resolves the problems with the equipment. The new equipment or software is moved to a mass production phase, then marketed and sold to new buyers or existing buyers in the HE Sector.

## 5.5 Chapter 5 - Conclusions

In conclusion, the author has identified several interesting findings in the analysis of the buyer and supplier characteristics (demographics) data. Firstly, by identifying two new types of academics (buyer), building on the concept of the lead-user postulated by von Hippel, 1981; von Hippel, 1986; Urban et al 1988; von Hippel, 1988; Franke and von Hippel, 2003; Shaw 1985, Shaw 1988, and Tyrrell, 2015 by extending the dimensions of the PI end-user by adding the concept of the lead buyer type. For this study, the buyer is an individual academic, who is engaged in research but does not share their equipment with other academics. The next buyer is an academic that not only engages in research and teaching activities but also manages the equipment as a core facility for other university buyers. Neither of these characteristics have been identified by previous research studies, Therefore, this study's findings make a minor contribution to the characteristics of the lead end-user within university-industry collaboration.

Secondly, a very interesting finding, is that all the buyer participant's apart from P10 had already engaged in previous collaborations with the supplier before forming this new collaboration. These previous collaborations between the partners indicate that the buyers are serial innovators (Corradini et al, 2015; Griffin et al, 2014; Tuzovic et al, 2018; Vojak et al, 2012). This finding contributes to the serial innovator's literature, by providing cases that indicated that university academics are undertaking the role of serial innovators. P10 had only recently entered the collaboration with the supplier, therefore P10 had not developed a relationship with the supplier when the telephone interview was conducted. The author then cross-referenced the buyer responses against the supplier responses. From the supplier responses, three of the supplier's participants have engaged in several collaborations with different buyers over the three-year period, suggesting that the suppliers are serial innovators (Corradini et al, 2015; Griffin et al, 2014; Tuzovic et al, 2018; Vojak et al, 2012).

A third finding of the research study is buyer participants have previously collaborated with the suppliers to develop new innovations at the university department level. Consequently, the author proposed a new Triple Helix model, taking count of collaboration taking place between the buyer and supplier, this new model was entitled the Micro Triple Helix Model and can be found in figure 5.1. This new model contributes to knowledge and triple helix literature by confirming cases that identify that collaboration is taking place between university and industry at the departmental level between individual academics (buyers) and firms (suppliers) resulting in new innovations. Fourthly, all four suppliers have a similar global structure for production in the UK, Germany and/or the USA. By manufacturing the equipment in the local market, the supplier removes any transaction costs of import or/and export duties and can adjust the equipment to local market needs (Brikinshaw et al, 1998; Mesquitay, 2016; Yaprak et al, 2018). By having a local manufacturing facility to meet the needs of buyers, the supplier can offer value-added factors that complement the buyer's lacking resources and skills.

Additionally, as all the suppliers are engaged in collaboration, the suppliers have implemented an open innovation process using lead-user knowledge to create new scientific equipment and services (software development). This research study provides a minor contribution to the open innovation model conceptualised by Chesbrough's (2003a; 2003b; 2004; 2006) by indicating how a supplier embeds different buyer knowledge into their innovation process to develop new product ranges as shown in 5.2. This new model provides an example of how to implement the open innovation process within a public sector organisation and how the supplier gains advantage from assessing buyer knowledge.

Finally, after reviewing the secondary data, the author concluded that there was no buyer and supplier demographic data present to inform the study findings, therefore the author used the primary data in the buyer telephone interview and supplier virtual meeting transcripts for analysis when preparing the Chapter 5 findings. In Chapter 6, the author will discuss the findings from the primary and secondary data, identifying the value-added factors present in university-industry collaboration.

# Chapter 6: Important Value-Added Factors Identified in University – Firm Collaboration

## 6.1 Introduction

This chapter provides the data analysis and findings from the value-added factors identified in the specification documents, supplier tender returns, the buyer telephone interviews and supplier virtual meeting questions. As a qualitative approach has been adopted for this study on university-industry collaboration, the author has reflected on the value-added factors requested by the buyer to form the partnership. The value-added factors that the supplier receives from the collaboration have been identified in Chapter 7, as these are interlinked with the partners having a collaboration or research agreement in place, as the benefits the supplier receives from the collaboration will vary on this factor.

## 6.2 Secondary Data Use in Value-Added Factor Findings

After examining the secondary data consisting of 15, buyer tender specifications and supplier tender returns, the author identified several value-added factors that are exchanged by the partners during the collaboration. The author triangulated these important value-added factors against the buyer telephone interview and supplier virtual meeting responses. Table 6.1 provides a summary of all the important value-added factors identified across both the secondary and primary data sets. As no new value-added factors have been generated from triangulating the secondary and primary data, the author concluded that the important value-added factors had reached saturation point (Bryman, 2011; Glaser and Strauss,1967). Additionally, the author examined a blank tender specification form to identify if any specific value-added factors had been added by the procurement professional at the RIU, the author concluded that specific equipment related value-added factors in table 6.2 had been added by the RIU procurement professional using their own knowledge of the equipment market to obtain more value from the supplier during the collaboration. The author confirmed this theory, by triangulating this against P1's telephone interview response. A more detailed breakdown of the value-added factors identified by the author can be found in the rest of this chapter.

## 6.3 Data Analysis and Findings

Within the value-added literature, the concept of value-added has diverse meanings within different subject literature like marketing, procurement, public sector management etc. Value can also be defined as the products attributes (product orientation) using price, product availability, how well the goods perform, ease of use, quality, the cost of ownership and social acceptance including status, image, reputation, and trust, (Kaufman, 2001; Jolibet et al, 2012; Matthyssens et al, 2016).

Alternatively, value can be defined as the brand itself, the customer relationship between the manufacturer, distributor, and the customer, and the type of distribution channels used to supply the customer with the goods or service (McDonald et al, 2006). Value-Added is the benefits the buyer and supplier receive from their collaboration including skill or resource the partner does not possess.

After analysing the ITT document, supplier tender returns, the buyer telephone interviews and the supplier virtual meeting responses, the figure 6.1 below shows the value-added themes that have been identified by the buyer as important.

Themes are patterns across the different data sets that are important to the description of a phenomenon and are associated with to a specific research question (Maguire and Delahunt, 2017; Nowell et al, 2017). Alternatively, according to Bell et al, (2019, p519) a theme "is a category identified by the analyst through his/her data; relates to the analyst's research focus (and quite possibly the research questions); builds on codes identified in transcripts and/or field notes; provides the researcher with the basis for a theoretical understanding of his or her data that can make a theoretical contribution to the literature related to the research focus”.

The value-added factors are structured around the value-added groups identified in the literature gaps, these being grouped into student, collaboration, equipment, and research value-added factors. The buyer responses are then triangulated against the supplier participant’s responses that interlink to that specific tender. Table 6.1 provides a summary of the value-added factors that are important to buyers during the collaboration.

**Table 6.1 - Important Buyer Value-Added Factors**

| ***Equipment Value-Added Factors*** | ***Research Value-Added Factors*** |
|---|---|
| *Free Equipment Delivery, Installation and Commissioning (VI)<br>* Equipment Functionality (VI)<br>*Extended Warranty (VI)<br>*Account Manager (VI)<br>*Technical Support (VI)<br>*Free Equipment Training (VI)<br>*Free Equipment Manuals (VI)<br>*New Software (I)<br>*Free Equipment Accessories (I)<br>*Enhanced Maintenance (I)<br>*Equipment Price (N)<br>*Spare Parts (N)<br>*Free Storge (N)<br>*Free Extended Storage (N)<br>*Free Additional Equipment (N)<br>*Additional Free Upgrades (N)<br>*Reduced Pricing (N) | *Beta Equipment Test (I)<br>*Seminar/Workshops (I)<br>*PhD Studentship (I)<br>*Joint Research Projects (N)<br>*Onsite Scientist provided Free of Charge (Supplier) (N)<br>*Support Program (N)<br>*Access to further Funding(N) |
| ***Collaboration Value-Added Factors*** | ***Student Value-Added Factors*** |
| *Support Grant Applications (N)<br>*Continuing Collaboration (N)<br>*Access to Industry Network (N) | *Student Internship(s) (N) |

Source: Tyrrell (2022)

Key: (VI) Very important factors (all buyer’s agreed), (I) Important Factor (The majority of buyer’s agreed), (N) Neutral (only one buyer agreed this factor was important).

Following a review of the tender documents, tender returns, and participant responses, the above figure 6.1 provides a summary of the value-added factors that buyers consider important to access during the collaboration with the supplier. From the data table, there are three surprising findings from the data presented, firstly most value-added factors identified are equipment related, which are specific benefits that reduce the cost and time of the buyer completing their research. Secondly, within the tender specification form, there are several value-added factors that have been added to the tender specification that are not part of the original standard wording. These factors are Free Equipment Delivery, Installation and Commissioning (VI), Equipment Functionality (VI), Extended Warranty (VI), Account Manager (VI), Technical Support (VI), Free Equipment Training (VI) and Free Equipment Manuals (VI).

As the template was created by the procurement department, it is likely that these factors have been added to improve the value for money of the purchase, this is likely using the knowledge of the procurement professional, then approved by the buyer. As procurement's role has traditionally focused on carrying out the tendering process and selecting a supplier that can deliver goods and/or services on time, offer consistent quality and price, be financially stable, keeps its promises, keeps up with the buyer's needs, updates the buyer/organisation on its processes and provides consistent technical support (Bailey et al, 2015; Benton W. C. Jr, 2010; Lysons,1993; Lysons and Farrington, 2016).

Today, procurement's role goes beyond generating savings (Luzzini et al, 2015) by developing strong supplier-buyer relationships by engaging in joint activities with suppliers focusing on planning and forecasting demand, co-creation, and NPD development, discussing specifications, exchanging information, cost reductions and sharing cost savings (Benton W. C. Jr, 2010; Bidault et al, 1998; Burt and Pinkerton, 1996; Cox, 1996; Grudinschi et al, 2014; Matthyssens et al, 2016). However, there is limited research on the value that can be added to the tender documents and process through the procurement/category managers knowledge. Dumond (1994) hints on this knowledge by commenting on the functional interaction which allows the procurement manager to deliver value to the end-user by interlinking the external environment with the end-user needs (Arias Peregrina, 2011; Telgen and Sitar Pop, 2001). This finding is surprising, as the author was not aware that the procurement professional enhances the value-added factors within the tender specification with their own knowledge of the market and scientific equipment.

Although P1 hints at the expertise of the procurement professional involved in the tender process by stating

> *"Yeah, it is imperative to have one not only at a local department level, such as we have within our own institution, but centrally such as with the university itself, it is imperative that from central procurement representative is a specialist in the scientific sector, should be involved more and more, and there should be adequate resources in place. This is a problem that exists nowadays, as there are insufficient resources in place to allow for things like this that we are trying to improve upon and get things going in a more positive manner".*

This quotation indicates that employing a procurement professional with scientific knowledge will improve the tender process and deliver additional value-added factors for the buyer in the collaboration. However, these factors are not added as a standard part of the tender specification template. These value-added factors are unique to university – industry collaborations.

Table 6.2 below provides a summary of unique value-added factors and the benefits the buyer received from them being added to the specification template.

**Table 6.2 - Specification Template (Pre-Added Value-Added Factors)**

| ***Value-Added Factors*** | ***Buyer Benefit*** |
|---|---|
| **Free Equipment Delivery /Installation /Commission (e)** | There is no additional cost to the equipment being installed, delivery and commissioned into the buyer department. This removes the cost, so the buyer has additional funding to purchase other equipment or services from the supplier. |
| **Free Extended Warranty (e)** | By adding extended warranty into the specification there is no additional cost to the buyer if the equipment needs servicing during the collaboration. |
| **Free Software Firmware, Patches, Upgrade (e)** | To extend the life of the equipment, by adding free firmware, patches, and software upgrades, reduces the cost of the equipment long term. |
| **Free Technical Support (e)** | As buyers may have issues operating the equipment, which needs to be reported to the supplier for repair. Or a question about running an experiment on the equipment, by providing technical support either online or by phone, the buyer can fully utilise the equipment and speed up their research and teaching activity. |
| **Free Equipment Training (e)** | As training on the equipment is free of charge, there is no additional cost of training existing PhD students or other department staff in use of the equipment, this free's up time for the buyer to focus on writing research papers. |
| **Account Manager (e)** | By appointing an account manager to manage all aspects of the project including the relationship between the supplier and buyer. The buyer has more time to focus on delivering teaching and research activities more quickly. |
| ***Beta* Testing Equipment (e)** | Apart from S2 that does not offer beta testing due to the size of the equipment. All suppliers offered beta-testing equipment to the buyer, this gives the buyer access to new equipment that has not been launched to the market, for testing and modification. This allows the buyer access to the latest technology without any cost. |
| **Free Equipment Manuals (e)** | The equipment manual provides the buyer with information on the operation of the equipment; the buyer can identify new methods and processes to adopt in their experiment which may lead to data and research papers being published faster. |

Source: Tyrrell (2022)

By adding these value-added factors as part of the specification template, the buyer will automatically receive benefits from the collaboration. As all the buyers did not change these value-added factors the author concluded these where very important factors as they related to the equipment benefits from the collaboration. From the other value-added factors listed in table 6.1, the remaining factors are specific to each buyer's lack of resources and objectives, as P1 remarked.

> *"For this particular tender return, they offered additional products, as accessories to go with the main hardware. We had an extended service agreement as part of it, and an annual preventive maintenance agreement for the instrumentation and in addition to that we were able to as part of the tender delay, the shipping, the delivery, installation, and commissioning of the equipment until such time as the building was ready to receive it. In addition to that, we as the buyer was not responsible for meeting any additional costs, for the extended storage time due to delay in the building being open, received said equipment".*

The buyer quote's context refers to the value-added factors the buyer added to the tender specification and mandatory questions in the three tenders used to equip a new medical building for teaching and research activities.

In contrast, S13, suggested that the value-added factors that are very important to the buyer.

> *"Is a combination of price and added-value, but also the relationship they have with the supplier, and confidence that supplier, will not only maintain their equipment but will support their research, beyond five years, for typically ten years, I think there is an element of trusting the organization that aren't delivering something that is just part of a tender, truly a partnership that will last the lifetime of the equipment*".

S13 was making this quotation in the context of value-added factors the buyer considers when purchasing equipment from the supplier. From the supplier quotation, we can conclude that it's not only the value-added factors that are important but also the CSC factors that are combined to make the collaboration successful.

After reviewing the procurement, marketing, management, and innovation literature on the concept of value-added, the author combined all the various value-added factors that had not been added into a single study. The author then used these factors to develop telephone interviews and virtual meeting questions to identify the value-added factors that are important to the buyer and supplier participants during the collaboration. From the data analysis stage, the author was able to identify other value-added factors not identified in the literature that are specific to a project for both buyer and supplier. Table 6.3 is a summary of the value-added factors identified in the literature or if they are unique to university-industry collaboration.

### Table: 6.3 - Value-Added Literature and Study's Unique Value-Added Factors

| ***Literature Value-Added Factors Identified*** | ***Study's Unique Value-Added Factors*** |
|---|---|
| ***Expertise (c)***<br>Halseth and Ryser, 2007 | ***Free Consumables (e)*** |
| ***Enhanced maintenance (e)***<br>Baily et al, 2015; Wisern et al, 2019 | ***Consumables Discounts (e)*** |
| ***Technical Support (e)***<br>Bailey et al, 2015; Benton W. C. Jr, 2010; Lysons, 1993; Lysons and Farrington, 2016 | ***Supplier Design's Specification (e)*** |
| ***Spare Parts (e)***<br>Bin Dana, et al 2018, Morris and Pinto, 2007 | ***Free Equipment Delivery, Installation and Commissioning (e)*** |
| ***Equipment Functionality (e)***<br>K Jolibet et al, 2012; Kaufman, 2001; Ling et al, 2015; Matthyssens et al, 2016; Menezes and Quelch, 1990; Torvinen and Ulkuniemi, 2016; Vanhaverbeke and Du, 2010 | ***Extended Warranty (e)*** |
| ***Price (e)***<br>Bailey et al, 2015; Benton W. C. Jr, 2010; Eglin, 2013; Ellram and Tate, 2015; Hong and Boong Kwon, 2012; Lyson and Farrington, 2016; Kaufman, 2001; Jolibet et al, 2012; Matthyssens et al, 2016; Teichgräber and de Bucourt (2012) | ***Free Equipment Accessories (e)*** |
| ***PhD Studentship(s) (r)***<br>Abramovsky and Simpson, 2008; Tyrrell, 2015 | ***New Software (e)*** |
| ***Student Internship(s)***<br>Harman; 2010; Howells et al, 2012; Jonbekova et al, 2020; Prigge, 2005; Thune, 2010 | ***Free Software Upgrade (e)*** |
| ***Industry Network (c)***<br>Fayolle and Redford, 2014; Jamil et al, 2015 | ***Extended Storage (e)*** |
| | ***Equipment Training (e)*** |
| | ***Support Grant Applications (c)*** |
| | ***Support Program (c)*** |
| | ***Account Manager (e)*** |
| | ***Additional free upgrades (e)*** |
| | ***Equipment Manuals (e)*** |
| | ***Continuing Collaboration (c)*** |
| | ***Further Funding (c)*** |
| | ***Free Additional Equipment (e)*** |
| | ***Beta Equipment Testing (r)*** |
| | ***Seminars/Workshops (r)*** |
| | ***Onsite Scientist provided Free of Charge (Supplier) (r)*** |
| | ***Potential Research Projects (r)*** |

Key: (e) equipment value-added factor, (s) student value-added factor, (r) research value-added factor, (c) collaboration value-added factor.

Source: Tyrrell (2022)

From table 6.3 above, the author concluded that buyers are interested in mainly equipment-related value-added factors being provided by the supplier during the collaboration. Although research, students, and collaboration value-added factors are present, these are specific to certain buyers that are missing specific resources and skills. Some of these factors identified building on the existing value-added literature in the left-hand column, however, the right-hand column shows the unique value-added factors present in university-industry collaboration. After reviewing the buyer participant responses, the author concluded that an integral part of the collaboration is the value-added factors that are obtained from the supplier during the partnership. Within the triple helix and entrepreneurial university literature, an individual university can gain economic benefit from technology transfer through patenting, licensing, and incubation (spin off new venture capital firms) (Etzkowtiz et al, 2000; Etzkowitz, 2003; Etzkowitz, 2004; Etzkowitz, 2008).

Unfortunately, there is limited literature on the economic benefits an individual academic receives through the Triple Helix Model, as the model does not examine department - firm collaboration. Nor does the model identify the value-added factors that buyers receive from the collaboration; this literature gap has now been closed. From the analysis of the data and participant responses, the author concluded that the research question had been answered as the author has identified the value-added factors that drive new product innovation and what factors are considered important by buyers and suppliers during the university-industry collaboration.

Finally, value-added factors defined as neutral are value-added factors that are provided to a specific buyer by a supplier. From the value-added factors identified from the data, the author concluded that most value-added factors received from the suppliers were related to equipment benefits, there were only a few value-added factors in the collaboration, research, and student categories. This may be due to the buyer tendering to access funding and resources to meet a specific need that is not currently funded by the grant. The benefit to the buyer of having these equipment value-added factors is that the buyer does not need to allocate some of their funding for these factors in the tenders, meaning the buyer can use these funds for other purposes, like recruiting a laboratory researcher to support the lab work until the end of the project, as these employees are normally on short term employment contracts. In the next section, the author summarizes the conclusions for the value-added factors chapter.

## 6.4 Chapter 6 - Conclusions

After analysing the value-added factors identified in the specification template, supplier tender returns, the buyer telephone interviews and supplier virtual meeting responses, the author concluded there was three main findings from the data. The value-added factors are structured around the value-added groups identified in the literature gap, these being grouped into student, collaboration, equipment, and research value-added factors. From the data, the author concluded that buyers prefer equipment value-added factors to be provided by the supplier during the partnership. A full list of value-added factors can be found in table 6.1. The category with the lease value-added factors was students, with only one buyer responding they requested the supplier to provide internships for their students.

Another interesting finding is there are several value-added factors not a standard part of the tender specification template, these value-added factors are unique to university-industry collaborations. These value-added factors are equipment focused including free equipment delivery, installation and commissioning, free extended warranty to keep the equipment working, free software firmware, patches, upgrades to improve the equipment’s operation, free technical support provided during the week, free equipment training to show the staff and students how to operate the equipment, access to an account manager to manage the account, access to new equipment not launched to market through the beta testing program and free equipment manuals identifying the functionality options of the equipment. As these value-added factors have been added to the specification by procurement services, to deliver additional value for money. The third surprise finding is the procurement professional managing this commodity category, is involved in the development of the specification along with the buyer during the tender process.

The author was not aware that the procurement professional had scientific knowledge to support the buyer in the development of the specification. As P1 hints at the expertise of the procurement professional involved in the tender process in their quotation. After reviewing the procurement, marketing, management, and innovation literature on the concept of value-added, the author was able to combine the value-added factors identified in the literature and contrast them against the unique value-added factors only associated with university-industry collaboration. Table 6.3 provides a summary of the value-added factors identified in the literature or if they are unique to university-industry collaboration. From table 6.3, there are several equipment-related value-added factors that are unique to this research study.

After identifying the value-added factors present in university-industry collaborations, in the next chapter the author examines the CSC factors that are critical to making the collaboration a success.

# Chapter 7: Important CSC Factors Identified in University-Industry Collaboration

## 7.1 Introduction

This chapter provides the data analysis and findings from the CSC factors identified in the specification documents, supplier tender returns, the buyer telephone interviews and supplier virtual meeting questions. As a qualitative approach has been adopted for this study on university-industry collaboration, the author has reflected on the CSC factors that influenced or can hinder university-industry collaboration success.

## 7.2 Data Analysis and Findings

Within the CSC literature, the cross-sector critical success factors are defined as those characteristics, conditions, or variables that when properly managed has a direct impact on the partnership operation and shared vision between partners (Ukalkar, 2000). For public sector bodies, a partnership allows the public body to access resources they do not hold, allows the partners increased capability to address complex problems, increased viability of scope and scale of public sector efforts, access to new funding and capabilities during a time of increased limited resources and public austerity measures (Johnston and Finegood, 2015). After reviewing the CSC literature and identifying the literature gaps, very few studies summarized all the cross-sector collaboration factors into a single table. The author created a new table summarizing all CSC factors into a single table, then integrated these factors into both the buyer telephone interview and supplier virtual meeting questions. Table. 1.17 with all the CSC factors listed can be found in Chapter 2 – Literature Review.

Using the participant responses from the buyer telephone interview and supplier virtual meetings, the author will examine each of the CSC factors and determine if each are present in university-industry collaboration. The findings have been structured around the question structure in the buyer telephone interviews and supplier virtual meetings forms. Within the telephone interview and supplier virtual meeting questions, the first CSC factor being investigated is how the external environment impacts the creation of university-industry collaboration.

### 7.2.1 External and University Internal Factors Driving Buyer-Supplier Collaboration

Within the CSC factors, all collaborations can be influenced by the external market the partnership operates within, including the inter firm competition and competitivity of the market. The policy that the government adopted to manage the economy, legal and tort reform, management practices, unionization, and organisational culture. All these factors can influence if a collaboration will be successful in one context and not another (Bryson et al, 2006; Clarke and Fuller, 2010; Hartman and Dhanda, 2018; O'Leary and Vij, 2012; Osborne, 2006; Perkmann et al, 2014). Within UK universities, the main factor influencing university operations is the UK government's decision to transfer the cost of funding universities from the state (taxpayer) to individuals (students) (Belfield et al, 2017). This approach influences both internal and external funding to universities and individual academics. As part of the buyer telephone interview questions, the author asked several questions related to the internal and external funding factors that influence the buyer's decision to select a specific supplier for collaboration. These questions cover if the buyer has found it more difficult to obtain funding to conduct their research. If external competition for funding has become more difficult, and if the buyer is finding it difficult to access resources to conduct their research, this includes manpower etc. From the responses received from the buyer participants, the consensus of all participants is that both internal funding and external funding are becoming more competitive. These buyer telephone interview responses have been cross-referenced using triangulation with the supplier virtual meeting responses and they have confirmed that suppliers have seen a reduction in funding. Below are the questions on internal and external funding, that were asked to the buyer participants, and the triangulated responses from the suppliers.

**In Question 1 the author asked participants "Have you found competitions for grant funding for scientific equipment more competitive?"**

All participant's agreed that external funding for scientific equipment has become more competitive. The following quotations confirm this, as P1 stated: "I think the answer to that is yes, because you find, there is less and less money going around. There is a greater number of people for said same pot". Yeh, it is extremely competitive". In contrast P12 suggested "my impression is that it is still highly competitive, it's always been highly competitive and is remaining so." Alternatively, S3 commented "Yes, we are seeing considerably less, uhm equipment purchases in academia, uhm, cycle obviously".

However, in the responses there are two anomalies, firstly, P10 undertakes teaching and research activities in physics, this is a highly specialized area, and only a few universities offer this subject area. Resulting in less competition for funding. Although P10 has confirmed that he is aware that funding is a competitive process. P10 comments "It's not specific to my field but generally in higher education field there are too many people fighting for too little funding. So, yes, it is quite competitive".

Secondly, some suppliers have seen an increase in sales due to the COVID-19 pandemic. For example, S1 has seen an increase in business due to the supplier manufacturers, Biological Safety Cabinets, C02 Incubators, Ultra Low Freezers, a range of Bench Top Centrifuges, a range of peripheral equipment, Safety Based items (flammable storage cabinets) and Ultra and Floor Standing Centrifuges. The Ultra Low Freezers, Bench Top Centrifuges and Co2 Incubators are equipment that is essential to diagnosing and developing a vaccine for COVID-19. Therefore, the supplier would have seen an increase in demand from university medical schools (working only on COVID research), NHS Trust's and pharma companies. As S1 stated ""maybe in recent times, for the supplier it has gone up, I think because of COVID. I think the state of funding is steady, as there is funding coming in from Europe, but I don't know what is going to happen with Brexit and everything like that. But COVID-19 has intervened".

From these quotations we can conclude that competition for funding has become fierce and therefore an important factor that drives university-industry collaboration.  With more buyers applying for a smaller pot of money, caused by the dual funding system in which academics submit applications against each other and having their work assessed by a panel of experts to decide if their proposed project will be funded (Adams and Bekhradnia, 2004; Harman, 2000; Hughes et al, 2013; Johnes, 1996) there is a general reduction in funding available. The exception to this fierce competition is within the field of Physics, which has fewer buyers, resulting in less competition for grant funding. Finally, COVID has had an impact on funding, firstly some suppliers that provide COVID scientific equipment used to complete research, diagnostic work and vaccine creation have seen an increase in their scientific equipment sales (S1). However, most of the other suppliers have seen a reduction in grant funding available for scientific equipment. As competition for external funding becomes more aggressive, these factors influence the buyer to collaborate with the supplier to access resources the buyer does not possess.

**In Question 2 the author asked participant's "Have you experienced difficultly accessing resources to conduct your research? If so, what are the reasons for this competition?".**

From the buyer participant's, there was a consensus that accessing resources has become more difficult, however the meaning of resources varies between each of the buyer participants, with several including funding as a resource. As P1 stated "Yeah, because a lot of it's to do with constrains of funding and can only conduct your research based on your level of funding you have. Also, we have to rely on a lot of individual groups having their own equipment, we have a **lack of core facilities.** Only core facilities we have tend to be high end specialist area's rather than general core facilities. Such as a room full of centrifuges you can go and use at any one point. **Everything is to do with individual PI's having their own equipment,** that they don't necessary like sharing". In response to the question P2 responded "I think whenever you are asking for money, big things particularly big things that are seen as being unique to you, things get harder every bit of that, as there is a kind of resistance to paying for a fixed bit of kit. So, however national or internal it is, there are still the people around who see it like that".

In contrast P3's departmental funding is split funded, as the department receives 50% of funding from the MRC and 50% funding from the university to carry out its operations. The response made by P3 reflects this situation:

> *As P3 stated "Yes, that's right, they want to manage the risk! So that becomes quite difficult, so you have to satisfy both of the funders, at the same time and they sometimes have conflicts, that's external, internal wise, uhm for our particular centre. I find* ***it very difficult to access internal resources,*** *uhm either funding or any kind of support or prioritization basically. Support yeh, I struggled yeh. For the last MRI, the contract was signed last minute by the University Vice Chancellor, he just hated it, and he was furious actually! He, you know, that the sort of approach, we just don't get prioritization at all". P5 suggested "it's not money,* ***it's about time****".*

This limitation on time is a factor that P10 requires.

Alternatively, P10 confirmed "The main limitation on resource is time, and essentially it is people power if you put it that way. The author stated, "So in other words, it is getting support, or funding to work with you". P10 comments "Or **PhD students, it's a limitation,** in terms of equipment we have at the university we are in a good position. However, the University VC needs to know we are all miserable and we need to apply for more funding"! In contrast P12 stated "So, yes and I can say though that the university does make resources available to make your grant application more attractive say a 10% cash contribution to the cost of the equipment, **but I don't get anything!** So, and the reason was because the funds are superfluously, transparent and their availability is known to a hand full of people and they tend to add the money to their grants". The author clarified this answer by asking P12 "so it's down to understanding how the internal funding mechanism works and trying to get access to the funding mechanism, OK". P12 responded "yeh", to this specific question.

From these responses, the author concluded that not only was funding an important factor, but also access to people to conduct the research. As the external environment is competitive, recruiting for both PhD students and staff to conduct research can impact the speed of the research being completed. Given that there is now increased competition to complete research outcomes faster than the original grant deadline date. Another factor that has impacted on the buyer's research, is time, as the buyer only has so much time in the week to dedicate to research and teaching activities. By having additional staff or PhD students to conduct teaching and research activities this free's up the buyer's time to try and access additional funding or speed up their research project outcome.

**In Question 3, the author asked the buyer participants "Has your department/university designated a "centre for excellence" for research methods training to you or your department"?**

Within the literature, another income stream is funding provided by the different research councils to teach world class research methods to academics to benefit research, patients, and society. Each year the MRC and NIHR, offer grant funding to perspective researchers to set-up "centres of excellence" in research methods training. Researcher's that apply for the funding must be in award of existing or pending funds from that specific funder, the process is very competitive and is run in a similar way as individual grant awards (UKRI, 2022). From the buyer participant responses there was some confusion over the term “centre of excellence”. This included whether the department or university has been designated as a “centre for excellence” for research methods training. Most buyers have not been awarded a “centre of excellence” funding. According to buyer P1 commented “my understanding is that we do, but this does need to be confirmed”. As the research conducted by P2 is unique, there is no “centre of excellence” accreditation for this research area. However, due to the uniqueness of the area, as P2 comments “I get requests from the States, Japan, China, Latin America and Europe because they cannot do what we do, so we created something ahead of the game”.

In other words, the buyer receives a request from other researchers across the globe to use or conduct their research on the new platforms purchased by buyer P2. Allowing P2 to access additional income from visiting academics using the platforms. In contrast P3 stated that their department was not a centre for excellence. Only P5 received external funding for a “centre of excellence” for PhD training, this may explain why P5 is supervising 11 PhD students and acts as a secondary supervisor to another 4-5 PhD students in 2021. Neither buyer’s P10, P12 and P13, have been awarded a “centre of excellence” grant from the funders. From these responses received the author concluded that having “centre of excellence” status had no impact on the decision to engage in a collaboration with a supplier.

**In Question 4, the author asked the buyer participants “Has the university started to reduce your teaching and/or research budget due to financial constraints”?**

With the HE and education literature, universities manage their internal resources use a resource allocation model that distributes income and resources between different academics and administrative departments, including rules to govern the charges made to these departments by the university for the use of central services (Wood, 2008). However, there is a plethora of debates, empirical studies, and different resource allocation models that are adopted by different universities (Deem, 1998; Liefner, 2003; Knight et al, 2011; Tahar and Boutellier, 2013). Consequently, a university may decide to allocate resources and income based on the workload of the department, national rank, and number of faculty members, number of undergraduate and postgraduate students enrolled, engagement with business and so on (Pfeffer and Salancik, 1974). From across the buyer participant group there was a consensus, that they had all experienced both a drop in their teaching and research budgets due to the university's financial constraints during the buyer telephone interviews. Although this is an interesting finding, the author did not have the information on why the budgets had been cut at the RIU, this finding would need further investigation, as this maybe just specific to this HEI.

On the question of reduced internal funding P1 commented "I understand from talking to my colleagues, it's always a **challenge to receive the right amount of funding**". P1 remarked "From the university it is always a struggle, everything is about justification". P2 obtain all his funding from external sources, therefore this question did not apply. In contrast P3 stated that the budget had been cut by stating "**they have already, yes, of course the research budget**". P5 funding is provided from external sources, therefore P5 has not seen a reduction in his teaching or research budget.

Alternatively, P10 commented "no". This is due to P10 conducting research and teaching within Physics, where there are less academics competing for teaching or research funding. In contrast, P12 suggested:

> *"They don't really provide a budget, for uhm, you know there is uhm, there are expenditure budgets, but some of these seem to be only notional". P12 laughs at this point, then continues to say "**there is no flow of university money into discretionary accounts**, uhm there is small competitions for funding available, but it is the university only funding, but that is for external money just being organised by the university. So, the funder provides blocks of money for some areas of interest and then we have internal competitions. So, it's difficult to know if funding is drying up or not".*

These comments indicate the P12's research is funder completely by external funding, not from university funding.

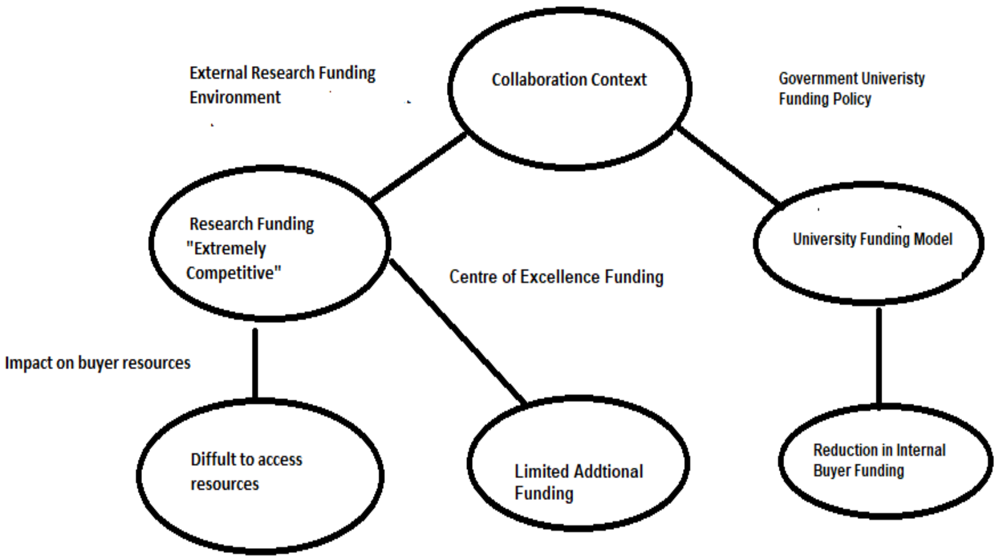
Finally, P13 stated:

> "*Generally, our grant is OK, then we generate income from our platform, as far as I am aware, and I am sure more is going on about how we can spend the money we create, it seems counter intuitive, when we generate that money, we are doing it because we have worked out what the cost is for running the systems. We need to be able to spend that money, so we can run the systems. And now* ***what we find there is an increase amount of push back on spending that money****. We need to generate business cases, increased rules already in existence and restrictions on what we can spend, and how we can spend our money. How much we can spend, uhm that makes it a lot more difficult to spend".*

Within the buyer participant group, P13 is in a unique position in that P13 rents out the system to other academics to generate income as P13 is a core services academic. However, from the statement made by P13, the university is restricting the use of this income. From these quotations, we can conclude that some of the buyer's, P2, P5, P10 and P12 currently have no issues with a reduction in their teaching/research budgets mainly as they receive funding from external sources. Buyer's P1, P3 and P13 have seen a reduction in their teaching/research budget provided by the university to run their departments. This is an important factor as it puts increased pressure on the buyer to identify other sources of income and access to resources, these factors increase the buyer's desire to form a collaboration with a scientific equipment manufacturer.

Figure 7.1 below, provides a visual representation of the themes identified in the buyer participant responses.

**Figure 7.1 – External and Internal Buyer Funding Environments**




Source: Tyrrell, 2022

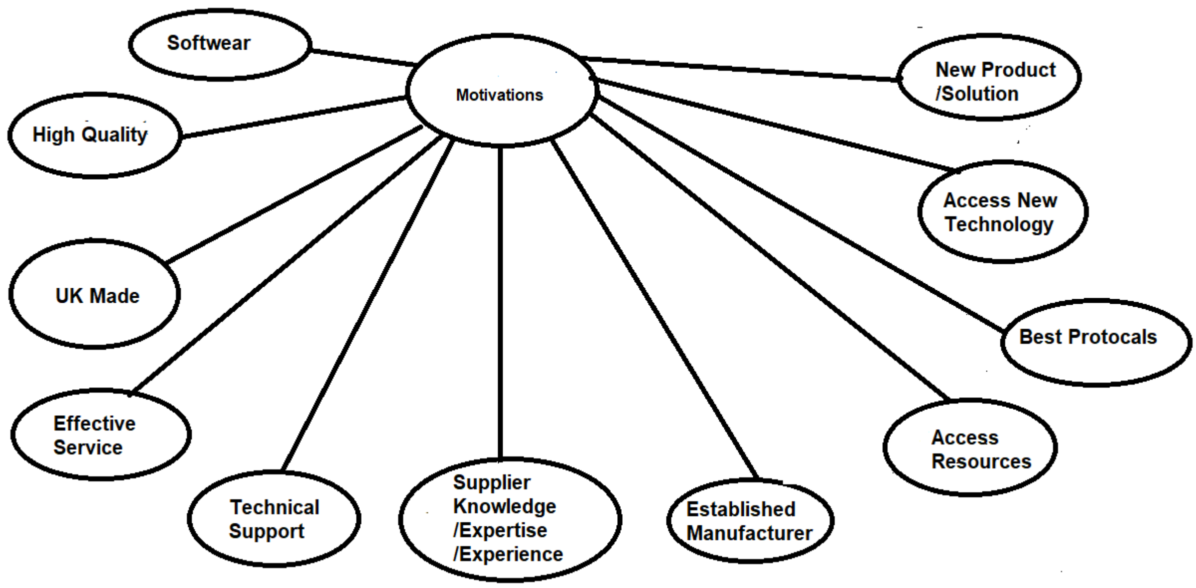
From this model, we can see that both external and internal funding have been reduced or made more competitive by government funding policies and university finance strategies for buyers to access funding.

### 7.2.2 Collaboration Purpose and Motives of the Collaboration

The collaboration purpose refers to the shared vision and goals of the partners during the collaboration. Each partner will have different reasons for forming a collaboration, for firms this includes in the interest of the firm's leadership and the firm's approach to corporate social responsibility. Corporate social responsibility focuses on the social and ethical concerns, which may benefit the firm by creating business through goodwill and extends it external contacts (Austin, 2010; Bryston et al, 2009; Clarke and Fuller, 2010; Johnson and Finegood, 2015; Mayo et al, 2014; O'Leary and Vij; 2012; Ukalkar, 2000). However, the traditional aims of the firm include focusing on increased revenue, firm profitability, and number of customers purchasing goods and services (Reijonen, 2008).

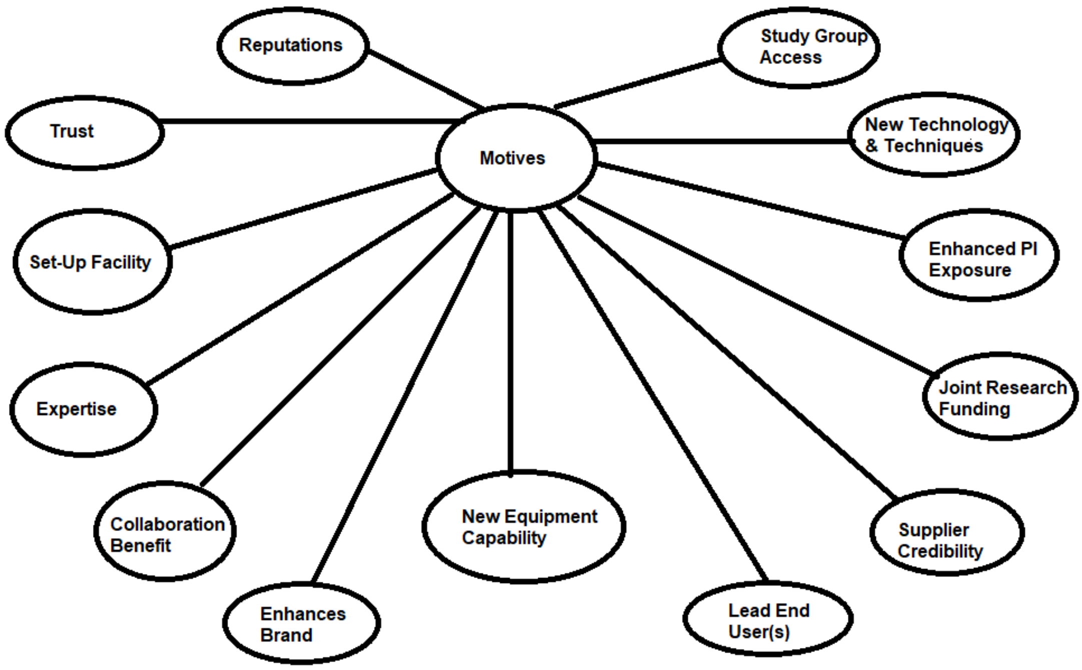
From the buyer perspective, this includes finding a supplier that has the knowledge and resources to produce the buyer's specification to further the buyer's research and teaching activities. Within the CSC literature there are two CSC factors that can be used interchangeably, these are the motives and reasons for the collaboration. Consequently, the author has merged the "Purpose of the Collaboration" and "Collaboration motivations and commitment" into figure 7.2. Collaboration motivations and commitment refers to each skill the partners bring to the collaboration, skills, knowledge, experience, expertise, and resources. Before forming a collaboration, each partner needs to assess if the other partner has the skills and resources to make the collaboration a success (Clarke and Fuller, 2010; O'Leary and Vij, 2012; Thune, 2011; Ukalkar, 2000). Figure 7.2 below is a summary of the buyer participant responses to the reasons why the buyer has formed a collaboration with the scientific equipment manufacturer (supplier).

**Figure 7.2 - Buyer Motivation for the Collaboration**



From the above figure 7.2, we can conclude that each of the buyer's that participated in this study have different reasons for collaborating with the scientific equipment manufacturer. The buyer's own specific circumstance regarding external/internal funding, access to resources, knowledge and manpower have influenced these reasons for collaboration. Both P1, P2, P3, P5, P12 and P13 (6 participants) agreed that the supplier "expertise" was the main reason why they collaborated with the scientific equipment manufacturer. As buyer P3 comments "Expertise. It's really more expertise" when asked about the motivations and skill provided by the supplier before forming a partnership with the supplier (Halseth and Ryser, 2007). In contrast the supplier responses provide a different perspective on the reasons why they have collaborated with the buyers. Figure 7.3 below is a summary of the participant responses from the supplier virtual meeting concerning the reasons for collaboration.

**Figure 7.3 - Supplier Motivation for the Collaboration**




Source: Tyrrell (2022)

Once again there is diverse reasons why each supplier has engaged in collaboration with each buyer. This is based on each supplier's product range, market share and status, profits made, resources, manpower and knowledge. The factor that supplier S1, S6 and S13 share as a common goal is to develop new equipment with enhanced functionality (Kaufman, 2001; Jolibet et al, 2012; Matthyssens et al, 2016; Torvinen and Ulkuniemi ,2016; Vanhaverbeke and Du, 2010). Another factor shared is accessing the knowledge from the lead-user, in the case of S1, this is P1. In the case of S3, this is all the lead-users that use the equipment within the department. Only S3 and S13, share similar equipment, as they are both MRI scanner manufacturers, however S3 also makes other medical equipment that is used for diagnostics work. Therefore, S3 focuses on improving their reputation in the market and accessing the lead-users knowledge and clinical study groups (Franke and von Hippel, 2003; Padilla-Meléndez and Garrido-Moreno, 2012; Ogawa and Pongtanalert, 2013; Shaw 1985; Shaw 1988; Tyrrell, 2015: von Hippel, 1981; von Hippel, 1986; von Hippel, 1988; von Hippel et al, 2011: Urban et al, 1988).

Another factor that is important when deciding on the purpose for the collaboration is the supplier sharing their goals and vision with the buyer during the collaboration (Austin, 2010; Bryston et al, 2009; Clarke and Fuller, 2010; Johnson and Finegood, 2015; Mayo et al, 2014; O'Leary and Vij; 2012; Ukalkar, 2000). By sharing the goals of developing new scientific equipment, this creates a commitment between the partners to meet their objectives. During the buyer telephone interviews the author asked participants "if the supplier share their goals/vision of the collaboration". From the buyer telephone interview responses, all the buyer's stated "yes" the supplier shares their vision/goals during the collaboration. To confirm this P5 comments "yes they are very honest with me". In contrast P13 stated "Yes, but there will be other motivators". Another factor that can impact on the success of the collaboration, is the cordiality of the relationship. According to five of the buyers the relationship between the supplier and buyer is "good". P1 stated that the relationship was "Always professional". In contrast P5 stated the relationship was "collaborative".

This is interlinked with the buyer’s concept of the length of the relationship, in every case apart from P10, all buyer’s stated that the relationship with the supplier was long term (Mendel and Brudney, 2018; Mohr and Spekman, 1994; Vernis et al, 2006; Ukalkar, 2000). An indicative response can be seen by P1 who comments “Oh no”, it has been and always will be long term, it is not about a quick sale, or a quick buy, it’s not about that”. Alternatively, P3 stated “long-term, yes”.

From the buyer telephone interview responses, all the buyer’s agreed that they consider the supplier goals during the partnership. This is confirmed by these buyer quotations, as P10, stated “there is overlap in goals, I don’t have to make money, but they do”. In contrast P12 stated "parts of the organization do, parts of them don’t, that is evident in, there uhm in, some of their activities, as they make donations of equipment to (name of hospital) for example, and they hum, have their own PhD, and PhD funding, and PhD student through the research councils, they likely to be hum, involved in research with universities and cutting-edge research, that’s all very good, but on the other hand other parts of the business need to sell instruments”. Additionally, P13 stated “Yes, but there will be other motivators in their research goal”, in this instance developing new equipment for market”.

### 7.2.3 Partner Selection Process and Capability

As time progresses, each partner learns to access each other’s resources during the collaboration. Capability is the skills and resources provided in the collaboration to make the partnership a success (O’Leary and Vij, 2012). For the buyer this includes resources the buyer can access during the partnership and the skills that the supplier brings to the collaboration. Within the case university, the tender specification document has a statement made by the buyer confirming the requirements of the collaboration. Once the returns have been submitted by the suppliers, the buyer will mark the return based on the criteria in the specification including the collaboration requirements and select the supplier based on the criteria the best matches these requirements.

As the term “skills” and “resources” have been used interchangeably by the buyers during the telephone interview responses. The author has merged the buyer responses for both skills and resources into table 7.1. From the various buyer responses, the author has identified various factors which are an integral part of the collaboration and therefore important to the buyer. The author has group these together into equipment, research, collaboration and student skills and resources, these factors interlink with the studies value-added factors.

**Table 7.1 – Supplier Skills and Resources Accessed**

| **Equipment Skills and Resources** | **Research Skills and Resources** |
|---|---|
| **Excellent Service*<br>**Technical Support*<br>**Account Manager Knowledge*<br>** Account Manager/Manage Account*<br>** Technical Specification*<br>** Training*<br>** Demonstrations* | **Project Management Skills*<br>** Advanced Techniques*<br>** Subject Specific Knowledge*<br>**Joint Publication*<br>** Comparison with Competitor Equipment* |
| **Collaboration Skills and Resources** | **Student Skills and Resources** |
| ******Supplier Knowledge/Expertise*<br>***** *Node in Network of Users*<br>******Long-Term Loans*<br>**Goodwill* | None |

Source: Tyrrell (2022)

Based on the buyer responses above, all buyer participants have suggested that the supplier brings their knowledge and expertise on the products, equipment market and protocols to the partnership (Halseth and Ryser, 2007). Only P5 disagrees with this statement. As P5 stated that he understands the technology well and he can make suggestions to the manufacturer to “make a better machine”. This improved machine can be marketed to other buyers in the research field, P5 stated “yes, they do”. P5 confirmed that “we have developed the patent for other users to use it”. Another factor that is shared across all 6 buyers, is the technology and the new specification that the supplier can bring to the partnership (Kaufman, 2001; Jolibet et al, 2012; Matthyssens et al, 2016; Torvinen and Ulkuniemi, 2016; Vanhaverbeke and Du, 2010). However, P3 referred to "Expertise. It's really more expertise" to answer this question. This indicates that expertise of the supplier is very important in the partnership. Other factors that buyers consider important are the supplier technical support (4 participant agreed), where the supplier provides engineering support to solve issues with the equipment. The supplier offers an account manager to provide a point of contact between the buyer and supplier for technical support, (3 participant agreed) and training (3 participant agreed) which focused on the equipment operation and protocols that the buyer, their teams, and PhD students can adopt using the new equipment. The remaining factors identified are unique to a specific buyer that lacks that skill or resource.

In contrast the supplier responses provide an overview of the skills and resources that the buyer provides to the supplier during the collaboration. The author has group these together into equipment, research, collaboration and student skills and resources, these factors interlink with the studies value-added factors. Table 7.2 is a summary of these skills and resources the buyer provides to the supplier during the collaboration.

**Table: 7.2 – Buyer Skills and Resources Accessed**

| **Equipment Skills and Resources** | **Research Skills and Resources** |
|---|---|
| * *One point of Contact*<br>* *Specify what is required* | * *Equipment Techniques*<br>* *PI Research Output (Papers/Publications)*<br>**National Clinical Standards*<br>* *Clinical Protocol*<br>* *Research Vision*<br>* *Multi Centre Trial* |
| **Collaboration Skills and Resources** | **Student Skills and Resources** |
| ***** *Buyer Knowledge/Expertise*<br>**Promote the Brand*<br>* *Node in Network of Users*<br>**Enhancing our Brand*<br>* *Information/Advice* | None |

Source: Tyrrell (2022)

As the term “skills” and “resources” have been used interchangeably by the supplier during the virtual meeting responses. The author has merged the supplier’s responses for both skills and resources into a single table. From the number of supplier responses, the author has identified various factors which are an integral part of the collaboration and therefore important to the supplier. From the supplier responses, most skills, and resources that the supplier develops or obtains from the buyer is unique to that specific supplier. However, all the suppliers identify that knowledge and expertise are a key skill that the supplier accesses during the collaboration with the buyer (Franke and von Hippel, 2003; Padilla-Meléndez and Garrido-Moreno, 2012; Ogawa and Pongtanalert, 2013; Shaw 1985; Shaw 1988; Tyrrell, 2015: von Hippel, 1981; von Hippel, 1986; von Hippel, 1988; von Hippel et al, 2011: Urban et al, 1988). As S13 comments “the PI’s vision and knowledge allows us to a level of support that would lead us to a successful collaboration”. In contrast S3 commented “what we get from the PI is expertise” in relations to the resources they can access during the collaboration.

Comparing these responses against the buyer responses, we can conclude that accessing knowledge and expertise from both parties during the collaboration is very important, as all participants apart from P5 agreed. From the table above, both S1 and S3 (2 participants) agreed that they had obtained new equipment techniques from the buyer by collaborating with them on developing the new scientific equipment.

Both S3 and S13, confirmed that they had participated in working with the buyer to prepare research papers and publications using the new scientific equipment. This is an interesting finding as both suppliers compete against each other in the MRI scanner market. The benefit of engaging in research publications for both S3 and S13 has enhanced the supplier’s brand with the lead-end users but also with the wider user community (Padilla-Meléndez and Garrido-Moreno, 2012).

### 7.2.3 Collaboration Accountability

Firms and universities are not only accountable to the financial stakeholders, but other groups of stakeholders, including the public, students, suppliers, funding bodies, government, funders, employees, trade unions etc (Bozeman et al, 2013; Jongbloed et al, 2008). These stakeholder groups will vary between industry and university type. As both private and public sector organizations, operate their businesses via open and transparent approaches to decision making, the partners need to develop methods to make them accountable to all their stakeholders. One method used to make partnerships more accountable is a conflict resolution process (Bryson et al, 2006; Bryson et al, 2009; O'Leary and Vij, 2012).

From the buyer responses, the author concluded that there is some confusion among the buyers concerning if their partners in the collaboration have a conflict resolution process in place. For example, P1 suggested "The account manager in this instance is very experienced, and was able to channel all said issues and their role, to ensure that the appropriate members of their organisation dealt with accordingly and information being sent to us from their own particular divisions in what was going on in said problem when they did arise Which I must admit as part of this tender process was very minimal". P1's comments are made in the context of not only having a conflict resolution process but also issues with the equipment and account. In contrast P2 commented "Yes, in the contract". The quotation from P2 refers to the process for resolving issues with the equipment during the design in the commissioning phase of the project.

Alternatively, P3 commented "They would normally have a strategic advisor, strategic development officer, some kind of position like that, they would get in contact from time to time due to the number of scanners if we have a dispute or something like that, that particular person, who will start an investigation internally". This quotation refers to the dispute resolution process in place to deal with issues to the scanner, not to the relationships between the partners.

Instead, P13 comments “Yes, so if there was a technical fault with the systems, we have a helpline number we can call, they give us a ticket number and then it gets escalated to various chains of command. It starts off with the local engineers if they can fix it!”. Once again this is a resolution process to deal with failures in the equipment, not problems during the collaboration relationship. According P2, P5, P10 and P12, if there was an issue between the partners in the relationship, the buyer would need to contact the university procurement team and/or legal team to instigate any remedies or processes that can be adopted to resolve the dispute. From the original analysis performed on the tender documents, the author has reviewed the terms and conditions of the tender, although there are several remedies that the buyer can use to get the equipment repaired, replaced, or cancel the contract for faulty equipment or a service not being carried out. There is a limited resolution process for dealing with problems with the partnership in the tender terms and conditions. From these quotations the author concluded, there is no formal conflict resolution process, only a process for reporting faults with the equipment.

The buyer responses have been triangulated against the supplier responses (Brown and Hale, 2014; Myer, 2013; Stokes and Wall, 2014), the author was able to confirm that there was no formal conflict resolution process between the partners in the collaboration. As S3 commented “Yes, there clearly is a legal position, we are both fulfilling our contract, and because of research contracts, if there is extreme conflict”. This quotation indicates the company has a legal position to conflict resolution but not an actual policy. In contrast S6 comments that “I don’t think there is actually a process”. In contrast, S1 said “Yes, I am sure we do, we have a HR department, that would have something in place that’s for sure. No, no, all that stuff is there but we have never needed it!”. From this quotation, S1 seems to be uncertain if his firm’s conflict resolution process is in place to resolve any relationship issues with P1. Only S13 confirmed that his firm did not have a resolution process in place by commenting “No – there is no formal process”.

The supplier quotations confirms that apart from the remedies set out in the tender terms and conditions, there is no formal conflict resolution process for the collaboration. This is confirmed by the comments made by the buyer responses, that although there is an escalation process for problems with the equipment, using procurement and/or legal services to obtain remedies for the faulty equipment. There has not been a requirement during their collaboration to include or instigate a conflict resolution process. The fact there is no conflict resolution process in place indicates that both parties have developed trust in their relationship (Austin, 2010; Austin and Seitanidi, 2014; Bryson et al, 2006; Couchman and Fulop, 2009; Forrer et al, 2014; Johnson and Finegood, 2015; O'Leary and Vij, 2012; Osborne, 2006; Perkmann et al, 2014; Ukalkar, 2000). However, the comments from S6, indicates that a conflict resolution process should be added to the ITT to allow help to resolve any future conflict arising. One option would be to use the conflict resolution and mediation process through the Centre for Effective Dispute Resolution (known as CEDR). CEDR offer an arbitration service, that is independent and has an impartial person (the arbitrator) that reviews and makes decisions concerning conflicts and disputes without the need for the matter to go to court (CEDR, 2019).

### 7.2.4 Governance and Communications

Before forming a collaboration, both partners need to decide on the channels of communication that should be used to share and absorb knowledge and information required to make the collaboration a success (Austin, 2010; Austin and Seitanidi, 2014; O'Leary and Vij, 2012; Ukalkar, 2000). The collaboration needs to be seen by stakeholders as being legitimate, therefore a governance system needs to be put into place, so the actions of both parties are set within a set of norms, laws, and defined benefits during the collaboration (Bryson et al, 2006; Bryson et al, 2009; O'Leary and Vij, 2012). Within the buyer telephone interview and supplier virtual meeting questions, the author asked participants on the collaboration's governance and communication processes, the participant responses are below:

**Question 1: "Do you have regular contact with this supplier? Please explain".**

From the responses received from the buyer participants, the consensus of all participants is that regular communication was undertaken by the partners during the collaboration (Bollen et al, 2018; Huang et al, 2020; Scholten and Schilder, 2015). The following are examples of the indicative responses from the buyers. P1 commented "I would say I am in communication with them weekly, on a whole range of topics, on the service provisions, to technical support to new products, to be aware of new products coming on board and also as an institution to beta-testing the equipment that they are proposing to the marketplace". Alternatively, P3 comments "Yes, they do. Monthly or two monthly. They are maybe in contact three-four times a year as a regular contact, on top for all the other collaborations that we got".

In contrast, all suppliers agreed that that they have regular contact with the buyer to discuss the project. As S1 comments "Yes, I think he's in contact with so many people, I can't believe it! When I talk to somebody they say, oh yeh, P1 has just been on the phone about that or whatever, he does want to keep his finger on the pulse". As both set of buyer and supplier participants agreed in unison, that regular communication during the partnership is a very important factor to the success of the collaboration (Bollen et al, 2018; Huang et al, 2020; Scholten and Schilder, 2015).

**Question 2: "Do you have a research contract in place with this supplier/buyer? Please explain".**

Within the telephone interview schedule, this question investigates if the buyer and supplier have signed a research contract agreement for the development of the new product innovation. According to Cambridge University (2023) "Research contracts are legally binding agreements that govern collaborative research between the University and external organisations, whether those organisations are funding the research or are participating in the conduct of the research itself. Research contracts contain the terms and conditions under which specific research is to be conducted by the University and the external organisation(s)". The terms and conditions within the research contract govern the sharing of revenues and royalties associated with the innovation outcomes between the partners (Debackere and Veugelers, 2005; Ito et al, 2016; Okamuro and Nishimura. 2013; Young Sohn and Lee, 2012). The research contract also governs the relationships between the parties. If no research collaboration agreement has been signed between the two parties, it is likely this is an informal collaboration and not a formal relationship where royalties from the IP is shared between both partners.

Table 7.3 is a summary of the participants responses to the question if the partners have signed a contract to govern their relationship and the IP rights.

**Table: 7.3 - Research Collaboration Agreements in Place**

| Participant No | Research Collaboration Signed Yes/No/Don't Know |
|---|---|
| **P1** | No |
| **S1** | No |
| **P2** | Don't Know |
| **P3** | Yes |
| **S3** | Yes |
| **P5** | No |
| **S6** | No |
| **P10** | Don't Know – New Relationship |
| **P12** | Yes |
| **P13** | Yes |
| **S13** | Yes |

Source: Tyrrell (2022)

Analysing the participant responses, the author concluded in the case of P1, S1, P2 and P5 that the collaboration is an informal process, only governed by the tender terms and specification in the ITT. The relationship between P10 and the supplier is new, therefore at the time of the telephone interview neither party had signed any formal research collaboration agreement. However, an interesting finding is that both MRI scanner manufacturers (S3 and S13) have signed a research agreement with their key buyer (P3 and P13). As both S3 and S13 compete against each other in the sales market for new MRI scanners, both parties hold the IP in the new jointly created MRI scanners, which stop the other from duplicating the technology from the change into their own equipment. Additionally, by forming a research collaboration this formalises the communication channel that the buyer and supplier adopt to communicate the knowledge shared during the collaboration. However, P13's research contract does not restrict the use of the buyer knowledge for the supplier to turn into new scientific equipment, it just protects the IP in the research output and the research protocols developed on the new equipment. In contrast P12 research agreement also includes the process for managing and paying for the PhD studentships offered to the buyer in the supplier tender return documents.

Combining both buyer and supplier responses from the telephone interview and virtual meeting. This question investigates if the communication from both parties flows across each part of the partners organisation's structure. By allowing information to flow across different levels, there is a higher chance of the collaboration being a success. From the buyer responses, the interaction is restricted to those directly involved in the collaboration. As confirmed by P1's comments "Yeah, I am the main contact as the buyer for procurement and technical support specialist. I tend to be the main contact, as the go too person to undertake all the necessary dealings with this manufacturer". This is confirmed by P3 commenting "So usually, it's the PI who would raise the concern at the first instance, then it depends on how the group is set up, most of the time for our equipment, it is me talking to them. Not every program has a program manager like me full-time. So, usually it's the PI and the whoever in the facility, for example the MRI radiographers will get in contact with them if there is any problem".

Alternatively, interactions are limited to the PI's team including support department staff and directly related PhD student's as P2 comments "Well we have estates involved in that, as they are project managing (project name), and there is an interface between the building being completed and completion of the supplier's work". In contrast P12 comments "me and the appropriate post-doc, inside the research group and no one externally". From the supplier response, all suppliers agree that they are the main point of contact between the buyer and different teams within their organisation. As S3 comments "we have a dedicated group for it, that's what I do". S13 comments "I'm the point of contact for customers".

By not having a research contract in place, the supplier obtains several benefits that make the collaboration worthwhile. Firstly, if there is no restriction on the use of the IP, the supplier can transfer the new specification into a new model, that can be sold to the external market, allowing the supplier to obtain all revenue from the sale. The supplier can then patent the IP, to provide a long-term income stream and can take legal action against competitors trying to copy the design. Allowing the supplier to have unlimited access to potential buyers of the new equipment. With the buyer providing the knowledge to develop the new equipment and endorsing the design through the prototype phase, the supplier gains marketing of the brand without needing to adopt expensive marketing strategies. These are value-added factors that the supplier considers very important in the collaboration.

**Question 4: "From the university side, have you had any contact with the University Technical Transfer office? "**

Traditionally, the technical transfer office within a university aim is to manage the university's IP assets and works with industry to transfer knowledge and technology to the external market. However, the name of the TTO can also be called research services, research office, knowledge transfer office or business service/office. The main aim of the TTO is to develop a research contract between the partners during the collaboration to share revenues and royalties from the innovation. (Brescia et al, 2016; Decteret et al, 2007; Etzkowi, 2008, Etzkowitz and Leydesdorff, 2000; Miller et al, 2009; Tyrrell, 2015). By engaging the TTO in the innovation process, the university can obtain revenue from the knowledge and technology transfer to the firm from the university. However, this requires the PI with the appropriate knowledge or new technology developed to work with the TTO to find an external market to sell this IP. Table 7.4 is a summary of the buyers that have engaged the TTO to work with the supplier in developing the new scientific equipment.

**Table: 7.4 - Involvement of the TTO in the Collaboration**

| **Participant No** | **TTO Involvement Yes/No/Don't Know** |
|---|---|
| **P1** | No |
| **S1** | No |
| **P2** | No |
| **P3** | Yes |
| **S3** | No |
| **P5** | No |
| **S6** | Yes |
| **P10** | Yes |
| **P12** | No |
| **P13** | No |
| **S13** | No |

Source: Tyrrell (2022)

From the participant responses, the author concluded that the involvement of the TTO in the collaboration is not very important.

> *As P3 states "we definitely have worked with the university technical transfer group, uhm, this is because the program that I am managing at the moment, there is a specific term that requires us to work with the technical transfer office, uhm and they have actually not interacted with me that much uhm to be honest. I basically just told them about this grant, they said "OK thank you for keeping us involved". I think this is due to a bit of a complication of, of the ownership of the IP, so supplier 3 wants background and foreground IP, when we develop something new; they want to share it!"*

Indicating that P3 only involved the TTO because it was linked to the grant funding rules and she was unable to access the funds without agreeing to the clause to include the TTO during the collaboration.

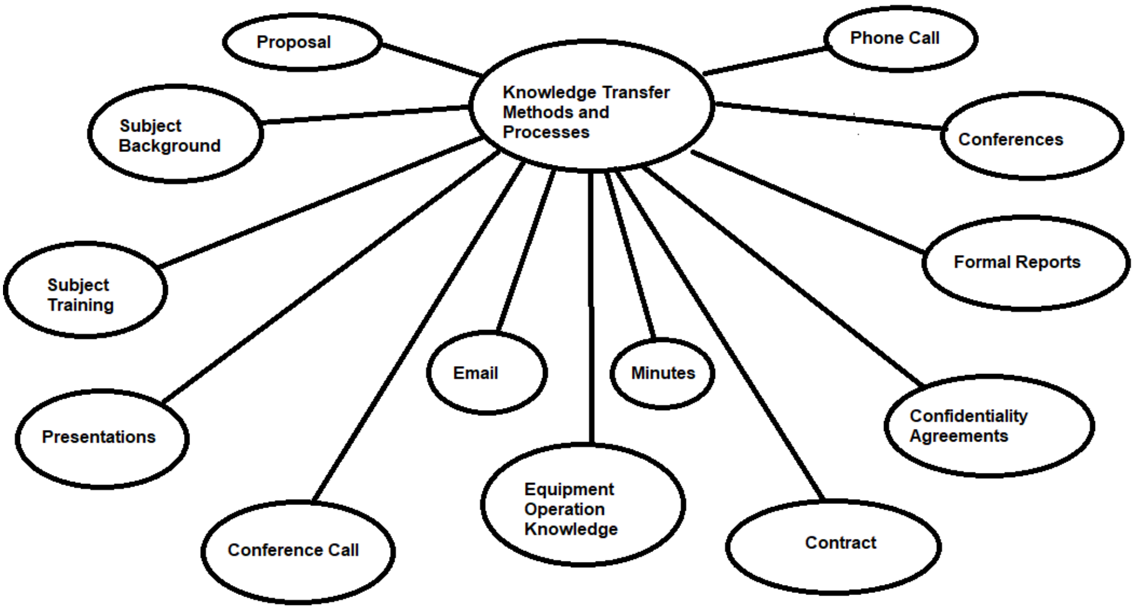
> *Alternatively, as S6 stated: "We have had contact with university business office, we had multiple discussions with them, because when we were under discussion about setting up a facility with P6, there was discussion about the naming, what name we can give etcetera, uhm university business office was included in that, they were talking about IP transfer, and we were talking about equal investments. The legalities of naming the university and supplier together and all sorts of things. So, we have had discussions with the university business office".*

In the host university being studied the TTO is referred to as the university business office, it carried out the same function as the TTO. In this instance, S6 and P6 created a new joint shared facility, consequently, there was major involvement of the TTO in this project. Finally, P10 commented they use the TTO "to get an NDA set up". A non-disclosure agreement is used to restrict trade secrets or confidential information, which can be information that is not publicly known (Ehrlich and Garbaunino, 2020). From these results the author concluded that the TTO involvement in the collaboration is not important, to the success of the collaboration.

**Question 5: "How is knowledge managed through your relationship with the buyer/supplier?"**

Combining both buyer and supplier responses from the telephone interviews and virtual meetings. This question investigates the process and methods used to record the flow of knowledge between the partners of the collaboration. Figure 7.4 below is a summary of the methods and processes used to transfer knowledge between the partners, the author noted that much of these responses are linked to communication methods adopted by the partners during the collaboration (Austin, 2010; Austin and Seitanidi, 2014; O'Leary and Vij, 2012; Ukalkar, 2000).

**Figure: 7.4 - Knowledge Transfer Methods and Processes**




Source: Tyrrell (2022)

From the buyer and supplier responses, there a variety of methods and processes used to share and gain knowledge between the partners during the collaboration. From figure 7.4 above, the author concluded that the majority of buyers and suppliers prefer to share knowledge via email (9 participants agreed) (Eagle et al, 2012; Fill and Turnbull, 2019) through conference calls (4 participants agreed), via phone calls (5 participants agreed) (Eagle et al, 2012; Fill and Turnbull, 2019), through direct contact (3 participants agreed) (Eagle et al, 2012; Fill and Turnbull, 2019) and finally through formal reports (2 participants agreed). Although some of the methods are different, it indicates that once again how important communication is to share knowledge. The other methods listed above are specific to certain buyers, depending on the requirement of the scientific equipment being delivered, installed, and commissioned.

**Question 6. “Does your department or senior management team support, developing a collaboration with the buyer or firm?”**

Both buyer and supplier participants agreed unanimously that their university or firm supported the development of collaboration with other universities and firms. This is confirmed by P13 commented “Yes, they support it”. As all buyers and suppliers confirmed that they receive internal support from their organisation to collaborate, the author concluded that internal management’s support is a very important factor in making sure the collaboration is a success. Another factor that impacts on the success or failure of collaboration, is the development of trust between the partners in the collaboration.

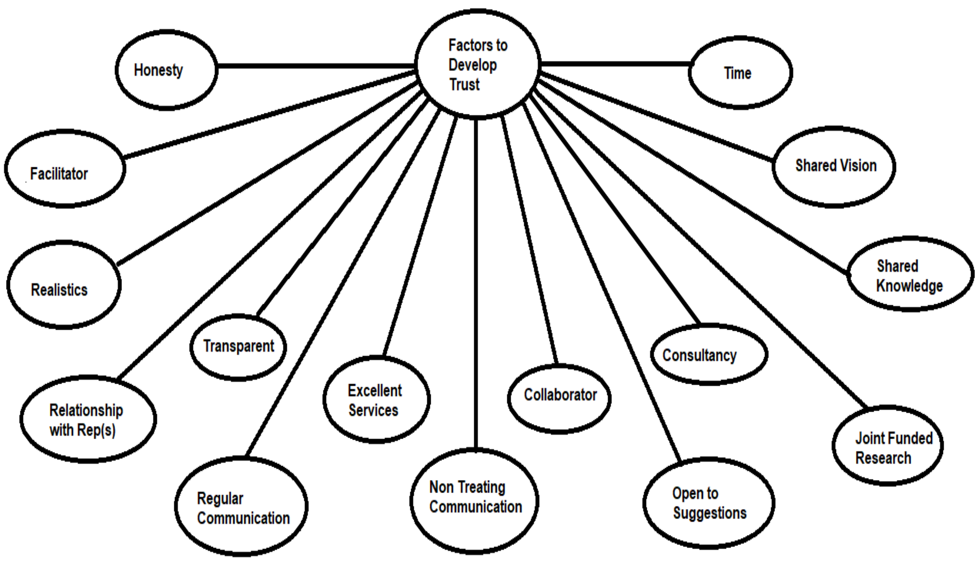
### 7.2.5 Developing Trust in the Collaboration

Within the buyer telephone interview and supplier virtual meeting questions, the author asked the participants about how trust has developed with the supplier. Trust can be developed by individual partners working together on small scale projects, so as time advances both partners start to gain experience and mutual trust of the other party which leads to trust developing between the partners. In some cases, individuals will only collaborate with another individual or firm if they have previous history of collaborating and trust has already been established previously (Austin, 2010; Austin and Seitanidi, 2014; Bryson et al, 2006; Couchman and Fulop, 2009; Forrer et al, 2014; Johnson and Finegood, 2015; O’Leary and Vij, 2012; Osborne, 2006; Perkmann et al, 2014; Ukalkar, 2000). From the buyer demographics in Chapter 7, all buyers apart from P10 had a previous relationship with the supplier they collaborated with on the current project. Both buyer and supplier participants were asked if trust was important in their relationship and how they have developed trust with their collaboration partner.

**Question 1. "Is developing trust important in your relationship with the buyer/supplier?**

From the responses received from both buyer and supplier participants, both agreed unanimously that trust is "important" in the relationship during the collaboration. These are some of the verbatim extracts about the importance of trust, as P1 commented "In one word "Yes", it is imperative". You have to have trust, if you do not have trust with the supplier/manufacturer then should situations arise, you as the client as the buyer would then suspect that basically they want to get rich quickly". In contrast, the supplier S1 said "Yes", in contrast S13 commented "Yes, important". As both buyer and supplier participants consider trust in the relationship is "very important", the author asked participant's what factors need to be implemented to develop trust between the partners to make the collaboration as success. Figure 7.5 is a summary of the factors that participants consider are fundamental in developing trust between the parties during the collaboration.

**Figure 7.5 - Factors Required to Develop Trust**




Source: Tyrrell (2022)

From figure 7.5, the author concluded that there are several factors that both buyer and supplier participants share to create a successful collaboration. The first factor is being honest in the relationship (7 participants agreed). The second factor is having regular communication between the partners at all stages of the relationship (6 participants agreed) (Bollen et al, 2018; Huang et al, 2020; Scholten and Schilder, 2015). Thirdly, that trust develops over time through the interactions and objectives achieved between the partners (5 participants agreed). Fourthly, being transparent in your dealing with the supplier, by explaining what your requirements and the reasons why they are needed. Fifthly, having a shared vision (3 participants agreed), this is where partners communicate openly about what benefits they wish to receive from the collaboration and their objectives for conclusion of the collaboration.

However, all these factors are interrelated as P1 quotes “An open and transparent working relationship is fundamental to this. So, whereas other people may say when they are trying to acquire either quotations or whatever! By saying “oh just give me the best you can, and we will consider it”, what I mean by being transparent, is that we have always been honest with the supplier when we have asked them to quote for equipment”. The importance of these factors is confirmed by P3:

> *P3, who comments” Just be very honest, I think, with the communications, so I find the best way of building up trust is, one is time obviously, the longer you work with them, the better you understand, their rational and goals, and their preferred way of communicating and working together. Basis on that you need to have a very solid, you need to have trust with the person you are working with first of all. That always comes with time, also you kind of need to know that the person is good at doing what they said they will do, and they will deliver their promise. So, without those two things, you can’t work with them at all, uhm so yeh that’s my feeling”.*

Another factor that can impact on the success or failure of a collaboration is how power is managed in the relationship.

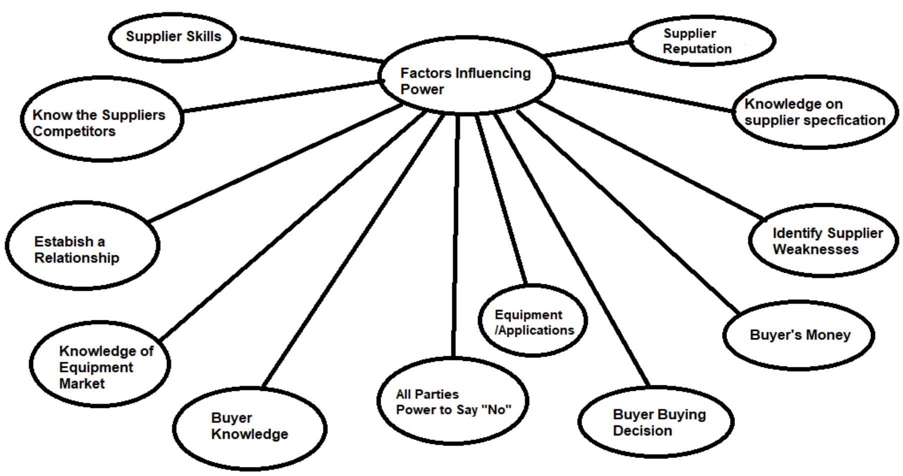
### 7.2.6 Partner Power in the Collaboration

Within the CSC literature, within the collaboration, there is a potential for an imbalance in the power held by partners, as one partner may have more resources and skills than the other partner. If this is the case, then mistrust can develop and cause the collaboration to fail. Therefore, the partners should find a legal mandate to share authority and power in the collaboration, this can improve the collaboration’s chances for success (Bryson et al, 2006; Hartman and Dhanda, 2018; O’Leary and Vij, 2012). Within the buyer telephone interview and supplier virtual meeting questions, the author investigated how power was managed during the collaboration.

**Question 1: “How do you manage power within your relationship? Please Explain”.**

Figure 7.6 is a summary of the buyer and supplier responses concerning the factors needed to influence the management of power between the partners during the collaboration.

**Figure 7.6 - Factors Influencing Power in the Relationship**




Source: Tyrrell (2022)

From the responses above in figure 7.6, we can conclude that some of the factors that influence power within the relationship are either unique to the buyer and the supplier or related to the equipment being purchased. This question interlinks with who holds power in the relationship as P1, used these factors to influence the supplier to provide the value-added requirement to their relationship.

> *As P1 suggests "It is two ways to do this, one knowledge is power, so always ensure that I try and be up to date on the technical specifications and the applications that the instrumentation we routinely buy from this said supplier. Or wish to buy/procure from this supplier and that I am knowledgeable about it. And more importantly, the most fundamental thing is by having an established relationship and by having a number of this company's instrumentation, and by being a buyer for let says esteemed status, as a university we have that esteemed status. Gives us that element of power".*

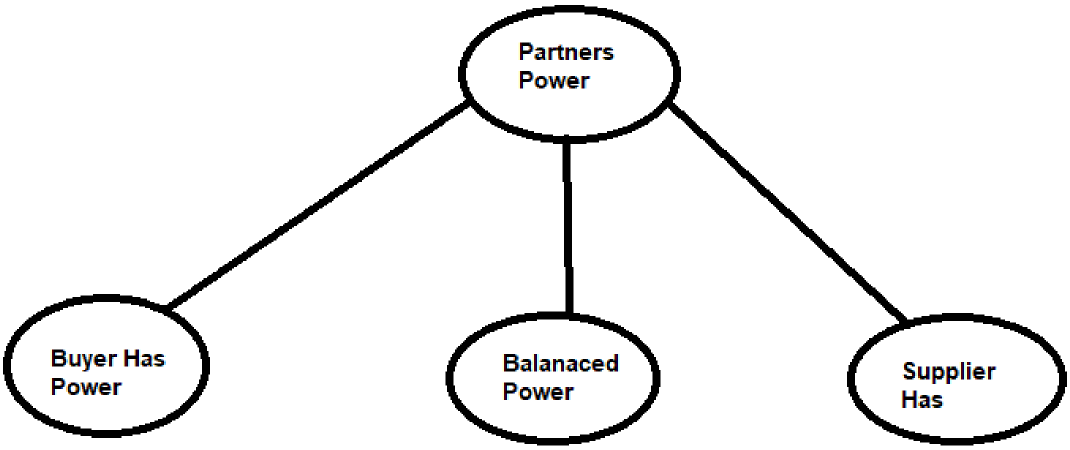
All participants responded to this question apart from both P5 and S13. P5 did not in their response provide any examples of factors that influence power in the relationship. In contrast S13, avoided a direct response about factors that influenced power. However, two factors are shared by both buyer and supplier participant's, firstly the funding the buyer has that can be used to influence the supplier to provide additional value-added factors.

As the buyer can make the decision to purchase from that company or not as P2 comments "We have power as we are paying them monthly". The second factor is the technology created through the expertise of the supplier, that the buyer needs to modify to support their research or teaching activities. As the supplier has the control over how this equipment and applications can be modified. If the supplier decided that there is no benefit to their firm of developing the new scientific equipment they may decline to work with the buyer.

**Question 2: "Who in the relationship holds the power?"**

This question asked by the author to participants to investigate if any one partner holds power over the other during the partnership. Figure 7.7 is a summary of who holds the power during the relationship.

**Figure 7.7 - Partners Power During Relationship**




Source: Tyrrell (2022)

The concept of who holds power in the collaboration is influenced by both the buyer and supplier perspective on what factors they feel should influence the relationship. For example, P1 actively, engages in obtaining knowledge about the supplier products and markets to influence the level of power he holds in the relationship with S1. As S1 comments "P1 has more power, as he can make a decision one way or the other can't he". S1 was referring to the buyer having the decision to purchase the equipment or not from his firm. This perspective of the buyer holding the power in the relationship is shared with supplier S3 and S6 (Sadeghi et al, 2022; Wang et al, 2016).

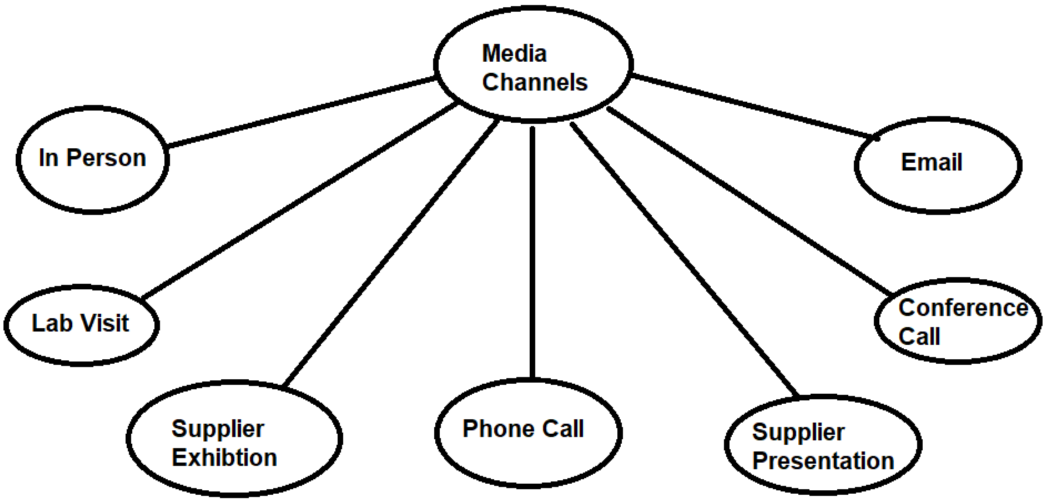
In contrast, the majority of buyer and supplier participants consider the power relationship is balanced within the relationship (6 participants agreed) (Alexander et al, 2001; Chicksand, 2015; Essabbar et al, 2016; Rehme et al, 2016). To support this view P3 commented “Before the tender, we totally have, after the tender they probably have. Because we are asking them to do things more after the tender process”. Because both partners in the relationship have resources that the other requires to create the new scientific equipment. Neither buyer nor supplier felt that the supplier had complete power over the buyer during the collaboration. Finally, P13 did not comment on the question who had the power in the relationship. Another factor that can influence the success or failure of the collaboration, is the use of technology to share and communicate knowledge between the partners during the collaboration.

### 7.2.7 Partner Information Technology Used

As all the supplier participants are employed by global firms, that operate and manufacture scientific equipment in various countries, the use of information technology to share and communicate knowledge between partners is a very important factor during the university-industry collaboration (Austin 2010; Austin and Seitanidi, 2014; O’Leary and Vij, 2012; Ukalkar, 2000). Within the buyer telephone interview and supplier virtual meeting schedules, study participants were asked on the media channels they adopted during the collaboration to share knowledge and how they manage the relationship through these media channels. The author has merged these two questions together as many of the study participants have duplicated their answer to these questions.

Figure 7.8 below is a summary of the media channels adopted by study participants during the collaboration.

**Figure 7.8 - Media Channels for Partnership Communication**




Source: Tyrrell (2022)

During the purchasing process, the buyer and supplier will adopt various communication media and decide if these are more suitable to adopt instead of face-to-face or paper-based interaction (Fraccastoro et al, 2021; Hänninen and Karjaluoto, 2017; Rodriguez Cano et al, 2005). From the participant's responses, we can see that the use of information technology is "very important" to a successful outcome in the collaboration. From the different media methods provided to share information, the major media method selected by participants to share knowledge is face-to-face meetings (Eagle et al, 2012; Fill and Turnbull, 2019; Fraccastoro et al, 2021; Hänninen and Karjaluoto, 2017; Hill et al, 2009; Rodriguez Cano et al, 2005).

This approach allows both buyer and supplier participants to develop trust and transparency through interactions (11 participants agreed). As P1 comments "Email, phone, and direct face-to-face". Next preferred channel of communication is via email (10 participants agreed) (Eagle et al, 2012; Fill and

Turnbull, 2019; Fraccastoro et al, 2021; Hänninen and Karjaluoto, 2017; Oshri et al, 2007; Rodriguez Cano et al, 2005), only P2 does not use email, as a new building needs to be created to house the new platform module. P2's preferred communication method is "Normally, it would be face-to-face meetings but due to COVID it is phone". During the COVID-19 pandemic, there was several periods, when face-to-face interaction was restricted to immediate family and those who had caring responsibilities during lockdown (Eagle et al, 2012; Fill and Turnbull, 2019; Fraccastoro et al, 2021; Hänninen and Karjaluoto, 2017; 2009; Oshri et al, 2007; Rodriguez Cano et al, 2005). Consequently, this may explain the shift to holding meetings online via conference calls (9 participants agreed), as conference calls offer the benefit of allowing partners to develop a rapport and trust, are easier to arrange and can streamline collaborations, as there is some face-to-face interaction via the internet. This is confirmed by S13 statement "Face-to-Face before Covid".

Another communication channel used is phone calls (6 participants agreed) (Eagle et al, 2012; Fill and Turnbull, 2019; Fraccastoro et al, 2021; Hänninen and Karjaluoto, 2017; Oshri et al, 2007; Rodriguez Cano et al, 2005). However, this method is used less by participants then email and in person communication (Eagle et al, 2012; Fill and Turnbull, 2019; Fraccastoro et al, 2021; Hänninen and Karjaluoto, 2017; Oshri et al, 2007; Rodriguez Cano et al, 2005). Although Lab visits (2 participants agreed) supplier exhibition and supplier presentations (3 participants agreed) are direct face-to-face interactions during COVID these methods would have been restricted due to lockdown rules. It is not known if these channels of communication would increase over time to being a major communication method, as this face-to-face communication is not specific to a project but used by the supplier to provide product and service information to other academics. For the buyer, lab tours allow the buyer to show the supplier the research projects being conducted in the department, to meet the buyer's research team, other academics, and PhD students to understand their requirements. For the supplier this is an opportunity to promote their brand to these groups. Finally, from the participant responses, we can conclude that face-to-face (in person) communication is very important to both buyer and supplier to share knowledge during the collaboration.

### 7.2.8 Partnership Length

Within the CSC literature, the duration of the partnership during a collaboration can be as short or long as the partners required to meet the desired outcome of the collaboration. The partnership will cease to be when one of the partners confirmed its intension to withdraw from the collaboration (Mendel and Brudney, 2018; Mohr and Spekman, 1994; Vernis et al, 2006; Ukalkar, 2000). In Chapter 5, the buyer and supplier characteristics (demographics) findings indicated that both supplier and buyer had already engaged in collaboration before this study was completed. Consequently, the buyer and supplier have already developed trust during their previous and current interactions (Austin, 2010; Austin and Seitanidi, 2014; Bryson et al, 2006; Couchman and Fulop, 2009; Forrer et al, 2014; Johnson and Finegood, 2015; O’Leary and Vij, 2012; Osborne, 2006; Perkmann et al, 2014; Ukalkar, 2000). The only exception is P10 that had just formed a collaboration with the supplier.

As part of the secondary data analysis based on the tender documents and supplier tender response, the author was able to identify the length of the collaboration. The collaboration length is based on the date the ITT was issued and returned, the date the new equipment was to be installed and value-added factors provided to the buyer, the service contracts start and end date and project completion date. This information will be used to identify the length of the collaboration between the supplier and buyer for each equipment type. Table 7.5 is a summary of the start and end dates for the partner’s collaboration, including the buyers and suppliers that had not participated in the study (from the secondary data sets).

## Table: 7.5 - Partnership Length

| Participant No/ Innovation Type | Equipment Type | Award Date | Delivery Date | Knowledge Transfer Duration | Completion Date | Length Year(s) |
|---|---|---|---|---|---|---|
| **P1/S1** | Co2 Incubators | 05/12/18 | 31/07/19 | 8 months | 31/07/21 | 5 years |
| **P1/S1** | Ultra-Low Freezers | 13/03/19 | 31/07/19 | 4 months | 31/07/21 | 5 years |
| **P1/S1** | Bench Top Centrifuges | 15/10/18 | 31/07/19 | 10 months | 31/07/21 | 5 years |
| **P2** | Platform Models | 03/02/19 | 03/01/22 | 11 months | 31/03/25 | 5 years |
| **P3/S3** | MRI Scanner | 18/07/18 | 1/02/19 | 8 months | 01/02/24 | 5 years |
| **P6** | MRI Scanner | 18/07/18 | 01/03/19 | 10 months | 01/03/23 | 5 years |
| **P5** | BEAMS System | 10/06/20 | 31/08/20 | 2 months | 31/08/23 | 3 Years |
| **S6/P6** | Confocal Microscope | 22/05/20 | 31/07/20 | 3 months | 31/07/23 | 3 Years |
| **S6/P7** | Inverted Confocal Microscope | 31/03/20 | 06/12/20 | 10 months | 06/12/23 | 3 Years |
| **P8** | XPS system | Missing | 30/03/19 | Not Known | 30/03/21 | 3 years |
| **P9** | Photon Microscope | 03/08/18 | 31/03/20 | 18 months | 31/03/25 | 5 years |
| **P10** | Super Resolution Microscope | 12/06/22 | 31/07/20 | 1 month | 31/07/23 | 3 years |
| **P11** | Dilution Refrigerator | 06/12/19 | 31/03/20 | 3 months | 31/03/22 | 3 years |
| **P12** | Raman Microscope | 30/04/19 | 01/10/19 | 7 months | 01/10/24 | 3 years |
| **P13/S13** | MRI Scanner | 08/06/18 | 06/07/19 | 16 months | 07/06/23 | 5 years |

Source: Tyrrell (2022)

For table 7.5, the author examined the tender documents, supplier tender returns, award letters and tender terms. Within the table the most important factor is delivery date, this is when the supplier needs to deliver, install, and commission the new scientific equipment as stated in the supplier tender return. For the value-added factors related to the scientific equipment, like training, technical support, free consumables, and add on equipment options, these are also delivered and provided on or near the delivery, installation, and commissioning date. The supplier has a very narrow window between the date the contract is awarded and the delivery date to obtain the knowledge from the buyer to create the new scientific equipment.

Although on average the collaboration length is either 3 years or 5 years, unless there is a PhD studentship that has been funded by the supplier (for P10 and P12), after the delivery period of the new equipment, the collaboration focuses on the ongoing services needed to operate the scientific equipment, plus any additional training required by the buyer. For example, P10 comments on the length of the agreement by saying “initially two years but will be four or five years. Beyond that it is too early to say”. Therefore, we can conclude that the collaboration length is very important, as the knowledge transfer happens shortly after the award letter has been issued to the winning bidder. With the average collaboration length 3 years for scientific equipment that can be installed on a bench and 5 years for scientific equipment that is installed into the fabric of the building. Other factors that impact the success or failure of a collaboration is how the collaboration is managed by the partners.

### 7.2.9 Collaboration Management Factors

Within the CSC literature, there are several factors that concern the management of the collaboration to reach its successful outcome.  These success factors include the development of cross-functional teams (Mendel and Brudney, 2018; Mohr and Spekman, 1994; Vernis et al, 2006; Ukalkar, 2000). The continuous monitoring and evaluation of the collaboration (Austin, 2000; Jamali and Keshishian 2009; Johnson and Finegood, 2015; Seitanidi et al, 2010; Von Tuder et al, 2016; Ukalkar, 2000). The continuing improvement of the collaboration (Johnson and Finegood, 2015; Ukalkar, 2000) and the culture of the partnership (Johnson and Finegood, 2015; Ivascu et al, 2016; Mendel and Brudney, 2018; Mohr and Spekman, 1994; Vernis et al, 2006; Ukalkar, 2000) and finally the leadership model adopted during the collaboration (Bryson et al, 2009; Crosby and Bryson, 2010; Malin and Hackmann 2019). Each of these factors are critical when the partnerships set up a separate function or firm to deliver the outcomes of the collaboration.

During the buyer telephone interview and supplier virtual meetings these factors were not raise by either participant groups. As most collaborations do not lead to a formal collaboration, or the setup of a new joint team between the partners, nor joint leadership arrangements. The author did review the research contract for the P13 partnership, however there is no reference to these management factors in the documents, the research contract defines the ownership of the foreground, background, and deliverable IP for the project. Both the P3 and P12 research contracts were not available for review in procurement department records. Therefore, the author concluded that these management factors where not critical or required during buyer and supplier collaborations.

## 7.4 Secondary Data use in CSC Factors Findings

As part of the data analysis process, the author examined the secondary data which included the tender specification, supplier tender returns, one research and development agreement and buyer/supplier meeting minutes to identify if any CSC factors was present in the secondary data. Unfortunately, the secondary data did not provide any CSC factors that could influence university-industry collaborations. Instead, the meeting minutes focused on the practical implications of delivering, installing, and commissioning of the equipment to the buyer's research laboratory. Therefore, the author, used the primary data from the buyer telephone interview and supplier virtual meetings to develop the findings for chapter 7.

## 7.5 Chapter 7 - Conclusions

In conclusion, after using thematic analysis (Braun and Clarke, 2006; Mcneil and Chapman. 2005; Quinlan et al, 2018; Vaismoradi et al, 2013) to identified themes in the participants responses, tender documents, supplier tender returns, tender terms and research contracts and using the CSC literature, the author has identified the very important CSC factors (and sub factors) that are critical to a successful university and industry collaboration. Table 7.6 below shows the specific CSC factors that are present and the level of importance within university – industry collaboration.

Table 7.6 summarised the participant responses based on a consensus view or the top response (2-4 responses) to specific sub factors of the main CSC factor. Any CSC factors that are not involved in the university – industry collaboration has been summarized in the table.

**Table: 7.6 - University - Industry CSC Factors Identified**

| Critical Success Factor | Sub Factors | Level | Literature reference |
|---|---|---|---|
| **Collaboration Context** | **Competitive External Funding Environment (Consensus)**<br>**Difficulty Accessing Resources (Consensus)**<br>**Centre of Excellence Funding (mixed response)**<br>**Competitive Internal Funding Environment (Consensus)** | ***VI***<br>***VI***<br>***N***<br>***VI*** | Bryson et al, 2006; Clarke and Fuller, 2010; Hartman and Dhanda, 2018; O'Leary and Vij, 2012; Osborne, 2006; Perkmann et al, 2014. |
| **Purpose of Collaboration, Motivation and Commitment** | **Motives - Expertise (Buyer - 9 participants agreed)**<br>**Motives - Expertise (Supplier - 7 participants agreed)**<br>**Motives - New Equipment Capability (Supplier - 3 participants agreed)**<br>**Buyer/Supplier Shared Goals (Consensus)**<br>**Long Term Relationship (Consensus)** | ***VI***<br>***VI***<br>***I***<br>***VI***<br>***VI*** | Austin 2010; Bryston et al, 2009; Clarke and Fuller, 2010; Johnson and Finegood, 2015; Ivascu et al 2016; Mayo et al, 2014; Mendel and Brudney, 2018; Mohr and Spekman, 1994; O'Leary and Vij; 2012; Perkmann et al, 2014; Thune, 2011; Vernis et al, 2006; Ukalkar, 2000. |
| **Partner Selection Process and Capability** | **Expertise/Knowledge (Buyer - 9 participants agreed)**<br>**Expertise/Knowledge (Supplier - 7 participants agreed)** | ***VI***<br>***VI*** | O'Leary and Vij, 2012. |

| | | | |
|---|---|---|---|
| **Collaboration Structure, Governance, and Communication** | **Regular Communication (Consensus)**<br><br>**Research Contract (Mixed Response)**<br><br>**Buyer/Supplier main point of Contact (Consensus)**<br><br>**TTO involvement (Mixed response)**<br><br>**Management Support for Collaboration (Both buyer and supplier – consensus)**<br><br>**-----------------------------------**<br>**Knowledge Transfer Methods - Email (9 participants agreed)**<br><br>**-------------------------------------**<br>**Knowledge Transfer Methods - Phone Call (5 participants agreed)** | ***VI***<br><br>***N***<br><br>***VI***<br><br>***N***<br><br>***VI***<br><br>**---------------**<br>***I***<br><br>***I*** | Austin 2010; Austin and Seitanidi, 2014; Bryson et al, 2006; Bryson et al, 2009; O'Leary and Vij, 2012; Mendel and Brudney, 2018; Mohr and Spekman, 1994; Perkmann et al, 2014; Vernis et al, 2006; Ukalkar, 2000.<br><br>---------------------------------------<br>Eagle et al, 2012; Fill and Turnbull, 2019; Fraccastoro et al, 2021; Hänninen and Karjaluoto, 2017; Oshri et al, 2007; Rodriguez Cano et al, 2005.<br>-------------------------------------<br>Eagle et al, 2012; Fill and Turnbull, 2019; Fraccastoro et al, 2021; Hänninen and Karjaluoto, 2017; Oshri et al, 2007; Rodriguez Cano et al, 2005. |
| **Power** | **Factor Influencing Power: Buyer's Money (3 participants agreed)**<br><br>**Equipment/Applications (3 participants agreed)**<br><br>**-------------------------------------------**<br><br>**Power Held:**<br><br>**Buyer (4 participants agreed)**<br><br>**Balanced between Partners (6 participants agreed)** | ***I***<br><br>***I***<br><br>***I***<br><br>***I*** | Bryson et al, 2006; Hartman and Dhanda, 2018; Mayo et al, 2014; O'Leary and Vij, 2012.<br><br>**-------------------------------------**<br><br>Sadeghi et al, 2022; Wang et al, 2016<br><br>Alexander et al, 2001; Chicksand, 2015; Essabbar et al, 2016; Rehme et al, 2016 |
| **Accountability** | **Conflict resolution process (mixed opinion)** | ***N*** | Bryson et al, 2006; Bryson et al, 2009; O'Leary and Vij, 2012. |

| | | | |
|---|---|---|---|
| **Legitimacy** | **Not required**<br>**(No formal collaboration)** | ***NI*** | Bryson et al, 2006; O'Leary and Vij, 2012. |
| **Trust** | **Trust in Relationship**<br>**(Consensus)**<br>-----------------------------------------<br>***Four Conditions to Develop Trust:***<br>**Honesty (7 participants agreed)**<br>**Regular Communication**<br>**(6 participants agreed)**<br>**Time (to develop relationship)**<br>**(5 participants agreed)**<br>**Transparency**<br>**(4 participants agreed)** | ***VI***<br>***I***<br>***I***<br>***I***<br>***I*** | Austin, 2010; Austin and Seitanidi, 2014; Bryson et al, 2006; Couchman and Fulop, 2009; Forrer et al, 2014; Johnson and Finegood, 2015; Mohr and Spekman; O'Leary and Vij, 2012; Osborne, 2006; Perkmann et al, 2014; Vernis et al, 2006; Ukalkar, 2000.<br>-------------------------------------<br>Ahimbisibweet al, 2012; Hardwick et al, 2013; Maser and Thompson, 2013; Ntayi, et al, 2010; Spekman and Carraway, 2005.<br>Bollen et al, 2018; Huang et al, 2020; Scholten and Schilder, 2015.<br>Ahimbisibweet al, 2012; Hardwick et al, 2013; Maser and Thompson, 2013; Spekman and Carraway, 2005.<br>Maser and Thompson, 2013; Spekman and Carraway, 2005. |
| **Information Technology** | ***Four Media Channels:***<br>--------------------------------------<br>***In Person***<br>***(11 participants agreed)***<br>--------------------------------------<br>***Email***<br>***(10 participants agreed)***<br>--------------------------------------<br>***Conference Call***<br>***(9 participants agreed)*** | ----------------<br>***VI***<br>***VI***<br>***VI*** | Austin 2010; O'Leary and Vij, 2012<br>-------------------------------------<br>Eagle et al, 2012; Fill and Turnbull, 2019; Fraccastoro et al, 2021; Hänninen and Karjaluoto, 2017; Hill et all, 2009; Oshri et al, 2007; Rodriguez Cano et al, 2005.<br>-------------------------------------<br>Eagle et al, 2012; Fill and Turnbull, 2019; Fraccastoro et al, 2021; Hänninen and Karjaluoto, 2017; Oshri et al, 2007; Rodriguez Cano et al, 2005.<br>-------------------------------------<br>Eagle et al, 2021; Fill and Turnbull, 2019. |

| | | | |
|---|---|---|---|
| | **------------------------------------**<br>***Phone Call***<br>***(6 participants agreed)*** | **VI** | **-------------------------------------**<br>Eagle et al, 2012; Fill and Turnbull, 2019; Fraccastoro et al, 2021; Hänninen and Karjaluoto, 2017; Oshri et al, 2007; Rodriguez Cano et al, 2005. |
| **Culture** | **Not required**<br>**(No formal collaboration)** | ***NI*** | Johnson and Finegood, 2015; Ivascu et al 2016; Mendel and Brudney, 2018; Mohr and Spekman, 1994; Vernis et al, 2006; Ukalkar, 2000. |
| **Collaboration Monitoring** | **Not required**<br>**(No formal collaboration)** | ***NI*** | Austin 2000; Jamali and Keshishian 2009; Johnson and Finegood, 2015; Seitanidi et al. 2010; Von Tuder et al, 2016; Ukalkar, 2000. |
| **Collaboration Evaluation** | **Not required**<br>**(No formal collaboration)** | ***NI*** | Austin 2000; Jamali and Keshishian 2009; Johnson and Finegood, 2015; Seitanidi et al. 2010; Von Tuder et al, 2016; Ukalkar, 2000. |
| **Continuous Improvement** | **Not required**<br>**(No formal collaboration)** | ***NI*** | Johnson and Finegood, 2015; Ukalkar, 2000. |
| **Leadership** | **Not required**<br>**(No formal collaboration)** | ***NI*** | Bryson et al, 2009; Crosby and Bryson, 2010; Malin and Hackmann 2019. |
| **Partnership Length** | **Partnership Length**<br>**3 years – benchtop equipment**<br>**5 years – capital equipment (required installing into the fabric of a building)** | ***VI*** | Mendel and Brudney, 2018; Mohr and Spekman, 1994; Vernis et al, 2006; Ukalkar, 2000. |
| **Cross-Functional Teams** | **Not required**<br>**(No formal collaboration)** | ***NI*** | Mendel and Brudney, 2018; Mohr and Spekman, 1994; Vernis et al, 2006; Ukalkar, 2000. |

Key: VI - Very Important Factor, I - Important Factor, Neutral – Mixed Response from participants, Not Important – Factor missing.

Source: Tyrrell (2022)

In conclusion, from the tender documentation, supplier tender returns, research contract and participant responses, there are several “very important” and “important” CSC factors that are specific to a successful university-industry collaboration. Within the context of the collaboration, all buyer participants confirmed they had difficulty accessing resources, experienced increased competition within both internal and external funding environments to obtain funding for their teaching and research activities (Bryson et al, 2006; Clarke and Fuller, 2010; Hartman and Dhanda, 2018; O'Leary and Vij, 2012; Osborne, 2006; Perkmann et al, 2014). As buyers are unable to obtain funding or resources to conduct their research and teaching activities, these CSC factors drive buyers to develop collaborations with industry to access new scientific equipment. In contrast, when buyers were asked if they had a "centre of excellence" status which comes with additional funding only P5 was confident that they received this funding (UKRI, 2022). There was general confusion among the buyers on their status and its impact on their teaching and research activities. Therefore, the author defined this factor as neutral as it neither impacted nor influence the buyer to develop a collaboration with a supplier.

Within the collaboration's purpose (CSC factor), the main purpose and motivation for the collaboration between the buyer (9 participants agreed) and supplier (7 participants agreed) was to access the knowledge and expertise of their partner during the collaboration (Austin 2010; Bryston et al, 2009; Clarke and Fuller, 2010; Johnson and Finegood, 2015; Ivascu et al, 2016; Mayo et al, 2014; Mendel and Brudney, 2018; Mohr and Spekman, 1994; O'Leary and Vij; 2012; Perkmann et al, 2014; Thune, 2011; Vernis et al, 2006; Ukalkar, 2000). Another main motivation for the supplier (3 participants) was that the knowledge provided by the buyer results in new scientific equipment that can be sold to other academics in UK universities, allowing the supplier increase market share and create additional revenue. With reference to commitment, both buyer and supplier agreed that their relationship was long term, in most cases over various projects (Mendel and Brudney, 2018; Mohr and Spekman, 1994; Vernis et al, 2006; Ukalkar, 2000). Another commitment factor is both the buyer and supplier shared each other's goals for the collaboration, both factors are important, as it generates security and loyalty between the partners in the collaboration.

In contrast, within the section on supplier selection, process, and capabilities, once again both buyers (9 participants agreed) and suppliers (7 participants agreed) stated that knowledge and expertise was the method for selecting a partner with the capabilities to complement the other partner (O'Leary and Vij, 2012). As knowledge and expertise are used as a reason for the collaboration and partner selection, the author determined this was a very important factor for the success of the collaboration. Within the structure of the collaboration there was consensus among the participant's that regular communication was very important to transfer knowledge (Bollen et al, 2018; Huang et al, 2020; Scholten and Schilder, 2015), with most communication taking place via email (9 participants agreed), (Eagle et al, 2012; Fill and Turnbull, 2019; Fraccastoro et al, 2021; Hänninen and Karjaluoto, 2017; Oshri et al, 2007; Rodriguez Cano et al, 2005) and telephone calls (5 participants agreed), (Eagle et al, 2012; Fill and Turnbull, 2019; Fraccastoro et al, 2021; Hänninen and Karjaluoto, 2017; Oshri et al, 2007; Rodriguez Cano et al, 2005).

Although it is very important for both partners to obtain management support for the collaboration both from the university and the firm before, during and after the partnership. These collaborations are not formal collaborations as both questions asking participant's if they had a research contract in place or if they have involved the university TTO in developing a collaboration was mixed. Only the MRI buyers and suppliers (P3, S3, P13 and S13) and P12 had a research contract in place for the collaboration. From the participant responses, the main point of contact is the buyer and supplier representatives, who manage the transfer of knowledge between the university and firm.

Power in the relationship between the partners is influenced by two factors, firstly by the buyer having the money (3 participants agreed) to decide to purchase the equipment from a specific supplier or not. Secondly, by the supplier having the expertise to develop the new scientific equipment/application (3 participants agreed) (Halseth and Ryser, 2007). The author identified these factors as important and can impact on how power was managed during the relationship (Bryson et al, 2006; Hartman and Dhanda, 2018; Mayo et al, 2014; O'Leary and Vij, 2012). However, opinions on who holds the power in the relationship was mixed, as 4 participants suggested power was held by the buyer during the collaboration (Sadeghi et al, 2022; Wang et al, 2016) and 6 participants felt power was balanced throughout the collaboration (Alexander et al, 2001; Chicksand, 2015; Essabbar et al, 2016; Rehme et al, 2016). Although this is an important factor in cross-sector collaborations, the responses did not provide more details on how power is balanced during the relationship, this requires further investigation.

Another CSC factor which is very important to create during the collaboration is trust, all participant's agreed this was a "very" important factor (Austin, 2010; Austin and Seitanidi, 2014; Bryson et al, 2006; Couchman and Fulop, 2009; Forrer et al, 2014; Johnson and Finegood, 2015; Mohr and Spekman; O'Leary and Vij, 2012; Osborne, 2006; Perkmann et al, 2014; Vernis et al, 2006; Ukalkar, 2000). From the participant responses, there are four specific conditions for developing trust between the buyer and supplier, these are: 1) Honesty between the partners on their objectives and vision (7 participants agreed) (Ahimbisibweet al, 2012; Hardwick et al, 2013; Maser and Thompson, 2013; Ntayi, et al, 2010; Spekman and Carraway, 2005), 2) Regular communication between the partners to discuss the project (6 participants agreed) (Bollen et al, 2018; Huang et al, 2020; Scholten and Schilder, 2015), 3) Time, to develop rapport between the partners (5 participants agreed) (Ahimbisibweet al, 2012; Hardwick et al, 2013; Maser and Thompson, 2013; Spekman and Carraway, 2005), 4) Transparency, which allows partners to share their ideas, opinions, and feelings (4 participants agreed) (Maser and Thompson, 2013; Spekman and Carraway, 2005). These conditions need to be present for developing trust between the partners that leads to a successful collaboration.

From the participant responses, there are three-information technology processes that have been adopted to communicate the knowledge between the partners, these are: 1) Emails (10 participants agreed), (Eagle et al, 2012; Fill and Turnbull, 2019; Fraccastoro et al, 2021; Hänninen and Karjaluoto, 2017; Oshri et al, 2007; Rodriguez Cano et al, 2005), 2) Conference Calls (9 participants agreed), (Eagle et al, 2021; Fill and Turnbull, 2019), 3) Phone Calls (6 participants agreed), (Eagle et al, 2012; Fill and Turnbull, 2019; Fraccastoro et al, 2021; Hänninen and Karjaluoto, 2017; Oshri et al, 2007; Rodriguez Cano et al, 2005).

However, participants prefer face-to-face communication (11 participants agreed), (Eagle et al, 2012; Fill and Turnbull, 2019; Fraccastoro et al, 2021; Hänninen and Karjaluoto, 2017; Oshri et al, 2007; Rodriguez Cano et al, 2005) as this allows the partners to develop trust. Therefore, the use of information technology and face-to-face communication is very important to participants to transfer knowledge during the collaboration.

The duration of all collaborations being studied, is very short, the collaboration duration is split into two types. The first collaboration is of 3-years, based on new innovations on bench top scientific equipment and the second type is 5-year collaborations, based on capital equipment that needs installation into the fabric of the building (Mendel and Brudney, 2018; Mohr and Spekman, 1994; Vernis et al, 2006; Ukalkar, 2000). Although the author has defined collaboration length as "very" important factor in making a collaboration successful. The actual duration of the knowledge transfer to create the new scientific equipment is shorter, as once the contract has been awarded to the supplier, the supplier has until the delivery, installation, and commissioning date to develop a working prototype, in most cases this is a couple of months. Within the data, there are several CSC factors that are not present in university-industry collaboration.

Table 7.7 below provides a summary of these factors that are not present in university-industry collaboration.

**Table 7.7 - CSC Factors Not Present in University-Industry Collaboration**

| Critical Success Factor | Sub Factors | *Level* | Literature reference |
|---|---|---|---|
| **Legitimacy** | **Not required (No formal collaboration)** | ***NI*** | Bryson et al, 2006; O'Leary and Vij, 2012 |
| **Culture** | **Not required (No formal collaboration)** | ***NI*** | Johnson and Finegood, 2015; Ivascu et al 2016; Mendel and Brudney, 2018; Mohr and Spekman, 1994; Vernis et al, 2006; Ukalkar, 2000. |
| **Collaboration Monitoring** | **Not required (No formal collaboration)** | ***NI*** | Austin, 2000; Jamali and Keshishian 2009; Johnson and Finegood, 2015; Seitanidi et al. 2010; Von Tuder et al, 2016; Ukalkar, 2000. |
| **Collaboration Evaluation** | **Not required (No formal collaboration)** | ***NI*** | Austin, 2000; Jamali and Keshishian 2009; Johnson and Finegood, 2015; Seitanidi et al. 2010; Von Tuder et al, 2016; Ukalkar, 2000. |
| **Continuous Improvement** | **Not required (No formal collaboration)** | ***NI*** | Johnson and Finegood, 2015; Ukalkar, 2000. |
| **Leadership** | **Not required (No formal collaboration)** | ***NI*** | Bryson et al, 2009; Crosby and Bryson, 2010; Malin and Hackmann 2019. |
| **Cross-Functional Teams** | **Not required (No formal collaboration)** | ***NI*** | Mendel and Brudney, 2018; Mohr and Spekman, 1994; Vernis et al, 2006; Ukalkar, 2000. |

Key: Not Important – Factor missing

Source: Tyrrell (2022)

The reason these CSC factors are not important in university-industry collaboration, is most of these collaborations are not formal agreements, with cross-functional teams, but informal relationships in which buyers obtain new scientific equipment and value-added factors to further their research and teaching activities. While the supplier accesses the knowledge and IP benefits to develop and create a working prototype of the scientific equipment, to manufacture and sell to other university academics. Finally, the benefits obtained by the supplier from the collaboration and the CSC factors identified by the buyer are critical to the success of university - firm collaboration.

In conclusion from the data in the buyer telephone interview and supplier virtual meeting responses, the author has concluded that as most buyers do not have a collaboration or research agreement in place, the supplier obtains unlimited IP rights in the equipment and can obtain all revenue generated from the sales of the equipment to current and future buyers. This creates an incentive for suppliers to collaborate with the lead-user (buyer).

However, for the supplier to benefit from this relationship and obtain these value-added factors of the collaboration, the following critical success factors needs to be present for a collaboration to be successful and a new innovation created. The collaboration context (Bryson et al, 2006; Clarke and Fuller, 2010; Hartman and Dhanda, 2018; O'Leary and Vij, 2012; Osborne, 2006; Perkmann et al, 2014) has a major impact on the success of the collaboration, as the external and internal funding environment for buyers becomes more competitive, making it difficult to access resources to support their teaching and research activities. These two factors are driving buyers to form collaborations with suppliers to be able to access the skills and resources they lack.

This interlinks with the purpose, motivation and commitment (Austin 2010; Bryston et al, 2009; Clarke and Fuller, 2010; Johnson and Finegood, 2015; Ivascu et al, 2016; Mayo et al, 2014; Mendel and Brudney, 2018; Mohr and Spekman, 1994; O'Leary and Vij; 2012; Perkmann et al, 2014; Thune, 2011; Vernis et al, 2006; Ukalkar, 2000), from the participant responses the majority of participants agreed that the expertise of both partners was very important to ensure the new scientific equipment is developed. Participants unanimously agreed, that sharing the goals to jointly develop the new scientific equipment and for each partner to obtain certain value-added factors from the partnership is a key driving factor for collaboration. Finally, participants agreed unanimously, that the relationship between the partner was long term, this interlinks with the finding in Chapter 5 - Buyer and Supplier Demographics, that both partners are serial innovators (Corradini et al, 2015; Griffin et al, 2014; Tuzovic et al, 2018; Vojak et al, 2012), as both partners have repeatedly created new innovations that meet customer's needs and deliver long-term value for their firms.

A surprise finding is during the partner selection process and capability of the collaboration (O'Leary and Vij, 2012), the same finding can be found as in the purpose and motivation for the collaboration. That both partners motivations, selection process and partners capability focus is on the knowledge and expertise of the partners, in the collaboration. Another critical success factor within the model, is Collaboration Structure, Governance, and Communication (Austin, 2010; Austin and Seitanidi, 2014; Bryson et al, 2006; Bryson et al, 2009; O'Leary and Vij, 2012; Mendel and Brudney, 2018; Mohr and Spekman, 1994; Perkmann et al, 2014; Vernis et al, 2006; Kalker, 2000). For the collaboration to be successful, the buyer and supplier needs to have support from both the university and firm senior management team to form a collaboration, failure by each partnership to gain support from the senior management team could result in the collaboration failing, there was consensus between participant's this was a key requirement. As university-industry collaborations are not formal with no signed collaboration agreement or limited clauses in a research contract, the consensus among the participant's that the main point of contact was the buyer and supplier representative during the collaboration, as they act as a facilitator for their internal teams for knowledge transfer. This interlinks the requirement for regular communications between partners (Bollen et al, 2018; Huang et al, 2020; Scholten and Schilder, 2015), so the knowledge can flow freely during the partnership. The main knowledge transfer methods used by both buyer and supplier during the collaboration, as agreed by most of the participants, is email and phone calls between the partners.

Within the relationship power is an important factor that shapes the partnership, if one partner has more resources than the other, this can lead to mistrust developing between the partners and the failure of the collaboration (Bryson et al, 2006; Hartman and Dhanda, 2018; Mayo et al, 2014; O'Leary and Vij, 2012). Within university-industry collaboration, power can be influenced by two main factors in the partnership. At the start of the partnership the buyer has influence over the supplier, as the buyer holds the funding (money) to develop the new scientific equipment. Once the supplier has been selected the supplier holds the power, as the supplier holds the expertise and resources to develop the new scientific equipment.  This leads into who holds the power during the partnership, from the participants responses, the main perspective was that power is balanced during the relationship (Alexander et al, 2001; Chicksand, 2015; Essabbar et al, 2016; Rehme et al, 2016).

Trust plays a critical role during the partnership, trust is developed between the constant interactions between individuals involved in the partnership (Austin, 2010; Austin and Seitanidi, 2014; Bryson et al, 2006; Couchman and Fulop, 2009; Forrer et al, 2014; Johnson and Finegood, 2015; O'Leary and Vij, 2012; Osborne, 2006; Perkmann et al, 2014; Ukalkar, 2000). Study participants agreed unanimously, trust is a "very important factor with university firm collaborations. On further investigation, participants indicated four conditions for developing trust between the partners. Honesty (Ahimbisibweet al, 2012; Hardwick et al, 2013; Maser and Thompson, 2013; Ntayi, et al, 2010; Spekman and Carraway, 2005), and transparency (Maser and Thompson, 2013; Spekman and Carraway, 2005) are two factors that are "important" and interlinked, as to develop trust between the partners, each partner must be honest and transparent in the motives and objectives during their interactions with each other. An "important" factor is regular communication, (Bollen et al, 2018; Huang et al, 2020; Scholten and Schilder, 2015), this interlinks with time (Ahimbisibweet al, 2012; Hardwick et al, 2013; Maser and Thompson, 2013; Spekman and Carraway, 2005) to developed trust, regular communication helps the transfer of knowledge between the partners and develops shared goals which over time develops trust. These sub-factors are key critical success factors that are present in university-industry collaboration.

As the suppliers are geographically dispersed around the globe, information technology is a critical factor to ensure the smooth transfer of knowledge between the partners and check the progress of the collaboration objectives (Austin 2010; O'Leary and Vij, 2012). From the participant responses, there are four media channels that are used to communicate knowledge between the partners. The main method of communication is through face-to-face interactions which is preferred by both buyer and supplier participants during the collaboration (Eagle et al, 2012; Fill and Turnbull, 2019; Fraccastoro et al, 2021; Hänninen and Karjaluoto, 2017; Hill et al, 2009; Oshri et al, 2007; Rodriguez Cano et al, 2005). The other three methods are related to information technology, emails, phone calls and conference calls, all four of these media channels are "very important" (Eagle et al, 2012; Fill and Turnbull, 2019; Fraccastoro et al, 2021; Hänninen and Karjaluoto, 2017; Oshri et al, 2007; Rodriguez Cano et al, 2005). These factors develop rapport, create trust, share knowledge, and foster outcomes between the partners during the collaboration.

Within the research findings, equipment that does not require to be installed into the infrastructure of the building but placed on the bench top has a partnership length of around 3 years. Equipment that requires to be integrated in the fabric of the building requires a collaboration length of 5 years at minimum. Partnership length is a "very important" factor, as trust develops over time between the partners (Mendel and Brudney, 2018; Mohr and Spekman, 1994; Vernis et al, 2006; Ukalkar, 2000).

Finally, after reviewing the secondary data which included the tender specification, supplier tender return, one research and development contract and buyer/supplier meeting minutes. The author concluded that no CSC factors are present in the secondary data to confirm the CSC factors present in university-industry collaborations. As the buyer/supplier meeting minutes focused on the arrangements for delivering, installing, and commissioning the equipment in the buyer's laboratory. Consequently, the author used the findings from the primary data, to summarize the important CSC factors present in university-industry collaboration and the CSC factors not implemented in university-industry collaborations.

# Chapter 8: Recommendations to Change the ITT and Tender Process

## 8.1 Introduction

This chapter provides the study's recommendations correlated from the data analysis, findings collected from the buyer and supplier characteristics (demographics), value-added factors identified and CSC factors that are present in the collaboration from the specification documents, supplier tender returns, the buyer telephone interviews and supplier virtual meeting responses. As a qualitative approach has been adopted for this studying on university-industry collaboration, the author has reflected on these findings and provides recommendations on how to add the value-added and CSC factors into the tender document and tendering process.

As both final research questions are interlinked, with any recommendations to change the procurement process and tender documentation influence each other's outcome. The author has integrated these two questions together, asking study participants their opinions on the methods to improve the tender specification, ITT, and tender process to make it more conducive to university-industry collaboration. The university ITT being investigated by the author consist of several different sections as identified in Table 2.10 in Chapter 2 Literature Review. Samples of these sections have not been included in this study, as each section would identify the university under investigation (e.g., wording, layout, style, information requested from supplier etc). The section below is the recommendations made from the analysis of Chapter 5, 6 and 7.

## 8.2 Buyer and Supplier Demographics Recommendations

Although the suppliers in this research study have added the buyer into their open innovation process to obtain knowledge to create new innovations and services. Von Hippel (1998) did develop a 5-step process for implementing end-user innovation into a firm's research and development process, which consists of 1) Identifying a need to advance the instrumentation, 2) Create the instrument, 3) Build a prototype, 4) Identify the prototype's value and apply it. 5) Diffuse the knowledge on how the instrument can be replicated and defuse the value of the invention. However, von Hippel's model fails to define how the firms can identify the lead end-user (buyer) to embed in the innovation process within the firm.

One method of identifying the lead-user (buyer) characteristics is by using the enhanced demographics in this research study as a starting point to finding a lead end-user (buyer) to identify if they have a need to innovate within their specific scientific field the supplier operates within.

The lead-user (buyer) characteristics are:

1) A Professor, Doctoral Fellow, Research Fellow, or Reader.
2) A buyer that is either purchasing the scientific equipment for their own research, or a buyer that runs a core facility for other buyers to use (at as cost) for teaching and research activities.
3) Receives a large publicly awarded grant to carry out scientific research on a regular basis.
4) The buyer undertakes teaching and research activities.
5) Publishes journal articles and attend conferences regularly.
6) Undertakes teaching of PhD students.
7) The buyer obtains the equipment 6 to 12 month before market release.
8) This speeds up and improving the buyers research output.

Source: Tyrrell (2022)

Using these characteristics to identify the lead-user (buyer), this reduces the cost of the firm's marketing department trying to engage with buyers that are not the lead-end user (buyer) with the supplier customer base. Once the firm has identified that lead-user (buyer), they can then adopt von Hippel's five step process to develop the prototype. However, during the testing of the protype, the firm will need to work with the buyer to solve any teething troubles with the operation of the new scientific equipment, as the innovation process may not be a linear one. Once the firm has identified that lead-user (buyer), they can then adopt von Hippel's five step process to develop the prototype.

## 8.3 Changes to the Specification Template and ITT

Within the participant telephone interview and virtual meeting questions, the author asked participants their opinions on the changes that needs to be made to the specification and ITT to make it more conducive to collaboration. Table 8.1 below is a summary of the buyer and supplier participants responses to which value-added factors; CSC factors and general changes should be made to the tender specification template and ITT.

**Table 8.1 - Specification Form and ITT Changes**

| **Value-Added Factors** | **CSC Factors** |
|---|---|
| **Offer on pre-existing equipment*<br>**Annual preventative maintenance*<br>** Upgrades to existing Equipment*<br>**Add More Mandatory Questions*<br>**Procurement Knowledge*<br>**Procurement Support during Process* | **Include Supplier Review Meeting*<br>** PI Knowledge Offered*<br>*(Supplier Benefits of Collaboration)*<br>** Advanced Information (before tender)* |
| **General Process Design** | **Other Factors** |
| ** Process to Redesign the Specification*<br>** Reduce Tender Timeline*<br>** Change Marking Scheme*<br>** Project Stages and Sign Off*<br>** Simpler ITT*<br>** Terms Agreed in Advance of Award* | None |

Source: Tyrrell (2022)

From table, 8.1, the author has arranged the recommendations from the participants into four specific groups, firstly is equipment value-added factors which buyers consider important to obtain during the collaboration, as P1 suggested the supplier should make a "Offer on pre-existing equipment, annual preventative maintenance, and upgrades to existing equipment". Another factor is involving the procurement professional in the development of the specification. Secondly, group of recommendations includes general process designs to the tender process and ITT, thirdly specific CSC factors that can be added to the specification template to make the tender process more conducive to collaboration. Fourthly, there was no additional factors that fell outside of these three categories. However, the importance of procurement supporting the buyer to include value-added factors and CSC factors in the tender documents is supported by P2 comments "all universities undertaking equipment purchases, should have some form of collaboration in the spec, "this should be specified as a standard, but it would be different for different kinds of people and different situations". This quotation indicates that each of the CSC and value-added factors are specific to each buyer and supplier to meet their own objectives, research aims and teaching requirements. Therefore, the procurement professional should support the tendering process; to identify the value-added factors the buyer can add to the specification template.

Options for changing the specification template include as P2 and S6/7 (2 participants agreed) suggest adding a section in to allow buyers to change the specification after the contract has been awarded. For capital equipment that requires being built into the fabric of the building, this would be useful. Within the specification under "Implementation Plan", a question could be added to review the specification and make modifications before the final delivery, installation, and commissioning of the scientific equipment. Another change to make to the specification template, is the inclusion of review meetings into the spec (a CSC factor), these can be regular meetings between the buyer and supplier either face-to-face meetings or conference calls for updates on the collaboration. The review meetings (5 participants agreed) can be used as a process to transfer knowledge between the buyer and supplier by using email, progress reports, informational reports, and formal reports. The frequency of the meetings can be weekly, monthly, quarterly, or yearly, the frequency of these meetings should be discussed with the buyer, as the complexity of the project may require more regular communication (Bollen et al, 2018; Huang et al, 2020; Scholten and Schilder, 2015) during the collaboration. The author asked P4 if it would be beneficial to add review meetings to the tender specification, P4 suggested “oh, so I think anything like that, will definitely going to be helpful, because we are not just buying goods right, we are buying much finer equipment and also buying the service that they have to offer afterwards. So, I think it quite useful to have, in terms of what type of service do we get, with most of the research equipment, what you really have is if something goes wrong, then you call them and subject to your service agreement, will come to see it or they come to fix it”.

By adding a review meeting into the specification template, three CSC factors which are critical to a successful collaboration can be incorporated into the specification template. These CSC factors are trust (Austin, 2010; Austin and Seitanidi, 2014; Bryson et al, 2006; Couchman and Fulop, 2009; Forrer et al, 2014; Johnson and Finegood, 2015; O’Leary and Vij, 2012; Osborne, 2006; Perkmann et al, 2014; Ukalkar, 2000, information technology (Austin 2010; Austin and Seitanidi, 2014; O’Leary and Vij, 2012; Ukalkar, 2000) and regular communication (Bollen et al, 2018; Huang et al, 2020; Scholten and Schilder, 2015). All these CSC factors are interrelated, as regular use of information technology including conference calls and emails can help transfer knowledge between the parties including via progress report, informational reports, and formal reports. Regular communication can also help develop trust between the two partners, reduce conflict, help problem solving and builds better relationships (Bollen et al, 2018; Huang et al, 2020; Scholten and Schilder, 2015). Face-to-Face communication allows the partners to be honest and transparent in their interactions leading to the partners developing trust.

Another option to improve the specification documents to make it more conducive to collaboration, is to provide the supplier with information on the benefits the buyer will offer to the supplier by collaborating with them (2 participants agreed). As S3 comments

> "What we are looking for is what the PI brings to the table, there is no point asking for a completely weird machine, that going to cost 50 million to develop, we need to know that the site has 50 million quid's work of capability to bring this to fruition. Uhm, and so not don't, uhm I know this is a conversation I have with many buyers, is that they have to sell themselves to the other suppliers, there's a certain amount of yes, because you are asking for a huge amount of work and investment, we need to know that it's going to work at the end of it! Sometimes we can do that based on the reputation of the PI or institution, and sometimes we can't. Knowing what they are bringing to the table help's us immensely on whether we want to collaborate with them".

From this quotation a new section in the specification form needs to be added, called benefits of working with the buyer. This would allow the PI to state to any potential supplier the benefits they are prepared to offer to supplier's if they are prepared to engage in a collaboration with them. For example, access to clinical trial data sets, background research from the buyer research area, access to university facilities or PhD students and possible joint funding. However, each of these factors would depend on the resources the buyer had access to within their university. By adding the benefits of working with the buyer this would form part of the tender return and be covered by the contract terms.

Project stages (1 participant commented), could be added to the specification, as P12 commented "yes, it captures all the requirements, as long as you are familiar with that form, what you actually need, I think is, not just one form but a process that goes in onion layers, top level expectation and then you go to the next layer down, OK try to specify this, and you can get sign off. Define the top layer now, me and you have 6 months to buy and instrument, you have a one year grant, no buying equipment after 6 months rule, right I got to get from here to here, it almost as if you need a timeline, in week one you will do this, in week three you will do that, in week five, so on and so on, and at the beginning you define the high level, this is what I want and week three you drill down on the next bit, and it becomes a process, that would be ideal". Within the specification template, there is a section on implementation, this could be adjusted to add specific milestones that can be signed off and these linked to the pricing schedule in section 6. For scientific equipment that requires assembly into the fabric of the building, or have ongoing PhD funding, this would require the buyer and procurement professional to agree the project stages to include in the specification template and pricing schedule before the ITT is issued to potential bidders. This requires a step change in the procurement process to include procurement in the development of the specification form and ITT. This will be discussed in more details in paragraph 8.4.

This interlinks with the recommendation by P1 and P4 (2 buyers agreed) to include the procurement professional in the development of the specification and ITT. As P4 suggests, “thinking about the template, I always got a bit of concern about the template, so if the procurement officer was handling the template, you know me I have done a couple of times with (procurement professional named), explains a lot of what is expected, in the template you can ask what does this mean, what does that mean, I don’t have any doubt with the template”. As the procurement professional is involved in developing the tender documents and process, they can ensure that any changes made keep the principles of a fair and transparent process for tendering (Behzad Ghorbany Darabad, 2017; Khaled Mustafa and Waheed, 2019; Osei-Afoakwa, 2014; Thai, 2004). As procurement will support the development of the specification, with the approval of the buyer, more of the mandatory elements of the specification could move to the mandatory questions in section 4. These are questions or requirements that the supplier must pass to not be rejected from the tender.

> *As P1 argues” I would say we need to tie down and put in more mandatories to protect us. Because of the diversity that is existing, within the current marketplace for the equipment we trying to buy, what we need to ascertain if we are dealing with a company we believe is going to be here in 10 or 20 years’ time or are we potentially dealing with a company that all they are interested in is developing a said product, getting it out there, selling it and in five years’ time make enough money, to make sure they are viable enough to be sold on to another larger*

> *company, who could acquire them, that is all they believe that they want to do".*

However, any changes made to the mandatory questions would need to be general, not specific to stop all but one bidder from submitting a bid, as the process would no longer be transparent and fair (Behzad Ghorbany Darabad, 2017; Khaled Mustafa and Waheed, 2019; Osei-Afoakwa, 2014; Thai, 2004).

> *In contrast, S13 commented "uhm I think, what would be particularly nice, was for some of the more complex projects, uh, or a more formal way sharing the likely requirements ahead of tenders. The rationale behind that is something you are up against it with the time, so being given information ahead of the tender, particularly if you imagine we get a lot of academic customers wanting a lot of third-party items, and because they did not tell us ahead of time, we have challenges that the items are actually approved, or there is a huge amount of stuff we are having to do".*

From the quotation provided by S13, if the project is complex, procurement would need to provide advanced information ahead of the tender being issued or hold an information day with potential bidders to discuss the possible requirements for the project. This would require a step change to the tender process. The change in process will be illustrated in the section titled "8.1 Tender Process Changes".

Another recommendation is the inclusion of a conflict resolution process, as part of the ITT design, although in the past, buyer's and supplier have not needed a conflict resolution process, hopefully adding a reference to using CEDR's would encourage potential collaborators to collaborate with the university buyer. CEDR offer an arbitration service, that is independent and has an impartial person (the arbitrator) that reviews and makes decisions concerning conflicts and disputes without the need for the matter to go to court (CEDR, 2019).

However, the are several recommendations, that cannot be implemented as the specific parts of the tendering documentation and process, are interlinked with the requirement to make the tender process fair and transparent (Behzad

Ghorbany Darabad, 2017; Khaled Mustafa and Waheed, 2019; Osei-Afoakwa, 2014; Thai, 2004) to comply with the funder's guidelines.

Even though the university tender is being conducted outside the OJEC regulations, removing, or changing the marking scheme (1 participant agreed), changing the timelines to make the process shorter (3 participants agreed), pre-agree the terms and conditions with the suppliers before the tender is awarded (1 participant agreed), and simplifying the tender documents (4 participants agreed). These factors in the ITT, are governed by the principles of a fair and transparent process, where all bidders can apply and be selected on similar criteria with no discriminatory treatment (Behzad Ghorbany Darabad, 2017; Khaled Mustafa and Waheed, 2019; Osei-Afoakwa, 2014; Thai, 2004). Any changes to these factors could make the process unfair and favour a specific supplier, therefore these changes could not be implemented.

In conclusion the author has identified several changes that can be implemented in the tender specification template and ITT documents.

Table 8.2 is a summary of the changes and sections that need to be added to improve the tender process.

## Table: 8.2 - Specification Template Summarized Changes

| **New Section Added** | **Factor** | **Tender Documentation** |
|---|---|---|
| Process to redesign the specification | General Recommendation | Specification form – Add new line under ***Implementation Plan Section*** |
| Supplier Review Meeting Process | CSC factors (Regular Communication, Information Technology and Trust) | Specification form – Add New Section ***Review Meetings/Communications Process*** |
| Benefits of working with PI | CSC Factor Expertise | Specification form – Add New Section ***Benefits of working with University PI*** |
| Project Stages/Milestones | General Recommendation | Specification form – add new lines to incorporate changes in **Implementation Plan Section** |
| Free Equipment Delivery /Installation /Commissioning | Equipment Value-Added Factor | Specification form – Add new line under **Delivery Section** |
| Free Extended Warranty | Equipment Value-Added Factor | Specification form – Add new line under **Warranty Section** |
| Free Software Firmware, Patches, Upgrade(s) | Equipment Value-Added Factor | Specification form – Add new line under **Software Section** |
| Free Technical Support | Equipment Value-Added Factor | Specification form – Add new line under **Warranty Section** |
| Free Equipment Training | Equipment Value-Added Factor | Specification form – Add new line under **Training Section** |
| Account Manager | Equipment Value-Added Factor | Specification form – Add within New Section **Review Meeting and Account Management** |
| Free Beta Testing Equipment | Research Value-Add Factor | Specification form – Add new line under **Ongoing Development** |
| Free Equipment Manuals | Equipment Value-Added Factor | Specification form – Add new line under **Equipment Manuals.** |

Source: Tyrrell (2022)

By embedding these value-added factors into the specification template, the buyer will automatically receive benefits from the collaboration, as these factors no longer cost the buyer part of their budget for the equipment purchase. The recommendation for adding specific value-added factors by P1 (offer on pre-existing equipment, annual preventive maintenance offer and free upgrade to existing equipment will be discussed in more detail in section 8.4.

With reference to S13 suggestion to provide advanced information before the tender is issued and P1 suggestion to add more mandatory questions to the ITT, these will also be discussed in 8.4 as this requires a step change to the procurement tender process.

## 8.4 Tender Process Changes

Within the buyer telephone interview questions, the author asked buyer participant's if procurement services could provide a matrix of possible value-added factors that could be added to the tender specification template, to help the buyer understand what value-added factors would be suitable for their scientific equipment purchase. There was consensus among the buyer participant's that this would be a good idea. As confirmed by P2 commented "That would be a good idea" and as P5 argues "Yes, I think so". In the supplier virtual meetings, the supplier participants were not asked this question, as any factors that the suppliers suggested may be specific to their equipment offering which may make the tender process unfair (Fee et al, 2002).

Using the factors that have been identified in the value-added literature and triangulating against the value-added factors identified in the buyer responses, specification template, and supplier tender return. The author has summarized all the value-added factors from the value-added literature, tender returns, and participant responses below into a single table using the headings "equipment value-added factors", "research value-added factors", "student value-added factors" and "collaboration value-added factors".

Within table 8.3 the value-added factors identified as being present in university-industry collaborations, have been identified with (P) for present. Additionally, table 8.3 includes the buyer participant responses, to the question raised by the author "What value-added factors would you expect to see in the specification form that would persuade you to collaborate with this supplier?". The buyer participants response with the value-added factors they wish had been submitted by the supplier in the tender return, these have been added in the table 8.3 as "(D)" for desirable. Table 8.3 provides a summary of the value-added factors that can be added to the tender specification based on the buyer preference to each value-added factor.

**Table 8.3 - Value-Added Matrix**

| Equipment Value-Added Factors | Research Value-Added Factors |
|---|---|
| • Price (P)<br>• Equipment Functionality (P)<br>• Equipment Technical Support (P)<br>• Dedicated Account Manager (P)<br>• Enhanced Maintenance (P)<br>• Free Consumables (P)<br>• Discount Consumables (P)<br>• Supplier Design's Specification (P)<br>• Free Equipment Accessories (P)<br>• New Software (P)<br>• Free Software Upgrade(s) (P)<br>• Free Equipment Delivery//Installation/Commission (P)<br>• Free Extended Storage (P)<br>• Extended Warranty (P)<br>• Equipment Training (P)<br>• Free Spare Parts (P)<br>• Additional Free Upgrades (P)<br>• Free Equipment Manuals (P)<br>• Free Additional Equipment (P)<br>• Future Cost Reduction (D)<br>• Product Quality (Component Level) (D)<br>• Project Stages – Hand Over Process (D)<br>• Access to Skills to Develop New Equipment<br>• Whole Life Costing<br>• Upgrade of similar Type Equipment by Supplier<br>• Dedicated Service Engineer | • Supplier Technical Support based On Campus (P)<br>• Beta Equipment Testing (P)<br>• Seminar/Workshops (P)<br>• Potential Research Projects (P)<br>• Future Supplier Financial Stability (D)<br>• Guest Speaker for Research Seminars (D)<br>• Support Bids for Research Grants (D)<br>• Training Post-Graduate Scientists<br>• Access to Resources<br>• Access to Funds<br>• Co-authoring Scientific Publications<br>• Joint Projects Collaboration<br>• Patenting<br>• IP Licensing<br>• Incubation (spin off - new venture capital firms)<br>• Access to Research Facilities<br>• IP Shared Profit<br>• Accessing Knowledge<br>• New Skills Methods and Techniques |

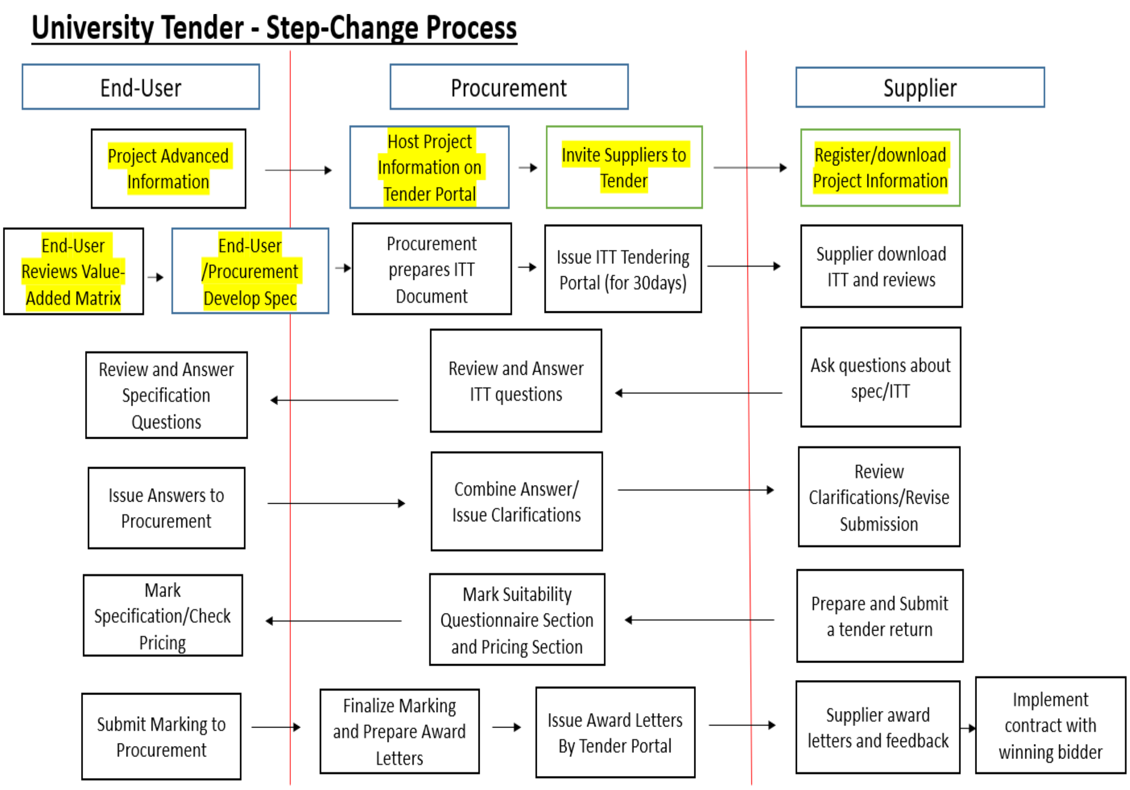
| | |
|---|---|
| • Faults Repaired within 24 Hours<br>• Develop New Techniques and Applications<br>• Product Quality<br>• Social Acceptance (including status, image,<br>• reputation, and trust) | |
| **Student Value-Added Factors** | **Collaboration Value-Added Factors** |
| • PhD scholarships (P)<br>• Offer a bridge between studies and work life skills by<br>• Offering Voluntary Internship (P)<br>• Undergraduate and Postgraduate placements (D)<br>• Increasing student work experience and skill to make<br>• Enhanced Student Employability<br>• Creating New Professional and Educational Courses<br>• Modifying current Courses to meet Employer Requirements<br>• Providing teaching and learning activities with the firm<br>• providing equipment<br>• Sponsoring Master and PhD student conferences<br>• Sponsoring of Master and PhD student poster displays<br>• Bursaries and Travel Grants<br>• Thesis Advice<br>• Off parameters for Student Projects<br>• Student Internships<br>• Student Access to Real-Life Case Studies<br>• Student Career Fair Support<br>• Firm Offers Student Recruitment Help<br>• Mentoring | • Technical expertise (P)<br>• Access to networks (P)<br>• Support Grant Applications (P)<br>• Support Program (P)<br>• Continuing Collaboration (P)<br>• Further Funding (P)<br>• Long term commitment to Collaboration (D)<br>• Access Supplier R&D<br>• Leverage on another collaboration or relationships with stakeholders<br>• Developing Research Services<br>• Technology Transfer<br>• Creating Informal Interactions<br>• Manage Risk<br>• Access to Venture Capital<br>• Supplier Location |

Key: **(P)**: Value-Added Factors that are present in university-industry collaboration. **(D)**: Value-Added Factors that buyer participants would have like provide by the supplier during the collaboration.

Source: Tyrrell (2022)

After confirmation from the buyer's that a matrix off value-added factors would be helpful in deciding what value-added factors to add to the tender specification template, a step change process should be implemented to allow the buyers to review and discuss with the procurement professional what factors are suitable to be added to their specification for tendering. As the value-added factors selected would be specific to the resources and skills that the buyer requires to complete their research and teaching activities. The specific value-added factor would complement the new value-added factors identified in table 8.2 that have been embedded as a standard requirement in the specification template. Any specific value-added factors identified in the table above by the buyer will be written in the tender specification template under the sections entitled “Ongoing Development”, “Collaboration” and the “Goods Performance”.  Figure 8.1 shows the new step change tendering process (with the updated and new steps highlighted in yellow), which includes the recommendation made by S13 to add an information stage to the tender process in advance of any tender being issued to potential bidders. This would allow suppliers for complex projects advanced warning to source additional products for the tender requirements.

**Figure 8.1 - University Tender Process Step-Change**




Source: Tyrrell (2022)

Figure 8.1 above shows two new stages and steps that have been added to the university tender process (these have been highlighted in yellow). The first stage is the advanced tender information being release to potential bidders on the tender portal in advance of a formal tender being issued to bidders. This allow suppliers advanced warning of requirements and alerts the market that there is a new contract for scientific equipment to be issued by the university. The next step change to the tender process, is to issue the value-added matrix to the buyer to review, then the procurement professional would discuss the various factors with the buyer and together decide which value-added factors should be included in the specification template. After which the original tender process would take place with the procurement department preparing the ITT for issue to potential bidders. The author theorized by adding this step into the tender process, value-added factors could be added to complement specific scientific equipment and provide the skills and resources the buyer lacks. This step change process provides a practical example for other HE procurement professionals of a method to embed value-added factors that support collaboration into the tender process.

## 8.5 Chapter 8 - Conclusions

From the buyer and supplier characteristics (demographics), the author recommended changing the 5-step process developed by von Hippel (1998) to embed the lead-user (buyer) into the firm’s innovation process, to adopt the study’s enhanced buyer characteristics data into a new 7-step process. By adopting these characteristics, the supplier can reduce the cost of its marketing budget, through the effective selection of the lead-user (buyer) who is able to provide the expertise to develop the new innovations.

From the participant responses, there has been several recommendations to change the specification template and ITT design, the author has grouped these changes into value-added factors, CSC factors and general changes to process or ITT design, and other factors these have been summarized in table 8.1. Recommendations for changing the specification template include, adding a new section under “Implementation Plan” to allow both parties to review and if required modify the equipment before delivery, installation, and commissioning. Another recommendation was adding a new section for review meetings in the specification template, this would allow partners to transfer knowledge using email, progress reports, informational reports, formal reports, to make sure the collaboration reaches it desired outcome. The frequency of the meetings should be discussed with the buyer before adding to the template. By adding review meetings to the specification template, three CSC factors which are critical to a successful collaboration can be incorporated into the specification template. These CSC factors are trust (Austin, 2010; Austin and Seitanidi, 2014; Bryson et al, 2006; Couchman and Fulop, 2009; Forrer et al, 2014; Johnson and Finegood, 2015; Mohr and Spekman; O’Leary and Vij, 2012; Osborne, 2006; Perkmann et al, 2014; Vernis et al, 2006; Ukalkar, 2000), information technology (Austin 2010; O’Leary and Vij, 2012) and regular communication (Bollen et al, 2018; Huang et al, 2020; Scholten and Schilder, 2015). All these CSC factors are interrelated, as regular use of information technology including conference calls and emails can help transfer knowledge between the parties including via progress reports, informational reports, and formal reports. Regular communication can also help develop trust between the two partners, reduce conflict, help problem solving and builds better relationships (Bollen et al, 2018; Huang et al, 2020; Scholten and Schilder, 2015). By undertaking face-to-face communication, the partners can develop trust through their interactions.

Another recommendation is to include the benefits of collaborating with the buyer for the supplier and have these stated in the specification template. By adding this to the specification template, this would engage bidders to collaborate, as the benefits of working with the buyer are identified and covered by the contract terms. Within the specification template another section could be added to implement project stages or milestones for scientific equipment that required assembly into the fabric of the building or if there is ongoing PhD funding offered by the supplier. This would require the involvement of the buyer and procurement services to agree the project stages to include in the specification template and pricing schedule. This required a step change to the procurement tendering process; this is illustrated in figure 8.1 “University Tender Process Step-Change” (the updated and new steps have been highlighted in yellow in the figure).

This interlinked with the recommendation made by two buyers that the procurement professional should be included in the development of the specification template and ITT design, as any changes made to the process can be checked for fairness and transparency by the procurement professional (Behzad Ghorbany Darabad, 2017; Khaled Mustafa and Waheed, 2019; Osei-Afoakwa, 2014; Thai, 2004). As the procurement professional will support the development of the specification and ITT, more of the mandatory elements of the specification can move to the mandatory section of the ITT. These are questions or requirements the supplier must pass not to have their tender rejected. However, any change to the mandatory questions should not be specific to one supplier to make sure the process is fair and transparent, procurement would need to monitor this process (Behzad Ghorbany Darabad, 2017; Khaled Mustafa and Waheed, 2019; Osei-Afoakwa, 2014; Thai, 2004).

Another recommended change includes providing advanced information ahead of the tender being issued or hold an information day with potential bidders to discuss the possible requirements for the project. This would require a step change to the tender process, this is illustrated in figure 8.1 “University Tender Process Step-Change”.  The author suggested that a conflict resolution process should be added as part of the ITT design, although in the past, buyer’s and suppliers did not require a conflict resolution process, hopefully adding a reference to using CEDR’s would encourage potential collaborators to collaborate with the university buyer. CEDR offer an arbitration service, that is independent and has an impartial person (the arbitrator) that reviews and makes decisions concerning conflicts and disputes without the need for the matter to go to court (CEDR, 2019).

However, there are several recommendations that cannot be implemented which are interlinked with the requirement to make the tender process fair and transparent to comply with the funder’s guidelines (Behzad Ghorbany Darabad, 2017; Khaled Mustafa and Waheed, 2019; Osei-Afoakwa, 2014; Thai, 2004). These recommendations include, removing or changing the marking scheme, change the tender timelines to make the process shorter, pre-agreeing terms and conditions with the supplier before the contract is awarded and simplifying the tender documents. All these factors could make the process unfair and favour a specific supplier, therefore these changes should not be implemented (Fee, et al, 2002).

The author has identified several changes that can be implemented in the tender specification template, these have been illustrated in table 8.2, by embedding these value-added factors into the specification template, the buyer will automatically receive benefits from the collaboration, as these factors no longer cost the buyer part of their budget for the equipment purchased. However, there are several recommendations that cannot be implemented as they are interlinked with the requirement to make the tender process fair and transparent (Behzad Ghorbany Darabad, 2017; Khaled Mustafa and Waheed, 2019; Osei-Afoakwa, 2014; Thai, 2004). These recommendations include, removing or changing the marking scheme, change the timelines to make the process shorter, pre-agreeing terms and conditions with the supplier before the contract is awarded and simplifying the tender documents. All these factors could make the process unfair and favour a specific supplier, therefore these changes should not be implemented (Fee, et al, 2002).

Within the buyer telephone interview, the author asked buyer participant’s if procurement services could provide a matrix of possible value-added factors that could be added to the tender specification template. The buyers unanimously agreed this would be a good idea. Using the value-added factors that have been identified in the value-added literature and triangulating against the value-added factors identified in the buyer response, specification, and supplier tender return. The author has summarized all the value-added factors into a new table 8.2 using the headings of “equipment value-added factors”, “research value-added factors”, “student value-added factors” and “collaboration value-added factors”. Using the data, the author summarised the value-added factors that are present in university-industry collaboration, as (P) for present and those buyers had wished the supplier had submitted in their tender return as desirable as (D) in the table.

Once the buyer has confirmed the value-added factors which are suitable for their specific project and embedded in the specification template. A step-change process is required to implement these changes into the tender process. Figure 8.1 shows the new step change tendering process, which included all recommendations made by participants during the buyer telephone interviews and supplier virtual meetings. The first step is to issue the advanced information on the tender to potential bidders via the universities tendering portal, this offers suppliers advanced warning of the requirements of the tender alerting the market to the opportunity. The next step change is to share the value-added matrix with the buyer for review, then the procurement professional can discuss with the buyer the value-added factors that should be included in the specification template. Once these two steps have been completed the procurement professional would finalise the ITT and issue to potential bidders via the tendering portal. From this point on, the original tender process would take place. Figure 8.1 provides a practical example to other HE procurement professionals of a method to embed value-added and CSC factors that support collaboration into the tender process.

# Chapter 9: Study Conclusions, Reflections, Limitations and Future Research

## 9.1 Introduction

This chapter provides a summary of the key findings and conclusions of this research study, including the findings from the buyer and supplier characteristics (demographics) in Chapter 5, the findings from both the value-added and CSC factors in Chapters 6 and 7. Then the practical recommendations in Chapter 8 to change the specification and tender process to include both value-added and CSC factors identified in this study to make the tender process more conducive to university-industry collaboration. This chapter provides an examination of the limitations of this research study and future research that can be undertaken to examine areas not investigated as part of this study. Finally, this chapter provides a summary of this studies contribution to new knowledge, new theory creation and how these fit within the current literature within the various subject fields.

## 9.2 Study Research Aims

This research project aimed to explore the value-added and cross-sector critical success factors (CSC factors) within the subject literature and identify the academic (buyer) and scientific equipment manufacturer (supplier) perceptions of these factors. While proposing a new procurement tender process that incorporates these factors to allow future scientific equipment tenders between university-industry to result in new innovations and knowledge exchange. Thereby removing our limited understanding of the procurement tender process conducive to Open Innovation and University-Industry Collaboration.
As this research study progressed and the author collected and analysed the specification templates, supplier tender returns, participant responses from the buyer telephone interview questions, supplier meeting questions and one

research and development agreement, to answer the research questions. As stated in the Literature Review in Chapter 2, the author continued to develop the end-user demographics of Ogawa and Pongtanalert (2013), von Hippel et al, (2011), Shaw (1985), Shaw (1988) and Tyrrell (2015). As the participant's characteristics (demographics) can influence the value-added and CSC factors being investigated in this research study, the author first examines the participant's characteristics to identify if they influence collaboration.

## 9. 3 Buyer and Supplier Demographics Data Findings and Conclusions

After using thematic analysis, a method of identifying, analysing, and reporting patterns (themes) within data (Braun and Clarke, 2006; Mcneil and Chapman, 2005; Quinlan et al, 2018; Vaismoradi et al, 2013), the author summarised the buyer demographics characteristics into table 5.1 in Chapter 5. From the participant responses, this research study builds on Tyrrell's (2015) empirical study and the empirical research of von Hippel, 1981; von Hippel, 1986; Urban et al, 1988; von Hippel, 1988; Franke and von Hippel, 2003 by extending the dimensions of the PI end-user by adding the concept of the lead buyer. Table 9.1 provides a summary of the new buyer types identified in this study.

**9.1 - New Buyer Types**

| **Buyer Type** | **Characteristics** |
|---|---|
| Individual Academic | Who is engaged in research but does not share their equipment with other internal or external academics or universities. The academic owns this type of equipment for their own research. |
| Core Service Academic | An academic that not only engages in research and teaching activities but also manages the equipment as a core facility for the university. |

Source: Tyrrell (2022)

A core facility is equipment that can be rented out to other academics, departments, and external collaborators. When the equipment is not in use by the main buyer, other academics internally or external to the university may hire the equipment at a cost for conducting research (Haley 2009; Hockberger et al, 2018; Zwick, 2021). This allows academics with limited funds to generate additional revenue for their research. This is a surprise finding, as neither von Hippel, 1981; von Hippel, 1986; Urban et al, 1988; von Hippel, 1988; Franke and von Hippel, 2003; Shaw, 1985; Shaw, 1988; and Tyrrel, 2015, included this designation in their lead-user typology. Therefore, this study makes a minor contribution to the characteristics of the lead end-user within university-industry collaborations.

Another surprise finding is from the buyer participant responses, all the buyers apart from P10 had engaged in working relationships with the suppliers before undertaking the tender process, as each buyer had existing equipment or alternative equipment from the same manufacturer in their laboratory. As buyers have already engaged in previous collaborations, this indicates that most of the participants are serial innovators, who are individuals within both SME's, medium, large, and global firms that who repeatedly create new innovations that meet customer's needs and deliver long-term value for their firms (Corradini et al, 2015; Griffin et al, 2014; Tuzovic et al, 2018; Vojak et al, 2012). This finding makes a minor contribution to the serial innovator's literature, by providing cases that indicate that university academics can also undertake the role of serial innovator. As there is limited literature on serial innovators within universities as the current literature focuses on the entrepreneurial university (Etzkowtiz et al, 2000; Etzkowitz, 2003; Etzkowitz, 2004; Etzkowitz, 2008) these universities obtain economic returns from generating knowledge and technology transfer from non-key activities of teaching and research, which is a macro view of innovation at a national level.

Another surprising finding is the buyer participants have previously collaborated with the supplier on other projects, indicating that innovation is taking place at the local departmental level of the university which is contrary to the triple helix model, that conceptualizes the university at the heart of any national innovation system (Santoen et al, 2014), each institution: university, government and industry takes on the role of the other within the model (Etzkowitz and Ledydesorff, 2000; Leydesdorff and Meyer, 2006). None of the triple helix models identified in the literature review have investigated innovation taking place at the university department level between the academic and a firm. This study contributes to knowledge and triple helix literature by providing a theoretical model and cases that show that collaboration is taking place between a buyer and supplier, which is a major contribution to knowledge within the Triple Helix Model. However, as certain value-added factors and CSC factors are critical to the formation of a collaboration between the buyer and supplier, this will be discussed in more detail in paragraphs 9.4. and 9.5.

General findings from the buyer characteristics (demographic) data, is that most buyers are engaged in teaching and research activities, including teaching PhD students and disseminating their research via books, journal publications and conference papers. Indicating that buyers are actively formally and informally promoting their knowledge to the external world (Adhikari, 2010; Mansor et al, 2015; Wilkins et al, 2021) except for P1 who is no longer an academic. Other characteristics shared by each buyer is each holds a PhD apart from P1, who works as the department's Operations Manager, troubleshooting issues with other academic's scientific equipment. All the scientific equipment is used for research and core facility purposes, only P10 does not use the equipment as a core facility. From table 5.1 most of the major innovations have been linked to very high-level grant funding from three specific suppliers. P3 and P13 have purchased MRI scanners and have been funded by Cancer Research UK or the Welcome Trust. P2, P5 and P10 have been funded by the Engineering and Physical Sciences Research Council. Funding for P1 is very low as this is for development of general laboratory equipment and new software functionality. Finally, within the buyer characteristics (demographics) there is no similarities between the age, gender, length of relationships with the supplier nor the innovation type between the buyer participants.

Adopting the same approach as the buyer data, the author summarised the supplier characteristics (demographics) data into table 5.2 in Chapter 5. An interesting finding from the supplier data, is that all four supplier's taking part in the study had similar manufacturing structures, with each supplier having a manufacturing facility in the UK, this gives the supplier direct access to the local market, but it also removes any transaction costs to their operations of import or/and export duties while adjusting the equipment to local market needs (Brikinshaw et al, 1998; Mesquitay, 2016; Yaprak et al, 2018). Consequently, all four suppliers have similar technical support locations, based in the UK (Bailey et al, 2015; Benton W. C. Jr, 2010; Lysons,1993; Lysons and Farrington, 2016). By implementing this organisation structure, the supplier can deliver value-added factors to the buyer in the local market at no extra cost. As the technical support services can offer a first-line assessment of any problem, this reduces the cost of sending the supplier engineers into the field unless the equipment needs repair. This interlinks with the structure of engineering support to the buyer, as all four suppliers offer engineers based in the country of the equipment purchased. Another surprise finding from the supplier characteristics (demographic) data, is that three of the suppliers have engaged with the buyer before on other projects, apart from supplier S4, was S4's equipment is related to clinical work, therefore any new equipment would need to be certified before use. This finding suggests that the suppliers are serial innovators by working with different buyers or buyer to develop innovations on different product ranges (Corradini et al, 2015; Griffin et al, 2014; Tuzovic et al, 2018; Vojak et al, 2012).

Finally, as all the suppliers have been engaged in collaboration, this indicates all suppliers have adopted an open innovation process by using lead-user knowledge in the creation of new scientific equipment and services (software development). By university-industry collaborations taking place through the tender process, this study data has provided an example of how to implement the open innovation process within a public sector organisation to create new innovations. This is a minor contribution to our knowledge on the open innovation model conceptualised by Chesbrough's model (2003a; 2003b; 2004;

2006), with the tender process give us an example of how buyers and suppliers can access knowledge that leads to new innovations that can be marketed to other HE buyers. A visual representation of how buyer knowledge is embedded in the innovation process to generate new innovations can be found in figure 5.2 in Chapter 5. In the new university-industry OI model, the supplier focuses on embedding each lead buyer into the research stage of the open innovation process, they obtain knowledge from each buyer for different products in their portfolio. The supplier then develops the prototype and issues it to the buyer to test. The buyer then tests the equipment and detects/reports any faults with the equipment; the supplier then resolves the problems with the equipment. The new equipment or software is moved to a mass production phase, then marketed, and sold to new buyers or existing buyers in the HE Sector. Finally, the author concluded that as buyer and supplier characteristics (demographics) have influenced the formation of the collaboration, through the value-added and CSC factors present in university-industry collaborations. The author confirms the second research question has been answered in part (related to participant characteristics).

## 9.4 Value-Added Factors Data Findings and Conclusions

Within the value-added literature, the concept of value-added has different meanings across different subject literature. Value can be defined as the products attributes (product orientation) using price, product availability, how well the goods perform, ease of use, quality, the cost of ownership and social acceptance including status, image, reputation, and trust, (Kaufman, 2001; Jolibet et al, 2012; Matthyssens et al, 2016). Alternatively, value can be defined as the brand itself, the customer relationship between the manufacturer, distributor, and the customer, and the type of distribution channels used to supply the customer with the goods or service (McDonald et al, 2006). Value-Added is the benefits the buyer and supplier receive from their collaboration and provides a skill or resource the partner does not possess.

After analysing the ITT document, supplier tender returns, the buyer telephone interviews and the supplier virtual meeting responses, the author summarised all the value-added themes that are “very important” to the buyer into a single table, structured around the value-added groups identified in the literature gaps in table 2.16, 2.17, 2.18 and 2.19 in Chapter 2. The buyer responses are then triangulated against the supplier participant’s responses that interlink to that specific tender. Table 8.1 within Chapter 8 provides a summary of the value-added factors that buyers consider important during the collaboration. There are three surprising findings within table 8.3. The first surprise finding is that most of the value-added factors identified are equipment related, which are specific benefits that reduce the cost and time of the buyer completing their research. Secondly, within the tender specification form, there are several value-added factors that have been added to the tender specification as standard wording.

Table 9.2 below, provides a summary of the value-added factors that have been added to the specification template that that the author classified as “very important” based on the buyer’s response and data from the supplier returns.

**Table 9.2 - Equipment Specific Value-Added Factors Added to Specification Template**

| ***Value-Added Factor*** | ***Importance Level*** |
|---|---|
| Free Equipment Delivery Installation and Commissioning | Very Important (VI) |
| Equipment Functionality | Very Important (VI) |
| Extended Warranty | Very Important (VI) |
| Account Manager | Very Important (VI) |
| Technical Support | Very Important (VI) |
| Free Equipment Training | Very Important (VI) |
| Free Equipment Manuals | Very Important (VI) |

Source: Tyrrell (2022)

All these value-added factors are shared across the buyer participant group and added to each tender specification by procurement services. Indicating that procurement's role, has changed from a traditional role ensuring that the supplier selected during the tender process provides the buyer the best quality, lowest price, is financially stable, meets the buyer's specification and provides consistent technical support (Bailey et al, 2015; Benton W. C. Jr, 2010; Lysons,1993; Lysons and Farrington, 2016), to procurement services focusing on developing buyer-supplier relationships, engaging in joint activities like co-creation, NPD development, discussing specifications, exchanging information, cost reductions, sharing cost savings and creating added-value (Benton W. C. Jr, 2010; Bidault et al, 1998; Burt and Pinkertonet, 1996; Cox, 1996; Grudinschi et al, 2014; Matthyssens et al, 2016). However, there is limited research on the value that can be added to the tender documents and tender process using the procurement professional's knowledge. Although in his response P1 did indicate that the knowledge of the procurement professional had been used to develop the value-added factors requested in the tender specification. This was a surprise finding, as the author was not aware of the procurement professional's role in adding value to the tender specification developed for tendering.

From table 6.2 in Chapter 6 the author has provided a summary of the value-added factors that are unique to university-industry collaboration, which includes a breakdown of the benefits a buyer receives from adding these factors to the specification template. As the buyer's had not changed or removed these value-added factors from the specification template, the author concluded that these factors are "very important" to the buyers. The author then, compared the literature review value-added factors against the value-added factors identified in the participant responses and supplier tender returns. Table 6.3 in Chapter 6 provides a summary of the value-added factors that are unique to this study against those value-added factors identified in the literature review. The author concluded that the buyer population was predominantly interested in obtaining equipment related value-added factors from the supplier during the collaboration. Although there are some student, research and collaboration factors present, these are allocated to a specific buyer who lacks a specific skill or resource. After reviewing the buyer participant responses, the author concluded that an integral part of the collaboration is the value-added factors that are obtained from the supplier during the partnership. Finally, from the analysis of the data and participant responses, the author concluded that the research question 1 and 2 had been answered as the author has identified the value-added factors that drive new product innovation, and which value-added factors are considered important by buyers (universities) and suppliers (firms) during university-industry collaboration.

## 9.5 Cross-Sector Collaboration (CSC) Data Findings and Conclusions

There are a several key findings from the CSC factors identified in Chapter 9. After reviewing the CSC literature, the author summarized all the CSC factors into a single table, as very few studies have consolidated these factors together in a single study, the table 1.17 in Chapter 2 shows the single table of CSC factors being investigated in this research study.

After analysing the data from the buyer telephone interviews, supplier virtual meetings, specification template, supplier tender returns and research contract, the author examined each CSC factor in table 1.17 and identified if each of these are present in university-industry collaborations. In Chapter 7, table 7.6, the author summarised the participant responses based on a consensus view or the top response (2-4 responses) to specific sub factors of the main CSC factor. Any CSC factors that are not involved in the university – industry collaboration has been summarized in table 7.6 a copy is below:

### Table: 7.6 - University - Industry CSC Factors Identified

| **Critical Success Factor** | **Sub Factors** | **Level** | **Literature reference** |
|---|---|---|---|
| **Collaboration Context** | **Competitive External Funding Environment (Consensus)**<br><br>**Difficulty Accessing Resources (Consensus)** | ***VI***<br><br>***VI*** | Bryson et al, 2006; Clarke and Fuller, 2010; Hartman and Dhanda, 2018; O’Leary |

| | | | |
|---|---|---|---|
| | **Centre of Excellence Funding (mixed response)**<br><br>**Competitive Internal Funding Environment (Consensus)** | ***N***<br><br>***VI*** | and Vij, 2012; Osborne, 2006; Perkmann et al, 2014. |
| **Purpose of Collaboration, Motivation and Commitment** | **Motives - Expertise (Buyer - 9 participants agreed)**<br><br>**Motives - Expertise (Supplier - 7 participants agreed)**<br><br>**Motives - New Equipment Capability (Supplier - 3 participants agreed)**<br><br>**Buyer/Supplier Shared Goals (Consensus)**<br><br>**Long Term Relationship (Consensus)** | ***VI***<br><br>***VI***<br><br>***I***<br><br>***VI***<br><br>***VI*** | Austin 2010; Bryston et al, 2009; Clarke and Fuller, 2010; Johnson and Finegood, 2015; Ivascu et al 2016; Mayo et al, 2014; Mendel and Brudney, 2018; Mohr and Spekman, 1994; O'Leary and Vij; 2012; Perkmann et al, 2014; Thune, 2011; Vernis et al, 2006; Ukalkar, 2000. |
| **Partner Selection Process and Capability** | **Expertise/Knowledge (Buyer - 9 participants agreed)**<br><br>**Expertise/Knowledge (Supplier - 7 participants agreed)** | ***VI***<br><br>***VI*** | O'Leary and Vij, 2012. |
| **Collaboration Structure, Governance, and Communication** | **Regular Communication (Consensus)**<br><br>**Research Contract (Mixed Response)**<br><br>**Buyer/Supplier main point of Contact (Consensus)**<br><br>**TTO involvement (Mixed response)**<br><br>**Management Support for Collaboration (Both buyer and supplier – consensus)**<br><br>**-----------------------------------**<br>**Knowledge Transfer Methods - Email (9 participants agreed)** | ***VI***<br><br>***N***<br><br>***VI***<br><br>***N***<br><br>***VI***<br><br>**---------------**<br>***I*** | Austin 2010; Austin and Seitanidi, 2014; Bryson et al, 2006; Bryson et al, 2009; O'Leary and Vij, 2012; Mendel and Brudney, 2018; Mohr and Spekman, 1994; Perkmann et al, 2014; Vernis et al, 2006; Ukalkar, 2000.<br><br>--------------------------------------<br>Eagle et al, 2012; Fill and Turnbull, 2019; Fraccastoro et al, 2021; Hänninen and Karjaluoto, 2017; Oshri et al, 2007; Rodriguez Cano et al, 2005. |

| | | | |
|---|---|---|---|
| | **-------------------------------------**<br>**Knowledge Transfer Methods - Phone Call (5 participants agreed)** | ***I*** | -------------------------------------<br>Eagle et al, 2012; Fill and Turnbull, 2019; Fraccastoro et al, 2021; Hänninen and Karjaluoto, 2017; Oshri et al, 2007; Rodriguez Cano et al, 2005. |
| **Power** | **Factor Influencing Power:**<br><br>**Buyer's Money (3 participants agreed)**<br><br>**Equipment/Applications (3 participants agreed)**<br><br>**-------------------------------------------**<br><br>**Power Held:**<br><br>**Buyer (4 participants agreed)**<br><br>**Balanced between Partners (6 participants agreed)** | ***I***<br><br>***I***<br><br>***I***<br><br>***I*** | Bryson et al, 2006; Hartman and Dhanda, 2018; Mayo et al, 2014; O'Leary and Vij, 2012.<br><br>**-------------------------------------**<br><br>Sadeghi et al, 2022; Wang et al, 2016<br><br>Alexander et al, 2001; Chicksand, 2015; Essabbar et al, 2016; Rehme et al, 2016 |
| **Accountability** | **Conflict resolution process (mixed opinion)** | ***N*** | Bryson et al, 2006; Bryson et al, 2009; O'Leary and Vij, 2012. |
| **Legitimacy** | **Not required (No formal collaboration)** | ***NI*** | Bryson et al, 2006; O'Leary and Vij, 2012. |
| **Trust** | **Trust in Relationship (Consensus)**<br><br>**-----------------------------------------**<br><br>***Four Conditions to Develop Trust:***<br><br>**Honesty (7 participants agreed)** | ***VI***<br><br>***I*** | Austin, 2010; Austin and Seitanidi, 2014; Bryson et al, 2006; Couchman and Fulop, 2009; Forrer et al, 2014; Johnson and Finegood, 2015; Mohr and Spekman; O'Leary and Vij, 2012; Osborne, 2006; Perkmann et al, 2014; Vernis et al, 2006; Ukalkar, 2000.<br><br>**-------------------------------------**<br><br>Ahimbisibweet al, 2012; Hardwick et al, 2013; Maser and Thompson, 2013; Ntayi, et al, 2010; Spekman and Carraway, 2005. |

| | | | |
|---|---|---|---|
| | **Regular Communication (6 participants agreed)**<br><br>**Time (to develop relationship) (5 participants agreed)**<br><br>**Transparency (4 participants agreed)** | ***I***<br><br>***I***<br><br>***I*** | Bollen et al, 2018; Huang et al, 2020; Scholten and Schilder, 2015.<br><br>Ahimbisibweet al, 2012; Hardwick et al, 2013; Maser and Thompson, 2013; Spekman and Carraway, 2005.<br><br>Maser and Thompson, 2013; Spekman and Carraway, 2005. |
| **Information Technology** | ***Four Media Channels:***<br>--------------------------------------<br>***In Person (11 participants agreed)***<br>--------------------------------------<br>***Email (10 participants agreed)***<br>--------------------------------------<br>***Conference Call (9 participants agreed)***<br>------------------------------------<br>***Phone Call (6 participants agreed)*** | ----------------<br>***VI***<br><br>***VI***<br><br>***VI***<br><br>**VI** | Austin 2010; O'Leary and Vij, 2012<br>------------------------------------<br>Eagle et al, 2012; Fill and Turnbull, 2019; Fraccastoro et al, 2021; Hänninen and Karjaluoto, 2017; Hill et all, 2009; Oshri et al, 2007; Rodriguez Cano et al, 2005.<br>------------------------------------<br>Eagle et al, 2012; Fill and Turnbull, 2019; Fraccastoro et al, 2021; Hänninen and Karjaluoto, 2017; Oshri et al, 2007; Rodriguez Cano et al, 2005.<br>------------------------------------<br>Eagle et al, 2021; Fill and Turnbull, 2019.<br>------------------------------------<br>Eagle et al, 2012; Fill and Turnbull, 2019; Fraccastoro et al, 2021; Hänninen and Karjaluoto, 2017; Oshri et al, 2007; Rodriguez Cano et al, 2005. |
| **Culture** | **Not required (No formal collaboration)** | ***NI*** | Johnson and Finegood, 2015; Ivascu et al 2016; Mendel and Brudney, 2018; Mohr and Spekman, 1994; Vernis et al, 2006; Ukalkar, 2000. |
| **Collaboration Monitoring** | **Not required (No formal collaboration)** | ***NI*** | Austin 2000; Jamali and Keshishian 2009; Johnson and Finegood, 2015; Seitanidi et al. 2010; Von |

| | | | |
|---|---|---|---|
| | | | Tuder et al, 2016; Ukalkar, 2000. |
| **Collaboration Evaluation** | **Not required (No formal collaboration)** | ***NI*** | Austin 2000; Jamali and Keshishian 2009; Johnson and Finegood, 2015; Seitanidi et al. 2010; Von Tuder et al, 2016; Ukalkar, 2000. |
| **Continuous Improvement** | **Not required (No formal collaboration)** | ***NI*** | Johnson and Finegood, 2015; Ukalkar, 2000. |
| **Leadership** | **Not required (No formal collaboration)** | ***NI*** | Bryson et al, 2009; Crosby and Bryson, 2010; Malin and Hackmann 2019. |
| **Partnership Length** | **Partnership Length**<br>**3 years – benchtop equipment**<br>**5 years – capital equipment (required installing into the fabric of a building)** | ***VI*** | Mendel and Brudney, 2018; Mohr and Spekman, 1994; Vernis et al, 2006; Ukalkar, 2000. |
| **Cross-Functional Teams** | **Not required (No formal collaboration)** | ***NI*** | Mendel and Brudney, 2018; Mohr and Spekman, 1994; Vernis et al, 2006; Ukalkar, 2000. |

Key: VI - Very Important Factor, I - Important Factor, Neutral – Mixed Response from participants, Not Important – Factor missing.

Source: Tyrrell (2022)

From table 7.6 above, there are several “very important” and “important” CSC factors that are specific to a successful university-industry collaboration. Within the context of collaboration, all buyer’s confirmed they had difficulty accessing resources, experienced increased competition within both internal and external funding environments to obtain funding (Bryson et al, 2006; Clarke and Fuller, 2010; Hartman and Dhanda, 2018; O’Leary and Vij, 2012; Osborne, 2006; Perkmann et al, 2014). As buyer’s experience increased competition to obtain funding and resources to conduct their research and teaching activities, these CSC factors drive buyers to develop collaborations with industry to access new scientific equipment. As most buyers are confused over if their department is classed as a “centre of excellence” and received additional funding, the author considered this factor to be neutral as it neither impacted nor influenced the buyer’s decision to develop a collaboration with a specific supplier.

From the participant responses, the main purpose and motivation for the collaboration between the buyer (9 participants agreed) and supplier (7 participants agreed) was to access the knowledge and expertise of their partner during the collaboration (Austin 2010; Bryston et al, 2009; Clarke and Fuller, 2010; Johnson and Finegood, 2015; Ivascu et al 2016; Mayo et al, 2014; Mendel and Brudney, 2018; Mohr and Spekman, 1994; O’Leary and Vij; 2012; Perkmann et al, 2014; Thune, 2011; Vernis et al, 2006; Ukalkar, 2000). For suppliers, another main motivation is accessing the knowledge of the buyer to create new scientific equipment that can be sold to other academics in UK universities, allowing the supplier to increase market share and generate additional revenue. With reference to commitment, both buyer and supplier agreed that their relationship was long term, in most cases over various projects (Mendel and Brudney, 2018; Mohr and Spekman, 1994; Vernis et al, 2006; Ukalkar, 2000). Another commitment factor is both partners shared their goals during the collaboration, as it generates security and loyalty between the partners during the collaboration.

Within the CSC factors focusing on supplier selection, process, and capabilities, once again, both buyers (9 participants agreed) and suppliers (7 participants agreed) stated that knowledge and expertise was the method for selecting a partner with the capabilities to complement the other partner during the collaboration (O’Leary and Vij, 2012). Consequently, as knowledge and expertise are the main reason why a partner is selected for collaboration, the author concluded this was a “very important” factor for the success of the collaboration. Within the collaboration structure there was consensus among the participant’s that regular communication (Bollen et al, 2018; Huang et al, 2020; Scholten and Schilder, 2015) was “very important” to transfer knowledge, this finding interlinks with the media methods used in figure 7.9 Although it is “very important” for partners to have support from their senior leadership team to develop a collaboration, these partnerships are not formal collaborations, as most buyers do not have a research contract in place nor have involved the university TTO in developing or signing a formal collaboration agreement. Only the MRI buyers and suppliers (P3, S3, P13 and S13) and P12 had a research contract in place for the collaboration. Nor does the contract include setting up a formal cross-sector team to manage the collaboration.

Power in the relationship is influenced by two factors, firstly by the buyer holding the money (3 participants agreed) and making the decision to spend it with a specific supplier or not. Secondly, with the supplier having the expertise to develop the new scientific equipment/application (3 participants agreed). The author concluded these factors are important and can impact on how power was managed during the relationship (Bryson et al, 2006; Hartman and Dhanda, 2018; Mayo et al, 2014; O’Leary and Vij, 2012). However, participant opinions on who holds the power in the relationship was mixed, with participants suggesting the buyer holds the power (4 participants agreed) (Sadeghi et al, 2022; Wang et al, 2016) and the power is balanced between the partners (6 participants agreed) (Alexander et al, 2001; Chicksand, 2015; Essabbar et al, 2016; Rehme et al, 2016). Although the author concluded this was an important factor in cross-sector collaborations, the responses did not provide more details on how the power is balanced in the relationship, this requires further investigation.

Trust is a “very important” factor in the collaboration, with all participants agreeing this was a critical factor. (Austin, 2010; Austin and Seitanidi, 2014; Bryson et al, 2006; Couchman and Fulop, 2009; Forrer et al, 2014; Johnson and Finegood, 2015; Mohr and Spekman, 1994; O’Leary and Vij, 2012; Osborne, 2006; Perkmann et al, 2014; Vernis et al, 2006; Ukalkar, 2000). For trust to develop within the relationship, four specific conditions need to be met between the partners, table 9.7 provides a summary of these conditions.

### 9.3 – Conditions for Trust to Develop

| Condition | Description | Participant Agreement |
|---|---|---|
| Honesty | Partners share their goal and vision for the collaboration | 7 participants agreed |
| Regular communication | Partners communicate with each other on a regular basis | 6 participants agreed |
| Time | It takes time for the partners to develop rapport during the collaboration | 5 participants agreed |
| Transparency | Partners need to be transparent in expressing their opinions, feelings, and ideas during the collaboration | 4 participants agreed |

Source: Tyrrell (2022)

These conditions need to be present for trust to develop between the partners that leads to a successful collaboration. The use of information technology is a “very important” factor in developing trust and sharing knowledge between the partners. After reviewing the participant responses, a surprise finding was both partners are using specific information technology to develop the collaboration. The specific media channels, participant agreement level and marketing literature is summarized in table 9.4 below.

### 9.4 – Information Technology Media Channels

| Method | Participant Agreement Level | Marketing Literature |
|---|---|---|
| Emails | 10 participants agreed | Eagle et al, 2012; Fill and Turnbull, 2019; Fraccastoro et al, 2021; Hänninen and Karjaluoto, 2017; Oshri et al, 2007; Rodriguez Cano et al, 2005 |
| Conference Calls | 9 participants agreed | Eagle et al, 2021; Fill and Turnbull, 2019 |
| Phone Calls | 6 participants agreed | Eagle et al, 2012; Fill and Turnbull, 2019; Fraccastoro et al, 2021; Hänninen and Karjaluoto, 2017; Oshri et al, 2007; Rodriguez Cano et al, 2005 |
| Face-to-Face | 11 participants agreed | Eagle et al, 2012; Fill and Turnbull, 2019; Fraccastoro et al, 2021; Hänninen and Karjaluoto, 2017; Oshri et al, 2007; Rodriguez Cano et al, 2005 |

Source: Tyrrell (2022)

However, most participants prefer to interact with their partner through face-to-face meetings, which is technically not a media channel, as this helps develop trust between the partners. Within the study, the author concluded that length is very important with all the collaborations investigated being short terms in length, with collaborations being split into 3-year collaborations, based on new innovations on bench top scientific equipment and 5-year collaborations, based on capital equipment that need installation into the fabric of the building (Mendel and Brudney, 2018; Mohr and Spekman, 1994; Vernis et al, 2006; Ukalkar, 2000). However, the knowledge transfer part of the collaboration is very short, as once the contract has been awarded, the supplier has until the delivery, installation, and commissioning date to develop a working prototype, in most cases this is a couple of months. Within the data there are several CSC factors that are not present in university-industry collaboration as summarised in table 7.7 in Chapter 7. As the majority of buyer and supplier collaborations are not formal agreements with the development of a spin off company or cross-functional teams between the partners. These CSC factors are not required in university-industry collaborations.

Finally, from the data analysis and participant responses, the author concluded that the research questions 1 and 2 had been answered as the author has identified the cross-sector collaboration factors that drive new product innovation and what factors are consider important by buyers (universities) and suppliers (firms) during university-industry collaborations.

## 9.6 Recommendations to Changes to the ITT and Tender Process Conclusions

As part of the buyer telephone interview and supplier virtual meeting questions, the author asked participants what changes should be made to the ITT and tender process to make the tender process more conducive to collaboration. Although the suppliers in this research study have added the buyer into their open innovation process to obtain knowledge to create new innovations and services. The 5-step process theorized by Von Hippel (1998) provides a process for implementing end-user innovation into a firm's research and development process. However, von Hippel's model fails to define how the firms can identify the lead end-user (buyer) to embed in the innovation process within the firm.

The author theorised that by using the enhanced demographics in this research study, a firm can identify the lead-user characteristics, that can reduce the cost of the firm's marketing department's budget on buyer engagement. Once the firm has identified the lead-user (buyer), they can then adopt von Hippel's five step process to develop the prototype. The new process for identifying the lead-user (buyer) characteristics is:

1) A Professor, Doctoral Fellow, Research Fellow, or Reader.
2) A buyer that is either purchasing the scientific equipment for their own research, or a buyer that runs a core facility for other buyers to use (at as cost) for teaching and research activities.
3) Receives a large publicly awarded grant to carry out scientific research on a regular basis.
4) The buyer undertakes teaching and research activities.
5) Publishes journal articles and attend conference regularly.
6) Undertakes teaching of PhD students.
7) The buy obtains the equipment 6 to 12 month before market release.
8) This speed up and improving the buyers research output.

Source: Tyrrell (2022)

Applying the buyer and supplier responses, the author summarised all the value-added factors, CSC factors and the general changes that should be made to the tender specification template and ITT, this summary can be found in 8.1 - Specification Form and ITT Changes in Chapter 8. Using P1's and P2's responses, the author offered several options to change the tender specification template to make it more conducive to collaboration, this includes adding a section in to allow buyers to change the specification after the contract has been awarded. For capital equipment that requires being built into the fabric of the building, this would be useful. Within the specification under "Implementation Plan", a question could be added to review the specification and make modifications before the final delivery, installation, and commissioning.

Another change is including review meetings into the spec (a CSC factor), these can be regular meetings between the buyer and supplier either face-to-face meetings or conference calls for updates on the collaboration. The review meetings (5 participants agreed) can be used as a process to transfer knowledge between the buyer and supplier by using email, progress reports, informational reports, and formal reports. The frequency of the meetings can be weekly, monthly, quarterly, or yearly, the frequency of these meetings should be discussed with the buyer, as the complexity of the project may require more regular communication (Bollen et al, 2018; Huang et al, 2020; Scholten and Schilder, 2015) during the collaboration.

By adding a review meeting into the specification template, three CSC factors which are critical to a successful collaboration can be incorporated into the specification template. These CSC factors are trust (Austin, 2010; Austin and Seitanidi, 2014; Bryson et al, 2006; Couchman and Fulop, 2009; Forrer et al, 2014; Johnson and Finegood, 2015; O'Leary and Vij, 2012; Osborne, 2006; Perkmann et al, 2014; Ukalkar, 2000,) information technology (Austin 2010; Austin and Seitanidi, 2014; O'Leary and Vij, 2012; Ukalkar, 2000) and regular communication (Bollen et al, 2018; Huang et al, 2020; Scholten and Schilder, 2015). All these CSC factors are interrelated, as regular use of information technology including conference calls and emails can help transfer knowledge between the parties. Regular communication can also help develop trust between the two partners, reduce conflict, help problem solving and builds better relationships (Bollen et al, 2018; Huang et al, 2020; Scholten and Schilder, 2015). Face-to-Face communication allows the partners to be honest and transparent in their interaction leading to the partners developing trust.

Another change to the specification template, would be to add a new section to include the benefits the supplier can offer to the supplier during the collaboration. For example, access to clinical trial data sets, background research from the buyer's research area, access to university facilities or PhD students and possible joint funding. However, each of these factors would depend on the resources the buyer had access to within their university. By adding the benefits of working with the buyer this would form part of the tender return and be covered by the contract terms.

For complex project, project stages can be added to the specification template as suggested by P12. By adding this to the specification template, under the section on implementation, this could be adjusted to add specific milestones that can be signed off and these linked to the pricing schedule in section 6 in the ITT. For scientific equipment that requires assembly into the fabric of the building, or have ongoing PhD funding, this would require the buyer and procurement professional to agree the project stages to include in the specification template and pricing schedule. However, this would require a step change to the tender process, which was shown in figure 8.1 in Chapter 8 titled "University Tender Process Step-Change", adding project stages would be discussed with the buyer during the completion of the specification template. This interlinks with the recommendation from P1 and P3 that the procurement professional should be included in the development of the specification and ITT. As the procurement professional is engaged in supporting the buyer with suggesting changes to the specification template, mandatory questions, and ITT, they can ensure that any changes made keeps the principles of a fair and transparent tender process (Behzad Ghorbany Darabad, 2017; Khaled Mustafa and Waheed, 2019; Osei-Afoakwa, 2014; Thai, 2004). As changes made to the mandatory questions would need to be general, not specific to stop all but one bidder from submitting a bid.

Another recommendation by S13, is to provide advanced information concerning the project to potential suppliers ahead of the tender being issued or hold an information day, this will require a change in the tender process to accommodate this change. Figure 8.1 in Chapter 8 shows a new step added to the tender process with advanced tender information being release to potential bidders on the tender portal before the formal issue of the ITT. This allow suppliers advanced warning of requirements and alerts the market that there is a new contract for scientific equipment to be issued by the university. Another recommendation is to include a conflict resolution process, as part of the ITT design. Although buyers and suppliers in the collaborations under investigation have not required a conflict resolution process in the past, hopefully adding a reference to using CEDR's would encourage potential collaborators to collaborate with the university buyer. CEDR offer an arbitration service, that is independent and has an impartial person (the arbitrator) that reviews and makes decisions concerning conflicts and disputes without the need for the matter to go to court (CEDR, 2019). A full list of all the changes recommended for the specification template and ITT documents that are shown in table 8.1 in Chapter 8.

However, the are several recommendations, that cannot be implemented as the specific parts of the tendering documentation and process, are interlinked with the requirement to make the tender process fair and transparent (Behzad Ghorbany Darabad, 2017; Khaled Mustafa and Waheed, 2019; Osei-Afoakwa, 2014; Thai, 2004). Even though the university tender is being conducted outside the OJEC regulations, removing, or changing the marking scheme (1 participant agreed), changing the timelines to make the process shorter (3 participants agreed), pre-agree the terms and conditions with supplier before the tender award (1 participant agreed), and simplifying the tender documents (4 participants agreed). These factors in the ITT, are governed by the principles of a fair and transparent process, where all bidders can apply and be selected on similar criteria with no discriminatory treatment (Behzad Ghorbany Darabad, 2017; Khaled Mustafa and Waheed, 2019; Osei-Afoakwa, 2014; Thai, 2004). Any changes to these factors could make the process unfair and favour a specific supplier, therefore these changes could not be implemented. Another question the author asked buyer participants was if procurement services could provide a matrix of possible value-added factors that could be added to the tender specification template, to help the buyer understand what value-added factors would be suitable for their scientific equipment purchase. The was consensus amongst the buyer population this was a good idea. The supplier participants have not been asked this question, as any factors that the suppliers suggested may be specific to their equipment offering which may make the tender process unfair (Fee et al, 2022).

Using the factors that have been identified in the value-added literature and triangulating against the value-added factors identified in the buyer responses, specification, and supplier tender return. The author has summarized all the value-added factors from the value-added literature, tender returns, and participant responses below into a single table using the headings “equipment value-added factors”, “research value-added factors”, “student value-added factors” and “collaboration value-added factors”.  Table 8.3 provides a summary of the value-added factors that can be added to the tender specification based on the buyer’s preference. Within the table 8.3 the author has classified with a (P), the buyer responses confirming the value-added factors submitted by the supplier in the tender return and the value-added factors that the buyer wished the supplier had submitted as “(D)” for desirable.

As the buyer confirmed that a matrix off value-added factors would be helpful in deciding what value-added factors to add to the tender specification template, a step change process should be implemented to allow the buyers to review and discuss with the procurement professional what factors are suitable to be added to their specification for tendering. Once these had been selected the tender would be issued to potential bidder via the tendering portal. Figure 8.1 in Chapter 8 shows the new step change tendering process, which includes issuing the value-added matrix to the buyer to review, then the procurement professional would discuss the various factors with the buyers and together decide which value-added factors should be included in the specification template. After which the original tender process would take place with the procurement department preparing the ITT for issue to potential bidders.  The author theorized by adding this step into the tender process, value-added factors could be added to complement specific scientific equipment and provide the skills and resources the buyer lacks. This step change process provides a practical example for other HE procurement professionals of a method to embed value-added factors that support collaboration into the tender process. Finally, from the analysis of the data and participant responses, the author concluded that the research question 3 had been answered as the author had integrated the value-added and CSC factors identified in Chapter 6 and 7 into the tender documentation and provided recommendations on how the procurement process could be changed to make university tenders more conducive to collaboration.

## 9.7 University-Industry Collaboration in Action

As buyer participants have previously collaborated with the supplier's in the tender cases being investigated, innovation is taking place at the local departmental level of the university which is contrary to the triple helix model, that conceptualizes the university at the heart of any national innovation system (Santoen et al, 2014), each institution: university, government and industry takes on the role of the other within the model (Etzkowitz and Ledydesorff, 2000; Leydesdorff and Meyer, 2006).

There are several versions of the triple helix model, with the main perspectives being: the neo institutional perspective, the neo evolutionary perspective, entrepreneurial university, and the Quadruple Helix, which adds another dimension to the model: that of community as an institution (Etzkowitz, 2003; Etzkowitz and Leydesdorff, 2000; Demawan ,2016). None of these models investigate or identify that innovation is taking place at the university department level between an academic and a firm.

This study makes a major contribution to knowledge and the triple helix literature by providing a theoretical model and cases that express that collaboration is taking place between university and industry at the local departmental level as shown in figure 5.1 in Chapter 5. Using the "Micro Triple Helix model" and the study's findings the author has theorised a visual model of university-industry collaboration in figure 9.1 entitled "University-Industry Collaboration in Action" shown below. This model includes the value-added factors, CSC factors and tender recommendations to allow readers to understand the steps within the tender process that makes a collaboration a success.

Within this model, the author has assumed that some of the steps are based on inputs and outputs within the collaboration/tender process (Leontief,1986). Additionally, some of the value-added and CSC factors identified in the findings drive the collaboration and provide specific outcomes and benefits for each of the partners in the collaboration.

Below is Figure 9.1 show "University-Industry Collaboration in Action".

**Figure 9.1 - University-Industry Collaboration in Action**

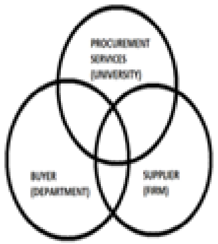
**(1) PRE-TENDER INPUT**
**(BUYER/PROCUREMENT SERVICES)**
*Resources/Skills/Funding Assessment
*Develop New Equipment/Software Functionality
*Add Value-Added & CSC Factors Specification Template
- Collaboration Length(3/5 years)(CSC)
- Supplier Benefits (Re)
*Project Summary - Issue to Bidders(Re)

**(2) TENDER DEVELOPMENT**
**(BUYER/PROCUREMENT SERVICES)**
*Update Specification
*Prepare ITT
*Review ITT & Specification (with Buyer)
*Issue ITT to Bidders
*Tender Process Starts

**(3) TENDER PROCESS**
**(BUYER/PROCUREMENT SERVICES/ SUPPLIER)**
*Supplier Clarifications Requests
*Buyer/Procurement Issue Answers
*Supplier submits Tender Return
*Tender Evaluated/Award Letters Issued
*Supplier Awarded Contract
*Senior Management Support Collaboration (CSC)
*Collaboration Begins

**4) COLLABORATION FORMED**
**(BUYER/PROCUREMENT SERVICES/ SUPPLIER)**

**Micro Triple Helix Model Formed**




*Set Up Regular Communication (CSC)
*Confirm Collaboration Motivations and Objectives (CSC)
*Review and Agree Milestones (Re)
*Buyer/Supplier share expertise(CSC)
*Partners conform point of contact (CSC)
*Buyer/Supplier transfer knowledge via Information Technology (CSC)
*Buyer has Power(CSC)
*Issue Purchase Order

**(5) COLLABORATION IN ACTION**
**(BUYER/PROCUREMENT SERVICES/ SUPPLIER)**
*Mirco Triple Helix Relationship Continues
*Continue Regular Communication (CSC)
*Trust Develops (CSC)
*Supplier has Power (CSC)
*Supplier disseminate Knowledge Internally
*New Equipment/Software Created
*Supplier Delivered, Installed and Commission's Equipment/Software (VA)
*Transfer of Value-Added Factors between Partners
*Buyer receives Free Training (VA)
*Buyer identify Faults
*Supplier rectifies Faults
*Knowledge Transfer Complete (6 months)
*Buyer Pays Supplier Invoice
*After Sales Service Begins
*Extended Warranty Begins (VA)
*Procurement Begins Supplier Review Meetings (Re)
*Ongoing Relationship

**(6) COLLABORATION OUTCOMES**
**(SUPPLIER)**
*Unlimited IP Rights (CSC)
*Unlimited IP revenue (CSC)
*Unrestricted access to PI (buyer) Market (CSC)
*Reduced Marking Cost New Equipment (CSC)

**(7) COLLABBROATION OUTCOMES**
**(BUYER)**
*Speed Up Research Outcomes
*New Equipment Functionality (VA)
*Extended Warranty (VA)
*Supplier Technical Support (VA)
*Free Equipment Training (VA)
*New Techniques Used

**(8) COLLABORATION OUTCOMES**
**(PROCUREMENT SERVICES)**
*New Tender Process (Re)
*Influencing Stakeholders
* Supplier Early Engagement (Re)
*New Specification Template (Re)
*New Value-Added Matrix (Re)
*Driving Change in the Organisation
*Procurement Services a Strategic Function

**Collaboration Context (CSC influencing Factor):** Competitive External and Internal funding environment, short time to spend funding (6) months and difficulty for buyer to access resources.

Key: **(VA)** refers to the Value-Added Factors identified in the study's findings; a full list of Value-Added Factor can be found in Table 6.1 (Chapter 6). **(CSC)** refers to the Critical CSC Factors required to make a collaboration as success, a full list of CSC factors can be found in Table 7.6 (Chapter 7). **(Re)** refers to study recommendations, these recommendations are discussed in more detail in Chapter 8.

Within the model entitled “University-Industry Collaboration in Action”, there are several steps that can be adopted by procurement professional’s, buyers, and suppliers to develop a collaboration. The author will discuss the steps and the implications of each action identified in the model above, in the next sections.

### 9.7.1 Collaboration Context

The Collaboration Context is a key CSC factor within the CSC literature, (Bryson et al, 2006; Clarke and Fuller, 2010; Hartman and Dhanda, 2018; O’Leary and Vij, 2012; Osborne, 2006; Perkmann et al, 2014) and is a major driver that influences the buyer’s decision to form a collaboration in the model. From the study’s findings, these influencing factors include the increased external and internal competition for grant funding, inability of buyers to access resources and the short period (6 months) that the RIU must spend the funding for the scientific equipment. These influencing factors are what drives university (buyer) and industry (supplier) to form a collaboration and not a transactional purchase of goods and/or service from the existing marketplace.

Within the model, the next step, is the pre-tender stage, in which the buyer and procurement professional meets to review the funding level awarded, identify the skills and resources the buyer lacks and identify if a collaboration can be formed based on the buyer having a potential idea for new equipment functionality and/or software.

### 9.7.2 Step 1 - Pre-Tender Stage

If the buyer identifies new equipment functionality and/or software, the buyer then completes the specification template, by adding the new functionality and/or software to the section in the specification entitled “Goods Performance”. Using the value-added matrix, the buyer and the procurement professional discuss and agree the value-added factors to add into the tender specification template, that will bridge the gaps in the buyer skills or resources. For example, this could include requesting PhD sponsorship for any future students, as the buyer has been unable to access internal and external funding for PhD studentships from the funders.

Next the buyer and procurement professional agree, the CSC factors that need to be included in the specification template. Firstly, both parties need to agree the frequency of review meetings with the supplier, as regular interactions between the partners can develop trust over time (Austin, 2010; Austin and Seitanidi, 2014; Bryson et al, 2006; Couchman and Fulop, 2009; Forrer et al, 2014; Johnson and Finegood, 2015; Mohr and Spekman; O'Leary and Vij, 2012; Osborne, 2006; Perkmann et al, 2014; Vernis et al, 2006; Ukalkar, 2000). Additionally, the information technology methods used to share the partners knowledge needs to be added to the specification template along with the milestones required to deliver, install, and commission the new equipment and/or software at the buyer's laboratory. Along with the written reporting required form the supplier during the life of the contract, which include meeting minutes, progress reports and milestone reports.

As the funding council's requires the buyer to spend the funding for the new scientific equipment within a 6-month period of issuing the grant funding award letter, the buyer has a limited time to transfer the knowledge and develop the collaboration with the supplier to deliver, install, commission, and pay for the new equipment to meet the funders deadline. The pressure to spend the funding in this limited time, effects the type of value-added factors that the buyer may add to the specification template. In the study's findings, most value-added factors added in the specification template are equipment related, as summarized in Table 6.1 (Chapter 6). Furthermore, as the funding influences the knowledge transfer stage from the buyer to supplier, the collaboration between the partners is not formal, involving a collaboration or research and development agreement to manage the partnership. These collaborations last no longer than 3-5 years (Mendel and Brudney, 2018; Mohr and Spekman, 1994; Vernis et al, 2006; Ukalkar, 2000), to cover the warranty period and the exchange of the value-added factors. Therefore, this is reflected in the specification template, with the buyer stating the length of the collaboration. e.g., 3 or 5 years.

Within the specification template, both the buyer and procurement professional will provide a summary of the benefits the supplier receives from working with the buyer. For readers, the author has summarised the possible supplier benefits in table 2.15 (Chapter 2) after examining the interdisciplinary literature. However, the study's findings suggest supplier's require specific benefits from the collaboration which can be seen in the model entitled "University-Industry Collaboration in Action" under step 6 entitled "Collaboration Outcomes - Supplier". An example of a benefit for the supplier is access to the IP to manufacture and sell the new equipment and/or software to the external market. By adding these benefits into the specification template, the procurement professional aims to encourage suppliers to bid for the collaboration.

Now the specification template has been populated with the new equipment functionality and/or software design and the value-added factors the buyer needs to close gaps in the buyer's skills or resources. The buyer and procurement professional add the CSC factors that can create a successful collaboration. For example, in the specification template, the regular communication methods used during the collaboration, that include review meetings based on project milestones, and the methods of transferring knowledge which can be written or verbal communication.

The buyer and procurement professional, can now summarize the project requirements, supplier benefits and timeline to be issued via the tendering portal to potential suppliers to inform them of a new tender about to be issued. By issuing a summary of the project to potential bidders, this give suppliers advanced warning a tender will be issued shortly, and this tender is focused on creating a buyer-supplier collaboration. Consequently, suppliers only interesting in collaborating should apply for the tender. In the next stage, the procurement professional develops the ITT ready for the tender process.

### 9.7.3 Step 2 - Tender Development

Within the model, this step involves the buyer preparing the Information to Tender (ITT), setting up a project on the tendering portal and releasing the ITT via the portal to potential suppliers. Once the buyer and procurement professional have finalised the specification template with the value-added and CSC factors required for the project. At this point the procurement professional will confirm with the buyer if any of the specification requirements are mandatory for a supplier to be awarded the contract. If this is the case, the procurement professional will develop a set of mandatory questions which are Pass/Fail to be included into the ITT. The aim of this is to eliminate suppliers that are not prepared to join a collaboration with the buyer. The procurement professional now prepares the draft ITT including the marking scheme for the ITT, the mandatory questions (if required) and the complete specification template. After assembling the ITT, the procurement professional and buyer review the draft ITT (including the completed specification) and make any corrections required. The procurement professional now finalises the ITT and post the document onto the tendering portal. The suppliers now have access to the ITT including the specification with the details of the new equipment functionality and/or software, value-added factors required by the buyer, CSC factors required to make the collaboration a success and the benefits the supplier can receive from the collaboration. At this point the tender process has begun.

### 9.7.4 Step 3 - Tender Process

Now the suppliers have access to the ITT, any questions they have concerning the specification and ITT, is sent back to the procurement professional via the tendering portal. The procurement professional now reviews the questions and with the buyer prepares a response to be issued via the tender portal to all suppliers registered for the project. To allow the process to be fair and transparent to all bidders, the ITT including the specification is available for review for a minimum of 30 days, to allow suppliers to ask questions concerning the ITT. Additionally, the university will not undertake a request to change the ITT contract or specification. Once the clarification period has closed, suppliers that wish to apply for the collaboration submit a tender return submission via the tendering portal. In the supplier tender submission, there will be confirmation that the supplier can meet the new equipment functionality and/or software, confirmation they can provide the value-added factors requested by the buyer and confirmation they are prepared to develop a collaboration with the university buyer.

If any of the suppliers do not meet the mandatory requirements for the project, the supplier is rejected from the tender process at this point. Now the buyer and procurement professional arrange a meeting to mark the supplier tender returns, based on the marking scheme state in the ITT. Both the buyer and procurement professional will undertake the marking and make the final decision on the supplier to be awarded the contract. Once the marking has been completed, the procurement professional will prepare the award letters for the winning supplier and unsuccessful suppliers. These award letters will be issued via the tender portal. Once the letters have been issued, the procurement professional will forward the final contract to the winning supplier to be signed off, this contract includes the final specification, value-added factors offered by the supplier, the terms and conditions of the collaboration, which the supplier needs to comply to throughout the duration of the collaboration.

The contract is then issued to the supplier for their senior management to sign off. As the supplier’s senior management team signs off the contract for the collaboration, the senior management team endorses the collaboration governance and structure. After the supplier has signed off the contract, the contract is signed off by the university’s senior management team, who also endorse the collaboration’s governance and structure. (Austin 2010; Austin and Seitanidi, 2014; Bryson et al, 2006; Bryson et al, 2009; O’Leary and Vij, 2012; Mendel and Brudney, 2018; Mohr and Spekman, 1994; Perkmann et al, 2014;

Vernis et al, 2006; Ukalkar, 2000). The signed contract is now filed by both the supplier and buyer for future reference. The collaboration now begins.

### 9.7.5 Step 4 - Collaboration Formed

At this stage in the tender process, the three partners meet to form the collaboration and in turn form the Micro Triple Helix Model, the procurement professional manages the interactions and ensures the new equipment and/or software is delivered, installed, and commissioned to the milestones agreed and in time to meet the funder's completion deadline. The buyer provides the knowledge to build the new equipment functionality and/or software and undertakes fault testing once the equipment has been received. The supplier received the knowledge from the buyer in written form, manages their internal R&D and manufacturing teams to create the new equipment.

During the first meeting, the partners review the tender specification and reconfirm methods of communication to be used during the collaboration (Austin, 2010; Austin and Seitanidi, 2014; Bryson et al, 2006; Bryson et al, 2009; O'Leary and Vij, 2012; Mendel and Brudney, 2018; Mohr and Spekman, 1994; Perkmann et al, 2014; Vernis et al, 2006; Ukalkar, 2000). From the study's findings, the preferred methods of communication include face-to-face meetings as this approach allows the partners to develop trust and transparency through interactions (Eagle et al, 2012; Fill and Turnbull, 2019; Fraccastoro et al, 2021; Hänninen and Karjaluoto, 2017; Hill et al, 2009; Rodriguez Cano et al, 2005). However, due to COVID-19 face-to-face meetings were restricted to those in your household bubble, face-to-face meetings now had to be held online via conference calls, as this method allowed the partners to develop trust and transparency through interactions (Eagle et al, 2012; Fill and Turnbull, 2019; Fraccastoro et al, 2021; Hänninen and Karjaluoto, 2017; 2009; Oshri et al, 2007; Rodriguez Cano et al, 2005). The two other methods used to undertake regular communication is email and phone (Eagle et al, 2012; Fill and Turnbull, 2019; Fraccastoro et al, 2021; Hänninen and Karjaluoto, 2017; Oshri et al, 2007; Rodriguez Cano et al, 2005). However, phone calls are used less, than communicating via email.

Next the partners share their motivations and goals (Austin, 2010; Bryston et al, 2009; Clarke and Fuller, 2010; Johnson and Finegood, 2015; Ivascu et al 2016; Mayo et al, 2014; Mendel and Brudney, 2018; Mohr and Spekman, 1994; O'Leary and Vij; 2012; Perkmann et al, 2014; Thune, 2011; Vernis et al, 2006; Ukalkar, 2000) for forming a collaboration, for the buyer this includes the delivery, installation and commissioning of the new equipment and/or new software with the new functionality added and the value-added factors stated in the specification template. In contrast the supplier will confirm they require the IP in the innovation, to allow the supplier to mass produce the equipment, sell to the external market, and obtain the profits from this action. During this formation phase of the collaboration, partners should be honest (Ahimbisibweet al, 2012; Hardwick et al, 2013; Maser and Thompson, 2013; Ntayi, et al, 2010; Spekman and Carraway, 2005) and transparent (Maser and Thompson, 2013; Spekman and Carraway, 2005) with each other about the motives for collaborating with each other, so that trust can develop between the partners (Austin, 2010; Austin and Seitanidi, 2014; Bryson et al, 2006; Couchman and Fulop, 2009; Forrer et al, 2014; Johnson and Finegood, 2015; O'Leary and Vij, 2012; Osborne, 2006; Perkmann et al, 2014; Ukalkar, 2000).

Once the motivation and goals of the collaboration have been reviewed and agreed, the next step is to finalise the project milestones, a recommendation made to make the tender process more conducive to collaboration in Chapter 8. The milestones include the steps required to create, develop a prototype, deliver, install, and commission the new equipment and/or software and the delivery of the free of charge equipment manuals. The milestones confirm the date the equipment training will be undertaken with the buyer, their research team and PhD students free of charge. During the milestone reviewing and resetting phase, the partners agree a updated the face-to-face meeting schedule to ensure the project meets the main goal of developing new equipment functionality and/or software before the funder's deadline.

Next the partners share their expertise (O'Leary and Vij, 2012), at this point the supplier provides an account manager to manage the partnership and coordinate the firm's internal teams to support the project. For the buyer this includes transferring information on the buyer's research and the buyer may give the supplier access to their research groups and to provide more insight into the research being conducted. The procurement professional will confirm they will act as the liaison between the university and the funder, to ensure funding is accessed to pay the supplier and deal with any issues during the collaboration. When sharing expertise the partners must be honest (Ahimbisibweet al, 2012; Hardwick et al, 2013; Maser and Thompson, 2013; Ntayi, et al, 2010; Spekman and Carraway, 2006) and transparent (Maser and Thompson, 2013; Spekman and Carraway, 2005) with each other on what expertise the partners possess, as exaggeration of expertise could impact the partners trust in each other (Austin, 2010; Austin and Seitanidi, 2014; Bryson et al, 2006; Couchman and Fulop, 2009; Forrer et al, 2014; Johnson and Finegood, 2015; O'Leary and Vij, 2012; Osborne, 2006; Perkmann et al, 2014; Ukalkar, 2000).

Within this stage, partners confirm the point of contact for each organisation and their roles within the collaboration, the buyer provides the knowledge and access to the direction of research. Allowing the supplier to develop the new equipment and/or software, the supplier provides the resources and manufacturing knowledge. The procurement professional co-ordinates the collaboration between the partners, university, and funders, to ensure the innovation is delivered by the funding deadline. Additionally, each partner acts as a point of contact within their own organisation and manages their internal teams to support the collaboration.

To ensure a smooth transfer of knowledge between the partners, the partners agree the information technology (Austin, 2010; Austin and Seitanidi, 2014; O'Leary and Vij, 2012; Ukalkar, 2000) adopted to share knowledge and meet the milestones on time during the collaboration. From the study's findings, most methods for transferring knowledge are the same as regular communication, via face-to-face meetings, via email, through telephone calls and online conferences. However, in the pre-tender phase, the procurement professional will have stated the written reporting required during the collaboration, this may be via meetings minutes, progress reports and milestone reports from the supplier to advise on the status of the value-added factors being delivered and the development of the new equipment and/or software.

Within the study's findings, the author concluded the power can influence the relationship between partners during the collaboration, at the start of the collaboration the buyer has the power over the supplier to meet the requirements set in the contract (Sadeghi et al, 2022; Wang et al, 2016), but this is only until the purchase order has been sent to the supplier. As the purchase order is the legally binding commitment that the buyer will purchase the new equipment and/or software from the supplier. At this point power transfers to the supplier to create the new equipment and/or software, to the buyer specification based on the milestones agreed by the partners. If the supplier fails to deliver the specification stated by the buyer, the buyer can take the supplier to court for not completing the contract. Within the study's findings, none of the collaborations have resulted in failure, that required legal recourse from both parties failing to create new equipment and/or software together. Consequently, the author concluded that power (Bryson et al, 2006; Hartman and Dhanda, 2018; Mayo et al, 2014; O'Leary and Vij, 2012) was an "important" CSC factor during a life of the collaboration. In the next step of the model, the author will discuss the collaboration in action and the supplier using the knowledge to create the innovation and deliver the milestones in the contract.

### 9.7.6 Step 5 - Collaboration in Action

At this stage in the collaboration, the Micro Triple Helix partners are fully engaged in the collaboration. Now the buyer has transferred their knowledge on the new functionality to the supplier via regular communication methods (Austin, 2010; Austin and Seitanidi, 2014; Bryson et al, 2006; Bryson et al, 2009; O'Leary and Vij, 2012; Mendel and Brudney, 2018; Mohr and Spekman, 1994;

Perkmann et al, 2014; Vernis et al, 2006; Ukalkar, 2000) using face-to-face meetings, email, telephone and conference calls between the partners on a weekly or daily basis. The partners begin to develop trust in each other through sharing goals and being transparent in their interactions with one another (Eagle et al, 2012; Fill and Turnbull, 2019; Fraccastoro et al, 2021; Hänninen and Karjaluoto, 2017; Hill et al, 2009; Rodriguez Cano et al, 2005).

The supplier now has the power (Halseth and Ryser, 2007), in the relationship, over the buyer, as the supplier now has the vital knowledge and the resource/expertise to translate the buyer’s knowledge into a working prototype and/or software with the new functionality (Kaufman, 2001; Jolibet et al, 2012; Matthyssens et al, 2016; Tyrrell, 2022; Torvinen and Ulkuniemi ,2016; Vanhaverbeke and Du, 2010). During the development of the prototype and/or software the supplier will be in regular communication with the buyer to clarify the technical functionality (Kaufman, 2001; Jolibet et al, 2012; Matthyssens et al, 2016; Tyrrell, 2022; Torvinen and Ulkuniemi ,2016; Vanhaverbeke and Du, 2010). Depending on the technical details, the supplier may arrange for the firm’s technical teams to meet with the buyer to clarify the design before finalising a prototype. Now the supplier’s internal teams create a working prototype of the new equipment and/or software to deliver, install and commission at the buyer’s laboratory.

When the prototype is ready, the partners meet to discuss the delivery, installation, and commissioning of the new equipment and/or software, at the same time the equipment is provided to the buyer, the supplier deliver’s most of the equipment value-added factors in table 6.1. From the study’s findings, once the new equipment and/or software has been delivered, installed, and commissioned by the supplier free of charge, the supplier provides the training, operating manuals and technical support helpline to the buyer, their research teams and PhD students free of charge. By including this as part of the collaboration, the buyer gains not only the financial benefit of the collaboration, but the benefits of all their team being trained in the new techniques to speed up the research outcomes. Additionally, the operating manuals and technical support helpline, provides the buyer, their research team and PhD students with support when operating the new equipment and/or software, advice on techniques to speed up their research and a method to report any defects on the new equipment and/or software that needs to be rectified by the supplier.

Now the new equipment and/or software is operational, during the next couple of months, the buyer, the research teams, and PhD students, will monitor and identify if any faults develop in the new equipment and/or software. If any faults are reported to the technical support helpline, the supplier will send a service engineer to rectify the fault on the new equipment and/or software, provided to the buyer free of charge. After 6 months of using the new equipment and/or software, the knowledge transfer part of the collaboration is complete.

As the funding deadline is getting close, the procurement professional, works with the buyer to ensure that the supplier invoice for the new equipment and/or software is processed and paid in full. The procurement professional, sends to the funder, confirmation of the equipment and/or software purchase and confirmation the invoice has been paid to comply with the funder's award terms. The collaboration now moves from a knowledge transfer phase to ongoing relationship phase, as the supplier now implements the remaining value-added factors agree in the supplier tender return. For example, in the study's findings these "important" value-added factors include providing the buyer with free seminars or workshops to the university department on the latest techniques being used in the field. Providing free equipment accessories to complement the new equipment functionality and for some buyer's, starting the process of transferring funds to support a PhD studentship. The extended warranty now is implemented by the supplier, this offers the buyer regular preventative maintenance to the equipment, which ensures that the equipment is in good working order.

The procurement professional, updates the regular meeting schedule between the buyer and supplier, a recommendation from the study's findings. The review meetings will monitor the new equipment and/or software operation and will record the actions between the partners. For example, any issues with the functionality, the latest research conducted from the new functionality, the supplier operations, including if the supplier can provide other beta testing equipment. After completing the collaboration in action step, the partners now benefits from the relationship and the development of the new equipment and/or software create. The author will discuss this in more details in the next steps.

### 9.7.7 Step 6 - Supplier Collaboration Outcomes

From the study's findings, a "very important" driver of the Micro Triple Helix collaboration, is the supplier gains unlimited access to the IP rights from the creating of the new equipment and/or software from the buyer knowledge. As the collaboration, does not have a formal R&D agreement in place to allow the buyer's university to access a percentage of the IP right and revenue from the innovation.

By accessing the IP rights, to generate a new mass-produced model for the external market, the supplier can obtain competitive advantage (Christensen, 2001; Porter, 1985; Powell, 2001; Wen-Cheng et al, 2011) over rivals by obtaining additional revenues to secure a dominant market position. By no longer focusing on generating the new ideas internally, the supplier saves time and money developing new models, that in turn enhances its competitive advantage position in the market (Christensen, 2001; Porter, 1985; Powell, 2001; Wen-Cheng et al, 2011) over rivals.

Additionally, by developing the new equipment and/or software functionality, the supplier has an unlimited access to the buyer market and can identify other lead buyers (von Hippel, 1981; von Hippel, 1986; Urban et al, 1988; von Hippel, 1988; Franke and von Hippel, 2003; Shaw, 1985: Shaw, 1988, Tyrrell, 2015) to collaborate with on other model types, as confirmed in the study's findings in Chapter 5. Indicating that all these factors are critical to a successful university-industry collaboration. In the next section, the author discusses the benefits the buyer receives from the collaboration.

### 9.7.8 Step 7 - Buyer Collaboration Outcomes

Within the study's findings, the buyer receives several value-added factors that impacts on the buyer teaching and research activities. From the creation of the new equipment and/or software functionality, the buyer, their research team, and PhD students have access to new techniques that can speed up the research process and allow the buyer to publish research outcomes faster than other academics. As the buyer can complete their research quicker than their peers, the buyer generates more research papers and in turn can access more funding. With the supplier providing free extended warranty on the equipment that has been installed, the buyer no longer needs to purchase expensive servicing, as the warranty includes an annual preventative maintenance visit.

Additionally, if there are issues using the equipment or a query on running samples through the equipment, the buyer no longer needs to pay for an expensive technical support line to help support the research work, as this is provided free of charge by the supplier. All these value-added factors are what drives a successful collaboration and drives the buyer to form a relationship with the supplier. For a full list of value-added factors, the buyer receives from the collaboration can be found in table 6.1 (Chapter 6). Finally, there are several benefits the procurement services receives from the collaboration; this will be discussed by the author in the next paragraph.

### 9.7.9 Step 8 – Procurement Service Collaboration Outcomes

From the new model entitled "University-Industry Collaboration in Action", the main benefits that the procurement service team receive from the collaboration is the development of a new tender process as shown in figure 8.1 (Chapter 8). This new tender process embeds procurement services as a function that can influence stakeholder behaviour during the collaboration process. Now the procurement services team is included in the development of the specification template and can influence the buyer on the value-added and CSC factors to incorporate into the specification template. Additionally, during the collaboration process, the procurement service team now have a key role in co-ordinating the collaboration during its duration. Consequently, procurement services now have a method to drive change within the university to embed value for money (Meehan et al, 2017) in the tendering process and can be viewed by the university as a strategic function.

From the study's findings, a new specification template was developed that include all the equipment value-added factors identified by the author from the secondary data (buyer specification template and supplier tender return) in shown in table 6.2 (Chapter 6). By embedding these value-added factors into the specification template, this saves time and enhances the value for money obtain from the specification for tenders that do not result in a collaboration. The new tender process now includes an early supplier engagement step, where the buyer and procurement professional provide a summary of the project's requirements for the tender. However, the project information is only issued to potential bidders once the buyer has received confirmation from the funder, they can purchase the new equipment, software, or services.

By adopting the steps in the "University-Industry Collaboration in Action", readers can develop their own tender process to make them more conducive to collaboration and include value-add factors which will benefit their organisations. Plus include in their tender documentation, CSC factors which will make the collaboration a success. From the new university-industry collaboration model, the author concluded that research question 4 had been answered. In section 9.8 the author reflects on the study's process, study limitations and future research can be generated from this study's findings.

## 9.8 Study Reflections, Limitations and Future Research

The author has made several changes to the original research design, including discarding the literature on co-creation. Co-creation theory focuses on the joint development of goods and services between buyers and suppliers, which creates new value for the partners both materially and symbolically (Galvagno and Dalli, 2014; Ind and Coates, 2013; Payne et al, 2008). However, as the author wanted to identify the benefits that both partners receive from the collaboration, that could be applied in future tendering specifications, the author decided not to use co-creation theory but value-added factors. As value-added factors can be identified and summarized into a single table, then discussed with the buyer to identify value-added factors that can be added to the specification template to be implemented in the procurement tender process. Additionally, the author discarded the theory of Public Procurement of Innovation (PPI), to underpin this study, as the RIU has not applied this innovation policy, as the RIU examined was not classed a contracting authority under PCR 2015, therefore the RIU was not required to implement this as part of its tender process. As the RIU receives funding at short notice and spent within a brief period (within 6 months). With the procurement service team ensuring that the equipment is delivered, installed, commissioned, and invoiced with the timescale set out by the funder, otherwise lose the funding. This makes the implementation of early supplier engagement (ESE) impossible, due to the uncertain grant funding process. Consequently, the author concluded the ESE theory will not underpin this research study.

Another change made to the research design involved swapping the supplier online questionnaire to an online virtual meeting, as the data collected from the supplier online questionnaire in the study pilot phase, did not provide the rich data that was required to answer the research questions. This delayed the supplier data collection process, as the supplier online questionnaire needed to be converted into a virtual meeting schedule and ethical approval was obtained for the new supplier data collection tool. Consequently, the author needed to update the participant consent form, participant information sheet and ethical approval form, full details can be found in Chapter 4.

There are several limitations of this study, as the author chose cases (tenders) resulting in collaboration based on three sections in the RIU tender specification documents entitled “Ongoing Development”, “Collaboration” and the “Goods Performance” completed by the buyer. The ongoing development section, normally referred to development of new software, the “goods performance” section, normally identifies if the equipment had new features and the “collaboration” section discusses the partnership requirements from the buyer’s perspective. The tender’s chosen have preselected the sampling frame based on purposive sampling (Patton, 2002; Quinlan et al, 2018), with a matching buyer and supplier dyads (Choi and Wu, 2009; Sundtoft Hald et al, 2009; Tanskanan and Aminoff, 2015) involved in the collaboration.

Consequently, the author created a selection criterion to select the buyer and supplier participants to take part in the study’s primary data collection stage. A full list of the selection criteria for the buyer can be found in Table 3.9 (Chapter 3) and the supplier selection criteria in Table 3.10 (Chapter 3). Additionally, the author created a selection criterion to reject participants from the study, these criteria are listed in Table 3.12 (Chapter 3). As the author did not investigate buyers who had engaged in a purchase of equipment already on the external marketplace. Over 300 tenders were rejected from the sampling frame, as these tenders did not result in collaboration, this made the sample size of the tenders being examined very small, with only 15 tenders being identified at the RIU as resulting in a collaboration.

As the data collection stage was conducted during the COVID-19 lock down, when the country had to work from home, to protect the NHS and save lives. The study’s data collection tools did not adopt face-to-face interviews, due to COVID-19 social distancing and a travel ban across the UK. It is not sure if the participation rate would have increased or decreased if there were no COVID-19 restrictions. During COVID-19, several suppliers furloughed or restructured their operations with several supplier participants leaving those firms being investigated. This reduced the number of suppliers participating in the virtual meetings and data obtained. This will have implications for transferring the study to another setting, as it is unlikely there will be a major pandemic again, which would influence the collection of data for research purposes.

This has implications for the study, although the author was able to identify all the value-added factors present in the 15 tenders examined and obtain a saturation point (Bryman, 2011; Glaser and Strauss,1967) in the secondary data where no new themes had emerged from the cases (tenders). The author was unable to triangulate (Ghauri and Grønhaug, 2010; Jankowicz,1995; Pole and Lampard, 2002; Saunders et al, 2000) these value-added factors with all 15 buyer and supplier participants, due to some participants declining to engage in the study. Consequently, this limits the ability to generalise (Rahman, 2017; Veal, 2005) the findings to another setting, as the author cannot verify if all participant responses agree with the value-added factors found in the secondary data (Dwyer and Slyman, 2016; Pole and Lampard, 2002; Saunders et al, 2000) or if there were any new themes that would have been generated from additional participant responses.

Additionally, the secondary data did not hold any participant demographics or CSC factor data, the author used the participant responses from the buyer telephone interview and supplier virtual meeting transcripts to identify what influences the participant's demographics have on the collaboration and what CSC factors are important during the partnership. As the response rate is low due to COVID19, once again the author cannot generalise to another setting, or if any new themes would have been generated from additional participant responses. If the author wishes to generalise the findings, another option would have been to increase the sample size by holding telephone interviews with the PhD students and PI's research group to obtain their perspective on the value-added factors and CSC factors required to make the collaboration a success.

For these telephone interviews to be conducted, the author would use a snowball sampling process (Bell et al, 2019; Newby, 2010; Riley et al, 2000; Zikmund et al, 2013), where the buyer invited to the telephone interview provides the names of other buyers, research staff and PhD students that used the equipment during the collaboration. By triangulating this primary data for this different data source, the author could corroborate the findings, against the other data sets. Allowing the author, to confirm that no new themes are present in the value-added factors and CSC factors present in the collaboration, indicating the primary and secondary data had reached saturation point (Bryman, 2011; Glaser and Strauss,1967). For the author, this increases the credibility of the findings (Anney, 2014; Lincoln and Guba, 1985; Korstjens and Moser, 2018; McInnes et al, 2017; Miyata and Kai, 2009: Morse et al, 2002; Shenton; 2003).

However, to mitigate these limitations, the author intended to make the findings transferable using Lincoln and Guba's (1985) naturalist framework. By using a thick contextual description of university-industry collaboration, the author has provided readers the methods to transfer the findings to another setting or context (Anney, 2014; Lincoln and Guba, 1985; Korstjens and Moser, 2018; McInnes et al, 2017; Miyata and Kai, 2009: Morse et al, 2002; Shenton, 2003) Supported by the author using verbatim extracts to illustrate the participant's perspectives, as evidence and context to support the study's findings and a representation of all the participant's sentiments related to the study's themes (Brinkmann and Kvale, 2015; Gillham, 2005; Lingard, 2019, Thorne 2020).

Additionally, by providing a breakdown of the research methods used for this study, including copies of the buyer telephone interview schedule, supplier virtual meeting interview schedule, participant information sheet and example consent form, the author has ensured that the study has dependability and the findings are stable over time (Anney, 2014; Lincoln and Guba, 1985; Korstjens and Moser, 2018; McInnes et al, 2017; Miyata and Kai, 2009: Morse et al, 2002; Shenton, 2003).

Consequently, should another researcher aim to replicate these findings within another institution, they may not get the same results, as the level of supplier participants could be higher due to firms recruiting to replace those employees made redundant during COVID-19. Additionally, COVID-19 made it much easier to access the buyer population during the lockdowns, as buyers where more willing to undertake the telephone interviews while working from home. If the telephone interviews where to be conducted today, it may not be easy to schedule a time to hold these with the buyers due to their work commitments. At the time of the virtual meetings taking place, buyer P10 had just formed a collaboration with a new supplier, although the new equipment had been delivered, the collaboration was new and needed to be monitored to confirm if the partnership was successful over the 3-to-5-year period. Consequently, this collaboration required further study. This study did not include primary data collected from research services, the technical transfer office, or the procurement services department. In the closing part of the buyer telephone interview, the buyer P1 expressed his opinion that that the procurement professional’s expertise on the scientific equipment market should be included in the tender specification and tendering process. Unfortunately, the procurement professional at the university being investigated had left the university to join another public sector body, therefore they were unable to undertake either a telephone interview or virtual meeting to obtain their perspective on how the specialist procurement professional can provide value-added expertise to the tendering process.

Due to the richness of the data from the participant responses (Ashworth, 2018. Dierckx de Casterle et al, 2011, Lambert and Loiselle 2008), the author was unable to investigate the direct/indirect links between other department academics and students during the collaboration due to the word limit. These interactions require further investigation and findings published. Although power is present within the CSC factors, further investigation needs to be carried out to determine if power is balanced within the relationship during the collaboration. As the participant responses do not provide any insight into how power is balanced between the partners.

There were several study surprise findings, firstly after conducting the literature review and identifying the CSC factors that are required to make the collaboration a success. Once the primary data had been collected, analysed, and findings presented, the author was surprised to discover that the CSC factors identified in the literature, where high level factors. From the participant responses, there are specific factors that have not been identified in the literature. Consequently, the author reviewed these factors and identified appropriate literature that could be adopted to show the importance of these factors in university-industry collaboration.

Within the buyer demographic data, an interesting finding was the university being studied had reduce or did not provide any internal funding for the buyers to conduct teaching and research activities. From the buyer participant responses, there was no indication what the reasons are for the university to undertake this action, this needs further investigation. This research study does not investigate the reasons why some buyers do not engage in collaboration with scientific firms, this is covered in part by Tyrrell (2015) study. This research study does not investigate tenders which have not resulted in collaboration, as these tenders are one off transaction's and do not result in new product innovation.

From the study's data collection, analysis and conclusions, the author will be able to disseminate the knowledge obtained from the study's findings within both academic and practitioner journals. As the new Micro Triple Helix model expands our understanding of university-industry collaboration between buyer (department) and supplier (firm), the findings can be presented at the Triple Helix Association conference, or in innovation and technology journals. The recommendations to change the tender specification and tendering process, can be presented to procurement professionals in the supply chain management magazine and the journal of supply chain management.

## 9.9 Contribution to Knowledge Summary and Transfer of Findings

As stated throughout the data analysis and findings section of this thesis, this study makes several contributions to knowledge, firstly, this study builds on Tyrrell's (2015) empirical study and the empirical research of von Hippel, 1981; von Hippel, 1986; Urban et al 1988; von Hippel, 1988; Franke and von Hippel, 2003 by extending the dimensions of the PI end-user by adding the concept of the lead buyer type. By identifying two new buyer types, not identified in the previous study, these are an individual academic, who is engaged in research but does not share their equipment with other academics. The next buyer is an academic that not only engages in research and teaching activities but also manages the equipment as a core facility for the university. A core facility is equipment that can be rented out to other academics, departments, and external collaborators. When the equipment is not in use by the main buyer, other academics internally or external to the university may hire the equipment at a cost for conducting research (Haley 2009; Hockberger et al, 2018; Zwick, 2021).

This allows academics with limited funds to generate additional revenue for their research or teaching activities from this equipment. Therefore, this study makes a minor contribution to the characteristics of the lead end-user within university-industry collaborations. From the buyer and supplier characteristics (demographics), the findings indicate that buyers have previously collaborated with the same supplier before the tender, this indicates that most of the participants are serial innovators, who are individuals within both SME's, medium, large, and global firms that who repeatedly create new innovations that meet customer's needs and deliver long-term value for their firms (Corradini et al, 2015; Griffin et al, 2014; Tuzovic et al, 2018; Vojak et al, 2012).

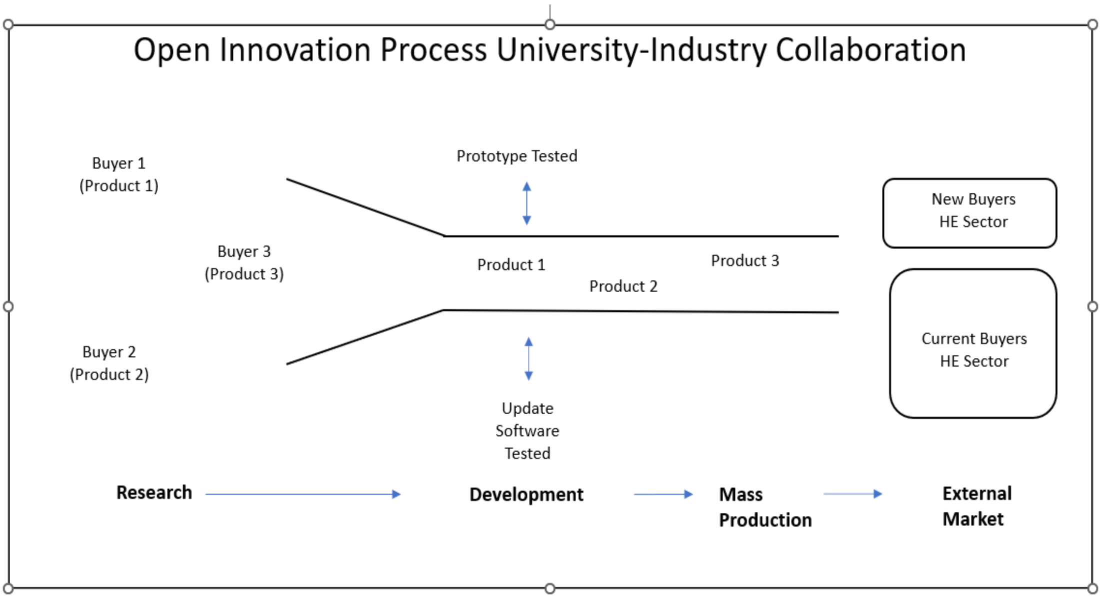
This finding is a minor contribution to the serial innovator's literature, by providing cases that indicated that university academics can also undertake the role of serial innovators. As there is limited literature on serial innovators within universities as the current literature focuses on the entrepreneurial university

(Etzkowtiz et al, 2000; Etzkowitz, 2003; Etzkowitz, 2004; Etzkowitz, 2008) focused on universities obtaining economic returns from generating knowledge and technology transfer from non-key activities of teaching and research, which is a macro view of innovation at a national level. Additionally, as both suppliers S13 and S6 had engage with at least 2 different buyers on developing innovations on different products within their product range, plus S1 had engaged in three separate innovations on Ultra Low Freezers, Bench Top Centrifuges and Co2 Incubators. This finding suggests that the suppliers are serial innovators by working with different buyers or a buyer to develop innovations on different product ranges (Corradini et al, 2015; Griffin et al, 2014; Tuzovic et al, 2018; Vojak et al, 2012).

This interlinks with the next contribution to knowledge, as the suppliers have engaged in collaboration with different buyer's or buyer, this indicates all suppliers have adopted an open innovation process by using lead-user knowledge in the creation of new scientific equipment and services (software development). By university-industry collaborations taking place through the tender process, this study data has provided an example of how to implement the open innovation process within a public sector organisation to create new innovations. This is a minor contribution to our knowledge on the open innovation model conceptualised by Chesbrough's model (2003a; 2003b; 2004; 2006), with the tender process giving us an example of how buyers and suppliers can access knowledge that leads to new innovations that can be marketed to other HE buyers.

Below is figure 5.2 from Chapter 5, which shows a visual representation of how buyer knowledge is embedded in the innovation process to generate new innovations.

**Figure 5.2 - Open Innovation Process in University-Industry Collaborations**




Source: Tyrrell (2022)

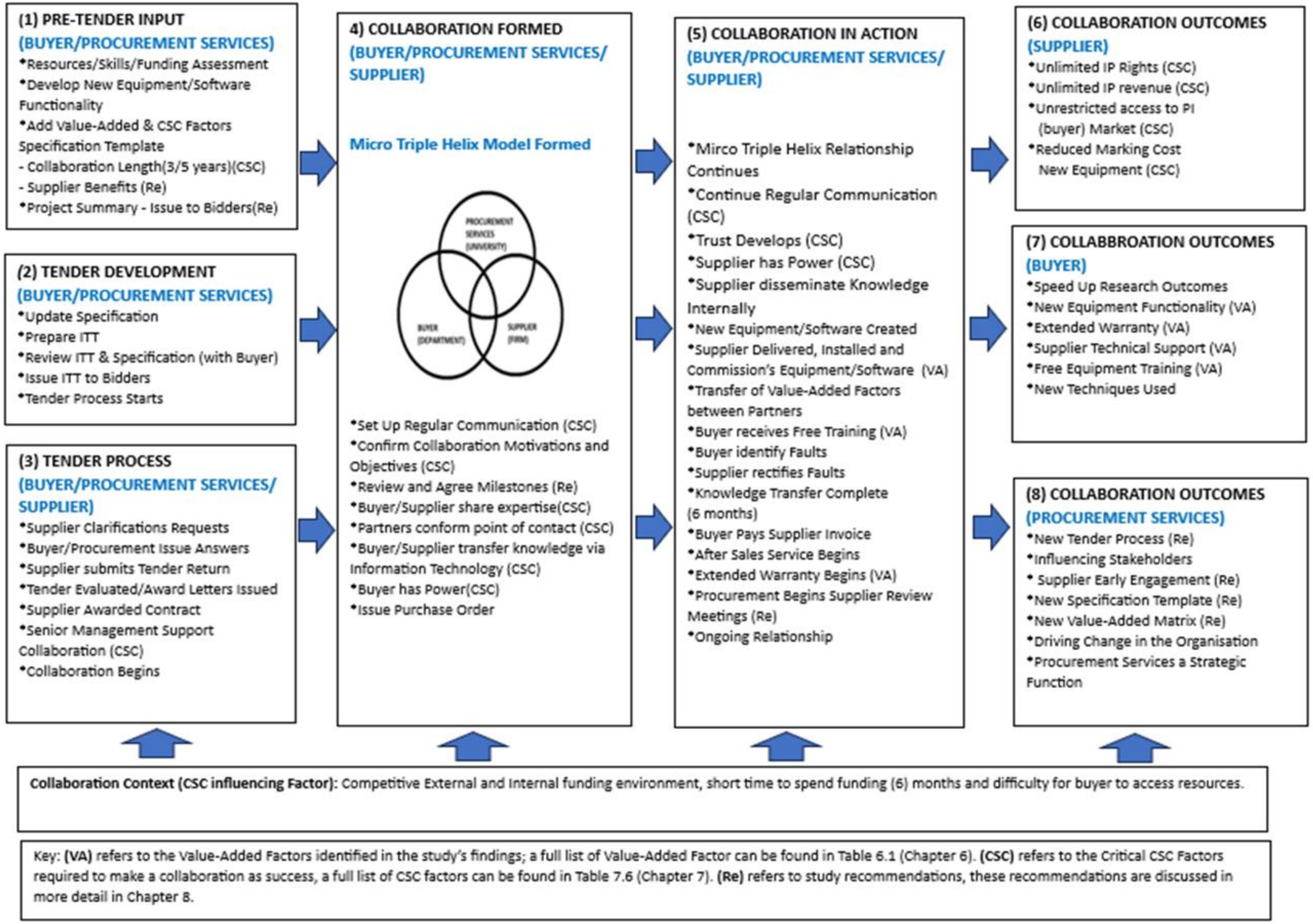
In the new university-industry OI model, the supplier focuses on embedding each lead buyer into the research stage of the open innovation process, they obtain knowledge from each buyer for different products in their portfolio. The supplier then develops the prototype and issues it to the buyer to test. The buyer then tests the equipment and detects/reports any faults with the equipment; the supplier then resolves the problems with the equipment. Once the problems have been resolved, the supplier then moves the innovations into their mass production process and sells the innovation to customers.

This study makes a major contribution to knowledge and the triple helix literature by providing a theoretical model and cases that express that collaboration is taking place between university and industry at the local departmental level as shown in figure 5.1. Using the study's findings, the author has incorporated the "Micro Triple Helix model" that expresses university-industry collaboration into the procurement tender process. This new theorised visual model of university-industry collaboration in figure 9.1 entitled "University-

Industry Collaboration in Action" includes the value-added factors, CSC factors and tender recommendations to allow readers to understand the steps within the tender process to create a collaboration and factors required to make a collaboration a success.

Below is figure 9.1 from Chapter 9, which shows a visual representation of university-industry collaboration including the micro triple helix model. The author has provided a step-by-step process for implementing a collaboration through the tender process.

**Figure 9.1 - University-Industry Collaboration in Action**



Within the model, each steps have a corresponding set of actions that need to be completed to ensure the collaboration is success. For a full breakdown of each step see in section 9.7 “University-Industry Collaboration in Action”.

This study makes a major contribution to knowledge and the triple helix model (Etzkowitz and Leydesdorft 1997; Etzkowitz, 2003a; Etzkowitz, 2003b; Etzkowitz and Leydesdorff, 2000 and Etzkowitz, 2008) as limited research has been conducted into the reasons for the collaboration between universities and firms within the Triple Helix Model and the individual value-added factors that both parties receive from the partnership.

Consequently, the author recommends that further research be conducted to identify which value-added factors are exchanged between partners in the Triple Helix Model. However, some adjustments will need to be applied to identify the value-added factors exchanged between partners and the different forms of innovation created from the Triple Helix model. For example, the value-added factors exchanged by the partners may be different between a joint venture company and the creation of a startup company within a university incubator. Future researchers will need to split up the different organisation types to examine the value-added factors present and investigate how these value-added factors impact on the development of economic growth through the Triple Helix theory.

For policy makers within firms, government and universities wishing to undertake a collaboration to access resources, skills, or funding, by undertaking future research, these groups will be able to identify the value-added factors required for collaboration and create policies to support the value-added factors adopted with the Triple Helix model. As the study’s findings indicate that the value-added factors present are interlinked with the critical CSC factors present in this study’s findings that result in the micro triple helix collaboration. Future researchers should examine how collaboration in the Triple Helix model is influenced by both value-added factors and CSC factors and how these factors impact on economic output within the Triple Helix model.

However, limited research has been conducted on the CSC factors present within university, firms, and government collaborations in the Triple Helix Model (Etzkowitz and Leydesdorft 1997; Etzkowitz, 2003a; Etzkowitz, 2003b; Etzkowitz and Leydesdorff, 2000 and Etzkowitz, 2008) and the critical success factors required to create a successful collaboration. As the study's findings have identified specific CSC factors present in university-industry collaboration, these CSC factors could be applied to the partners in the Triple Helix Model. By conducting this research policy makers within firms, government and universities can identify the reasons why collaborations fail and develop strategies to support the development of interfirm collaborations.

From the study's research design, findings and recommendations, the author concluded these can be transfer to UK universities, national health service (NHS) trusts, charities, local authorities, and private firms. With the NHS suffering from ongoing UK government budget cuts to run services, NHS Trusts are experiencing a shortage of skills, resources, and funding to manage their operations. The equipment value-added factors identified in Table 6.2 (Chapter 6) can be transferred into an NHS trust, who also purchases scientific and medical equipment for diagnostic use, would provide instant advantage for the buyer, below is a copy of Table 6.2 (Chapter 6).

**Table 6.2. – Specification Template (Pre-Added Value-Added Factors)**

| ***Value-Added Factors*** | ***Buyer Benefit*** |
|---|---|
| **Free Equipment Delivery /Installation /Commission (e)** | There is no additional cost to the equipment being installed, delivery and commissioned into the buyer department. This removes the cost, so the buyer has additional funding to purchase other equipment or services from the supplier. |
| **Free Extended Warranty (e)** | By adding extended warranty into the specification there is no additional cost to the buyer if the equipment needs servicing during the collaboration. |
| **Free Software Firmware, Patches, Upgrade (e)** | To extend the life of the equipment, by adding free firmware, patches, and software upgrades, reduces the cost of the equipment long term. |
| **Free Technical Support (e)** | As buyers may have issues operating the equipment, which needs to be reported to the supplier for repair. Or a question about running an experiment on the equipment, by providing technical support either online or by phone, the buyer can fully utilise the equipment and speed up their research and teaching activity. |
| **Free Equipment Training (e)** | As training on the equipment is free of charge, there is no additional cost of training existing PhD students or other department staff in use |

| | |
|---|---|
| | of the equipment, this free's up time for the buyer to focus on writing research papers. |
| **Account Manager (e)** | By appointing an account manager to manage all aspects of the project including the relationship between the supplier and buyer. The buyer has more time to focus on delivering teaching and research activities more quickly. |
| ***Beta* Testing Equipment (e)** | Apart from S2 that does not offer beta testing due to the size of the equipment. All suppliers offered beta-testing equipment to the buyer, this gives the buyer access to new equipment that has not been launched to the market, for testing and modification. This allows the buyer access to the latest technology without any cost. |
| **Free Equipment Manuals (e)** | The equipment manual provides the buyer with information on the operation of the equipment; the buyer can identify new methods and processes to adopt in their experiment which may lead to data and research papers being published faster. |

By ensuring the equipment value-added factors form part of the specification template, the buyer (clinical staff), patient and trust obtain the benefits of accessing the supplier's resources without paying additional charges. These savings can be transferred to other essential NHS services which can improve patient outcomes. This approach does not change the NHS procurement process being run under PCR 2015 but delivers instant value to NHS stakeholders. Additionally, other UK universities that purchase scientific equipment can adopt the same approach and apply the value-added factors in Table 6.2 (Chapter 6) into the specification template to obtain the benefits of accessing the supplier resources without paying additional charges, this would not change the universities procurement process but deliver value for money (Meehan et al, 2017).

The value-added matrix identified in Table 6.1 (Chapter 6) can be transferred to another UK university and NHS Trust's purchasing medical and scientific equipment. Below is a copy of Table 6.1 (Chapter 6) providing a summary of the value-added factors that are important to buyers and can be added to the specification template.

### Table 6.1 - Important Buyer Value-Added Factors

| ***Equipment Value-Added Factors*** | ***Research Value-Added Factors*** |
|---|---|
| *Free Equipment Delivery, Installation and Commissioning (VI)<br>* Equipment Functionality (VI)<br>*Extended Warranty (VI) | *Beta Equipment Test (I)<br>*Seminar/Workshops (I)<br>*PhD Studentship (I)<br>*Joint Research Projects (N) |

| | |
|---|---|
| *Account Manager (VI)<br>*Technical Support (VI)<br>*Free Equipment Training (VI)<br>*Free Equipment Manuals (VI)<br>*New Software (I)<br>*Free Equipment Accessories (I)<br>*Enhanced Maintenance (I)<br>*Equipment Price (N)<br>*Spare Parts (N)<br>*Free Storge (N)<br>*Free Extended Storage (N)<br>*Free Additional Equipment (N)<br>*Additional Free Upgrades (N)<br>*Reduced Pricing (N) | *Onsite Scientist provided<br>Free of Charge (Supplier) (N)<br>*Support Program (N)<br>*Access to further Funding(N) |
| ***Collaboration Value-Added Factors*** | ***Student Value-Added Factors*** |
| *Support Grant Applications (N)<br>*Continuing Collaboration (N)<br>*Access to Industry Network (N) | *Student Internship(s) (N) |

Source: Tyrrell (2022)

In the specification formulation stage of the tender process, the procurement professional can discuss with the buyer, the value-added matrix, which would allow the buyer to add additional value-added factors from the matrix into the tender specification template. This would not require the university or NHS trust to change its tender procedures under PCR 2015.

For NHS trust's, UK universities, charities, local authorities and private firms, the value-added matrix can be transferred into the procurement process in other category groups like IT and Estates (build, design, and services) by the procurement professional analysing previous tenders to identify specific value-added factors. For example, a value-added factor in IT could include enhanced laptop warranty – repair or replacement should the laptop have problems within a 3-year period. Within Estate, a value-added factor within a catering service contract may include cook to order to reduce foods waste. These value-added factors are specific to the category and organisation, and during the tender process need to be discussed with the stakeholders, to delivery additional benefits from the tender process.

For UK universities, NHS trusts, charities and local authorities operating under PCR 2015 regulations, to form a collaboration based on figure 9.1 (Chapter 9) the contracting authority (Bright, 1994; Bovis, 2015; Sanchez Graells and Gideon, 2016; Sigma, 2011) would be required to undertake an open procedure (Bailey, 2015). Under the PCR 2015 regulations, the contracting authority would need to change the tender timeline, evaluation process, tender marking and add a standstill period to comply with the open procedure requirements (Bailey, 2015), which is the quickest PCR 2015 procedure. However, the contracting authority would not be able to negotiate with the supplier once the ITT is issued to potential suppliers, otherwise the contracting authority runs the risk of a challenge for undertaking an unfair tender process (Edh Hesselgård, 2017). For UK universities and private firms, outside PCR 2015, wishing to form a collaboration to access resources, skills, or funding from the partnership, can adopt figure 9.1 in part or in full. This study's findings will complement the innovation tender process when the new Procurement Act 2024 comes into UK legislation, future researchers will need to adjust the recommendations around the new timelines for any negotiated procedure if the organisation is classed as a contracting body.

Finally, this study makes a minor contribution to the tendering literature, by providing a step-by-step process for creating a collaboration between buyer's and supplier's leading to innovation, via a university tender process. In section 9.10 the author summarizes the study's conclusions.

## 9.10 - Final Study Conclusions

From the study's findings and conclusions, the author determined that the study research aims, and research questions had been answered. With the author identifying the value-added factors and CSC factors that are present in university-industry collaboration. Plus, identifying the CSC factors that are not present in university-industry collaboration as these partnerships are not formal collaborations with a collaboration agreement in place between the partners. Using the value-added and CSC factors identified in chapter 6 and 7, the author has provided recommendations on how to change the tender documents and tender process to incorporate these factors to make the tender process more conducive to collaboration.

This study makes a major contribution to knowledge and the triple helix literature by providing a theoretical model and cases that express that collaboration is taking place between university and industry at the local university departmental level. The Micro Triple Helix Model shown in figure 5.1 has been incorporated into a new theorised model of university-industry collaboration in figure 9.1 entitled “University-Industry Collaboration in Action”. This model includes the value-added factors, CSC factors and tender recommendations to allow readers to understand the steps within the tender process to create a collaboration and factors required to make the collaboration a success.

The study’s findings have implications for the Triple Helix model (Etzkowitz and Leydesdorft 1997; Etzkowitz, 2003a; Etzkowitz, 2003b; Etzkowitz and Leydesdorff, 2000 and Etzkowitz, 2008) as limited research has been conducted into the value-added factors and CSC factors present between the partners within the Triple Helix Model. The author recommends that future research needs to be conducted, to investigate the value-added and CSC factors present and how these factors impact on economic output within each organisation type within the Triple Helix model. Additionally, by conducting this research, policy makers within industry, government and universities can identify the reasons why collaborations fail, the value-added and CSC factors present in these partnerships that make a collaboration a success, while creating strategies to support the development of interfirm collaborations.

From the study’s research design, findings and recommendations, the author concluded these can be transfer to UK universities, national health service (NHS) trusts, charities, local authorities, and private firms. A detailed discussion on implementing the findings in other settings can be found in Section 9.9.

This study contribution to knowledge includes making a minor contribution to end-user theory (von Hippel, 1981; von Hippel, 1986; Urban et al, 1988; von Hippel, 1988; Franke and von Hippel, 2003; Tyrrell, 2015) by identifying two new definitions of the buyer as an individual academic, who is engaged in research but doesn't share their equipment with other internal or external academics. The next buyer is an academic that not only engages in research and teaching activities but also manages the equipment as a core facility for the university. This buyer rents out the equipment to other academics from inside and outside the university to generate revenue to support the core facility's operations. As both buyer and supplier participants have engaged in previous collaborations this indicates that both buyers and suppliers are serial innovators (Corradini et al, 2015; Griffin et al, 2014; Tuzovic et al, 2018; Vojak et al, 2012). This finding contributes to the serial innovator's literature, by providing cases that indicates that university academics and firms are undertaking the role of serial innovators. This is a minor contribution to the serial innovator literature.

As all the suppliers have been engaged in collaboration, this indicates all suppliers have adopted an open innovation process by using lead-user knowledge in the creation of new scientific equipment and/or services (software development). By university-industry collaborations taking place through the tender process, this study data has provided an example of how to implement the open innovation process within a public sector organisation to create the new innovations. This is a minor contribution to our knowledge on the open innovation model conceptualised by Chesbrough's (2003a; 2003b; 2004; 2006), with the tender process giving an example of how buyer and supplier can access knowledge that leads to new innovations that can be marketed to other HE buyers by the supplier. Table 5.2 in Chapter 5 provides a visual representation of the new IO model.

Finally, as buyers and suppliers are collaborating with innovation taking place at the local departmental level of the university which is contrary to the triple helix model, that conceptualizes the university at the heart of any national innovation system (Santoen et al, 2014), each institution: university, government and industry takes on the role of the other within the model (Etzkowitz and Ledydesorff, 2000; Leydesdorff and Meyer, 2006). This study makes a major contribution to knowledge and the triple helix literature by providing a theoretical model and cases that express that collaboration is taking place between university and industry which can be visually represented in figure 9.1 in Chapter 9. For the collaboration to be success both the value-added and CSC factors identified in the figure needs to be present. In the next chapter entitled “Bibliography” the author provides a list of references that have been examined during the study.

# Bibliography

Abramovsky, L. and Simpson, H. (2008) Geographic proximity and firms-university innovation linkages: evidence from Great Britain. Journal of Economic Geography, Vol. 11, No. 6, (2011), pp 949 – 977.

Abreu, M. Demirel, P. Grinevich, V. and Karataş-Özkan, M. (2016) Entrepreneurial practices in research-intensive and teaching-led universities. Small Business Economics. Vol 47. No 3. pp 695-717.

Acosta, M. Coronado, D. Flores, E. (2011) University spillovers and new business location in high-technology sectors: Spanish evidence. Small Business Economics Vol. 36 pp365–376.

Adams, J. and Bekhradnia, B. (2004) What future for dual support? London. Higher Education Policy Institute.

Adams, A. and Cox, A. (2008) Questionnaires, in-depth interviews and focus groups. In: Cairns, Paul and Cox, Anna L. eds. Research Methods for Human Computer Interaction. Cambridge, UK: Cambridge University Press, pp17-34.

Adams, J. Khan, H. T. A. Raeside, R. White D., (2007) Research Methods for Graduate Business and Social Sciences Students. London. Response Business Books from Sage Publications Ltd.

Ahimbisibwe, A. Muhwezi, M. and Nangoli, S. (2012) Outsourced contracts, buyer-supplier trust, supplier opportunistic behaviour and supplier performance in Ugandan Public Procurement and Disposing Entities (PDE's). Journal of Public Procurement. Vol. 12. Issue. 4. pp435-470.

Ahadzi, M. and Bowles, G. (2004) Public-private partnerships and contract negotiations: an empirical study. Construction Management and Economics. No 22. pp967-978.

Ahmed, K. P. and Shepherd, D. C. (2010) Innovation Management: Context, strategies, systems, and processes. Harlow. Financial Times/Prentice Hall.

Adhikari, D.V. (2010) Knowledge management in academic institutions. International Journal of Educational Management. Vol. 24 No. 2. pp94-104.

Alexander, J. A., Comfort, M. E. Weiner, B. J. Bogue, R. (2001) Leadership in Collaborative Community Health Partnerships. NONPROFIT MANAGEMENT & LEADERSHIP. Vol. 12. No. 2. pp159-174.

Alfaro, L. (2016) Gains from Foreign Direct Investment: Macro and Micro Approaches. The World Bank Economics Review. Vol. 30. pp. S2–S15.

Allan, T. J. and O'Shea, R. (2014) Building Technology Transfer with Research Universities: An Entrepreneurial Approach. Cambridge. Cambridge University Press.

Anderson, L. Gold, J. Stewart, J. Thorpe, R. (2015) A Guide to Professional Doctorates in Business and Management. London. Sage Publications Ltd.

Anderson, H. Mûllern, T. and Danilovic, M. (2022) Exploring barriers to collaborative innovation in supply chains – a study of a supplier and two of its industrial customers. Business Process Management Journal. Vol. 29. No. 8. pp25-47.

Anney, V. N. (2014) Ensuring the Quality of the Findings of Qualitative Research: Looking at Trustworthiness Criteria. Journal of Emerging Trends in Educational Research and Policy Studies Vol. 5. Issue 2. pp272-281.

Antoft, R. and Houlberg Salomonsen, H. (2007). Studying Organizations by a pragmatic Research Design: the case of qualitative case study designs. Paper presented at European Group of Organization Studies "Beyond Waltz - Dances of Individuals and Organizations". Austria.

Amina, M. Z. K. Nørgaardb, L. S. Cavacoc, A. M. Witryd, M. A. Hillmane, L. Cernasevf, A. Desselle, S. P. (2020) Establishing trustworthiness and authenticity in qualitative pharmacy. Research in Social and Administrative Pharmacy. Vol. 16 Issue 10. pp1472-1482.

Arias Peregrina, L. E. (2011) The Value Added by the Purchasing Department to the Organization. Master of Science Thesis. Stockholm. Sweden.

Arnfalk, P. and Kogg, B. (2003) Service transformation—managing a shift from business travel to virtual meetings. Journal of Cleaner Production. Volume 11. Issue 8. December 2003. pp859-872.

Araujo, A. (2004). "Procurement Capacity Building in Developing Countries." Paper presented at the 1st International Public Procurement Conference, October 21-23, Fort Lauderdale, Florida, USA.

Ashworth, R. E. McDermott*, A. M. Currie, G. (2018) Theorizing from Qualitative Research in Public Administration: Plurality through a Combination of Rigor and Richness. Journal of Public Administration Research and Theory. pp318–333.

Audretsch, D. B. and Phillips R. (2007) “Entrepreneurship, state, economic development policy, and the entrepreneurial university”. Discussion Paper Series. No 6242. London. Centre for Economic Policy Research.

Audretsch, D. B. (2014) From the entrepreneurial university to the University for the Entrepreneurial Society. Journal of Technology Transfer No 39. pp313-321.

Austin, J. E. (2000) Strategic collaboration between nonprofits and businesses. Nonprofit and Voluntary Sector Quarterly. Vol. 29. No.1. pp69–97.

Austin, J. E. (2010) From Organization to Organization: On Creating Value. Journal of Business Ethics, Vol. 94, Supplement 1: CROSS-SECTOR SOCIAL INTERACTIONS (2010), pp 13-15.

Austin, J. E. and Seitanidi, M. M. (2014) Creating Value in Nonprofit-Business Collaborations. San Francisco. Jossey-Bass (A Wiley Brand).

Babiak, K. and Thibault, L. (2009) Nonprofit and Voluntary Sector Quarterly Volume 38. Number 1. pp117-143.

Bailey, P. Farmer, D. Crocker, B. Jessop, D. and Jones, D. (2015) Procurement Principles and Management. Harlow. Pearson Education Limited.

Bajpai, N. (2018) Business Research Methods. Second Edition. Pearson Education India.

Banister, P. Bunn, G., Burman. Daniels, J. Duckett, P. Goodley, D. Lawthom, R. Parker, I. Runswick-Cole, K. Sixsmith, J. Smailes, S. Tindall, C. and Whelean, P. (2011) Qualitative Methods in Psychology: A Research Guide. 2nd Edition. Maidenhead. Open University Press.

Behzad ghorbany darabad, R. T. (2019) The Role of Transparency in Tenders in Order to Maintain the Public Interest and the Rights of Suppliers. International Journal of Scientific and Technology Research. Vol. 6, Issue. 09, pp50-52.

Beins, B. (2018) Research Methods: A Tool for Life. Fourth Edition. Cambridge. Cambridge University Press.

Bidault, F. Despres, C. Butler, C. (1998) The drivers of cooperation between buyers and supplier innovation. Research Policy 26. pp719-732.

Bellgardt, F. Gohlke, J. Hasse, H. Parzonka, R. and Schicketanz, J. (2014) Triple helix and residential in science and technology park; the role of intermediaries. Triple Helix. Vol 1. No 10. pp1-14.

Birkinshaw, J. Hood, N. Jonsson, S. (1998) Building Firm-Specific Advantages in Multinational Corporations: The Role of Subsidiary Initiative. Strategic Management Journal. Vol. 19. pp221–241.

Bell, E. Bryman, A. and Harley, B. (2019) Business Research Methods. Fifth Edition. Oxford. Oxford University Press.

Bellgardt, F. Gohlke, J. Hasse, H. Parzonka, R. and Schicketanz, J. (2014) Triple helix and residential development in science and technology park; the role of intermediaries. Triple Helix. Vol 1. No 10. pp1-14.

Belfield, C. Britton, J. Dearden, L. and van der Erve, L. (2017) Higher Education Funding in England: Past, Present and Options for the Future. IFS Briefing Note BN211. The Institute for Fiscal Studies.

Bentley, J. P. and Thacker, P. G. (2004) The influence of risk and monetary payment on the research participation decision making process. Journal of Medical Ethics. Vol 30. pp293-298.

Bergman, M. A. and Lundberg, S. (2013) Tender evaluation and supplier selection methods in public procurement. Journal of Purchasing and Supply Chain Management. Vol 19. No 2. pp73-83.

Berg, B. L. (2009) Qualitative Research methods: For the Social Sciences. Seventh Edition. London. International Edition. Palgrave Education.

Berry, G. W. (1957) The American Journal of Nursing. Vol. 57. No. 8. pp998-1001.

Berry, S H. Burger, N. Dogo, H. Krishna, K. B. Malchiodi, A. Martini, J. Mengistu, T. Shatz, H.J. Smith, A. C. Usanov, A. and Yoong, J. A. (2014) Chapter Title: Methodologies for Data Collection and Handling. Book Title: Designing a System for Collecting Policy-Relevant Data for the Kurdistan Region—Iraq. Santa Monica. RAND Corporation.

Benton, W. C. Jr. (2010) Purchasing and Supply Chain Management. Second Edition. New York. McGraw Hill International Edition.

Bink, H. I. L. (1993) Validity and Reliability in Qualitative Research. Curationis. Vol. 16. No. 2. pp35-38.

Bight, C. (1994) Public Procurement Handbook. Chichester. WILEY Chancery Law.

Bishop, F. L. (2015) Using mixed methods research designs in health psychology: An illustrated discussion from a pragmatist perspective. British Journal of Health Psychology No 20. pp5–20.

Bladwin, C. and von Hippel, E. (2011) From Producer Innovation to User and Open Collaborative Innovation. Organization Science Vol. 22. No. 6. pp1399-1417.

Block, E. S. and Erskine, L. (2012) Interviewing by Telephone: Specific Consideration, Opportunities, and Challenges. International Journal of Qualitative Methods. Vol 11. No 4. Pp428-445.

Bhattacherjee, A. (2012) Social Science Research: Principles, Methods, and Practices. 2nd Edition. Tampa. Global Text Project.

Block, E. S. and Erskine, L. (2012) Interviewing by Telephone: Specific Consideration, Opportunities, and Challenges. International Journal of Qualitative Methods. Vol 11. No 4. Pp428-445.

Blumberg, B. Copper, D. R. and Schindler, P. S. (2011) Business Research Methods. Third European Edition. Maidenhead. McGraw-Hill Education.

Bogers, M. Afuah, A. and Bastian, B. (2010) Users as Innovators: A Review, Critique, and Future Research Directions. Journal of Management. Vol 34. No 4. pp857-875.

Bollen, A. Harrison, R. Aslani, P. and van Haastregt, M. C. J. (2018) Factors influencing interprofessional collaboration between community pharmacists and general practitioners. A systematic review. Health Society Care Community. Vol. 27. pp189–212.

Bolton, P. (2019) Higher education funding in England. Briefing Paper Number 7393, 1 July 2019. The House of Commons Library.

Bolton, A. (2000) Managing the Academic Unit. Managing Universities and Colleges: Guides to good practice. Buckingham. Open University Press.

Bowen, G. A. (2008) Naturalistic inquiry and the saturation concept: a research note. Vol. 8. Issue 1. pp137–152.

Bower, D. (2003) Management of Procurement. London. Thomas Telford.

Bovis, C. (2015) The Law of EU Public Procurement. Second Edition. Oxford. Oxford University Press.

Bozeman, B. Fay, D.  Slade, P. C. (2013) Research collaboration in universities and academic entrepreneurship: the-state-of-the-art. Journal of Technological Transfer. No.38. pp1–67.

Brem, A. and Viardot, E. (2013) Evolution of Innovation Management. Trends in an International Context. London/ Palgrave/MacMillan.

Briou, L. M. and Fawcett, S. E. (1994) Supplier involvement in integrated product development: A comparison of US and European practices. International Journal of Physical Distribution and Logistics, Management Vol. 25. No. 5. pp.-14.

Brown, M. and Hale, K. (2014) Applied Research Methods in Public & Nonprofit Organizations. San Francisco. Jossey-Bass /Wiley.

Brandt, E. Thune, T. and Ure, O. B. (2009) The Market for Continuing and Further Education in Norway: AN Analysis of Status., Strategies and Collaboration. NIFU STEP. Oslo. pp1-pp268. Available at: http://hdl.handle.net/11250/279682. Access Date: 29th November 2022.

Braun, V. and Clarke, V. (2006) Using thematic analysis in psychology. Qualitative Research Psychology. No 3. pp77-101.

Braun, V. and Clarke, V. (2013) Successful Qualitative Research: a practical guide for beginners. London. Sage Publications Ltd.

Brinkmann, S. and Kvale S. (2015) Interviews: Learning the Craft of Qualitative Research Interviewing. Third Edition. London. Sage Publications Ltd.

Bryman, A. (2011) Business research methods. Fourth Edition. Oxford. Oxford University Press.

Bryson, J. M. Crosby, B. C. and Middleton Stone, M. (2006) The Design and Implementation of Cross-Sector Collaborations: Propositions from the Literature. Vol. 66. Special Issue: Collaborative Public Management. pp44-55.

Bryson, J. M. Crosby, B. C. and Middleton Stone, M. Saunoi-Sandgren, E M. (2009) Designing and Managing Cross-Sector Collaboration: A Case Study in Reducing Traffic Congestion. Collaboration: Networks and Partnerships Series. Washington. IBM Centre for The Business of Government.

Bray, M. J and Lee, J. N. (2000) University Revenues from Technology Transfer: Licensing Fees vs Equity Positions. Journal of Business Venturing. No. 15. pp385–392.

Brescia, F. Colombo, G. and Landoni, P. (2016) Organizational structures of Knowledge Transfer Offices: an analysis of the world's top-ranked universities. Journal of Technology Transfer. No. 41. pp132–151.

Buffett, H. W. and Eimicke, W. B. (2018) The Evolution of Cross-Sector Partnerships in "A Management Framework for Effective Partnerships". New York. Columbia University Press. pp13-31.

Burt, B. A. and Pinkerton, R. L. (1996) A Purchasing Manager's Guide to Strategic Proactive Procurement. New York. American Management Association.

Burnett, M. (2009) Using Competitive Dialogue in EU Public Procurement – Early Trends and Future Developments. Eipascope. No 2. Maastricht. European Institute of Public Administration.

Burns, R.B. and Burns, R. A (2008) Business Research Methods and Statistics using SPSS. London. Sage Publication Ltd.

Cabinet Office (2020) Procurement Policy Note – Introduction of Find a Tender. Action Note PPN 08/20. London. Cabinet Office.

Cai, Y. (2013) Enhancing context sensitivity of the Triple Helix model: An institutional logics perspective. Paper for the Triple Helix XI International Conference; The Triple Helix in a context of global change: continuing, mutating, or unravelling? Track 3: Overall performance of the Triple Helix Approach: From efficiency of factors of production to "modes of coordination". London.

Cameron, S. and Price, D. (2009) Business Research Methods: A practical approach. London Chartered Institute of Personnel and Development.

Cankar, S. S. and Petkovšek, V. (2013) Private and Public Sector Innovation and The Importance of Cross-Sector Collaboration. The Journal of Applied Business Research. November/December 2013 Vol 29. No. 6. pp1597-1601.

Casper, G. (1998) Chapter Title: The Advantage of the Research-Intensive University. Book Title: The Winds. Yale University Press. pp169.

Castelnovo, P and Molin, M.D. (2021) The learning mechanisms through public procurement for innovation: The case of government-funded basic research organizations. Annals of Public and Cooperative Economics. 2021. Vol 92. pp411-446.

Casson, M. (2007) Multinational Enterprises: Their Private and Social Benefits and Costs. The World Economy. pp308-328.

Cavana, R. Y. Delahaye, B. L. and Sekaran, U. (2000) Applied Business Research: Qualitative and Quantitative Methods. Milton. John Wiley and Sons Australia Ltd.

CBI (2006) Improving Delivery: Realising best practice in procurement and contract management. Confederation of British Industry (November 2006).

Centre for Effective Dispute Resolution (2019) Arbitration: Guidance Notes for Customers. London. Centre for Effective Dispute Resolution. pp1-4.

Chana, K. A. Oerlemansa, L. A. G. and Pretoriusa, M. W. (2010) Knowledge exchange behaviours of science park firms: the innovation hub case. Technology Analysis & Strategic Management Vol. 22. No. 2. pp207–228.

Chesbrough, H. (2003) Open Innovation: The New Imperative for creating and Profiting from Technology. Boston. Harvard Business Press.

Chesbrough, H. (2004) Managing Open Innovation. Research Technology Management. Vol 47. No 1. pp23-26.

Chesbrough, H. Vankaverbeke, W. and West, J. (2006) Open Innovation: Researching a New Paradigm. Oxford. Oxford University Press.

Cheverton, P. and Van de Velde, J.P. (2011) Understanding: The Professional Buyer: What every sales professional should know about how the modern buyer thinks and behaves. London. Kogan Press.

Chicksand, D. (2015) Partnerships: The role power plays in shaping collaborative buyer-supplier exchanges. Industrial Marketing Management. No42. pp121-139.

Child, J. and Faulkner, D. (1998) Strategies for Co-operation: Managing Alliances, Networks, and Joint Ventures. Oxford. Oxford University Press.

Christensen, J. F. Olesen, M. H. Kjæ, J. S. (2005) The industrial dynamics of Open Innovation—Evidence from the transformation of consumer electronics. Research Policy. Vol 34. No.10. pp1533-1549.

Choi, T. Y. and Wu, Z. (2009) Taking the leap from dyas to triads: Buyer-supplier relationships in supply networks. Journal of Purchasing and Supply Management. Vol, 15. Issue. 4. pp263-266.

Chopra, S. and Meindl, P. (2016) Supply Chain Management: Strategy, Planning and Operation. Sixth Edition. Global Edition. Pearson Education Limited.

Choi, M. Y. (2015) Utilizing end user input in early product development. 6th International Conference on Applied Human Factors and Ergonomics (AHFE 2015) and the Affiliated Conferences, AHFE 2015. Procedia Manufacturing No.3. pp2244 – 2250.

Clark, M. and Fuller, M. (2010) Collaborative Strategic Management: Strategy Formulation and Implementation by Multi—Organizational Cross—Sector Social Partnerships, Journal of Business Ethics, Vol. 94, Supplement 1: CROSS-SECTOR SOCIAL INTERACTIONS (2010), pp 85-101.

Clark, T. Foster, L. Sloan, L. and Bryman, A. (2016) Social Research Methods. Sixth Edition. Oxford. Oxford University Press.

Clover, V. T. and Balsley, H. L. (1984) Business Research Methods. Columbus. Grid Publishing Inc.

The Council for Industry and Higher Education (2003) Business – University Collaboration: CUHE’s input to the Richard Lambert Review. London. The Council for Industry and Higher Education.

Cohen, L. Mansion, L and Morrison, K. (2000) Research Methods in Education. 5th Edition. London. Sage Publications Ltd.

Conti, A. and Gaule, P. (2011) Is the US outperforming Europe in university technology licensing? A new perspective on the European Paradox. Research Policy. No. 40. pp123–135.
Committee of Vice-Chancellors and Principles of the Universities of the United Kingdom. (CVCP). Action Plan on Purchasing. London. CVCP.

Copper, D. and Schindler, P. (1998) Business Research Methods. Sixth Edition. London. McGraw-Hill.

Copper, D. and Schindler, P. (2011) Business Research Methods. Eleventh Edition. London. McGraw-Hill.

Corradini, C. Battisti, G. and Demirel, P. (2015) Serial innovators in the UK: does size matter? Industrial and Corporate Change. Vol. 25. No.1. pp23–47.

Costantino, N. Dotoli, M. Falagario, M. and Pia Fanti, M. (2011) Using Fuzzy Decision Making for Supplier Selection in Public Procurement. Journal of Public Procurement. Vol. 11. Issue. 3. pp403-427.

Cox, A. (1996) Innovations in Procurement Management. Boston. Earlsgate Press.

Couchman, P. K. and Fulop, L. (2009) Examining partner experiences in cross-sector collaboration projects focused on the commercialization of R&D. Innovation Management, Policy and Practice. Vol 11. No1. pp85-103.

Crawford, C. M. and Di Benedetto, A. C. (2015) New Product Management. Eleventh Edition. International Edition. New York. McGaw Hill.

Crespin-Mazet, F. Ingemansson Havenvid, M. and Linné, A. (2015) Antecedents of project partnering in the construction industry — The impact of relationship history. International Marketing Management. No 50. pp4-15.

Christensen, C. M. (2001) The past and future of Competitive Advantage. MIT Sloan Management Review. Winter 2001. Vo. 42. No. 2. pp105-109.

Crosby, B.C. and Bryson, J. M. (2010) Integrative leadership and the creation and maintenance of cross-sector collaborations. The Leadership Quarterly No, 21. pp211–230.

Crowhurst, I. and Kennedy-Macfoy, M. (2013) Troubling gatekeepers: methodological considerations for social research. International Journal of Social Research Methodology. Vol 16. No 6. pp457-462.

Dan, B. Zhang, S. and Zhou, M. (2018) Strategies for warranty service in a dual-channel supply chain with value-added service competition. International Journal of Production Research, Vol. 56 No.17. pp5677-5699.

Dawson, C. (2013) Advanced Research Methods: A Practical Guide for Social Research Project. London. How to books.

Debackere, K. and Veugelers, R. (2005) The role of academic technology transfer organizations in improving industry science links. Research Policy No. 34. pp321–342.

Dector, M. Bennett, D. and Leseure, M. (2007) University to business technology transfer – UK and USA comparisons. Technovation. No 27. pp145-155.

Deem, R. (1998) 'New managerialism' and higher education: The management of performances and cultures in universities in the United Kingdom. International Studies in Sociology of Education. Vol.8 No1. pp47-70.

Del Giudice, M. Della Peruta, M. R and Carayannis, E. G. (2013) Unpacking Open Innovation. Highlights from a Co-Evolutionary Inquiry. New York. Palgrave Macmillan.

Demawan, D. (2016) THE IMPLEMENTATION OF QUADRUPLE HELIX MODEL (QHM) AS A COMPREHENSIVE EFFORT TO DEVELOP PHARMACEUTICAL RAW MATERIALS INDUSTRY IN INDONESIA. Conference: The 1st Annual International Conference and Exhibition on Indonesian Medical Education and Research Institute (The 1st ICE on IMERI 2016), 14th to 16th November 2016. At Faculty of Medicine, Universitas Indonesia.

Designing Buildings Ltd (2020) Competitive dialogue procedure for construction contracts. Designing Buildings Ltd. Access Date: 5th October 2020. Web Address:https://www.designingbuildings.co.uk/wiki/Competitive_dialogue_procedure_for_construction_contracts.

De Vaus, D. (2007) Surveys in Social Research. 5th Edition. Abingdon. Routledge.

Díez-Vial, I. and Fernández-Olmos, M. (2015) Knowledge spillovers in science and technology parks: how can firms benefit most? Journal Technology Transfer No. 40 pp70-84.

Dimitri, N. Piga, G. and Soagnolo, G. (2006) Handbook of Procurement. Cambridge. Cambridge University Press.

Dierckx de Casterle, B. Gastmans, C. Bryo,n E. and Denier, Y. (2011) QUAGOL: A guide for qualitative data analysis. International Journal of Nursing Studies. No 49. pp360-371.

Dodgson, M. Gann, D. and Salter, A. (2006) The role of technology in the shift towards open innovation; the case of Procter and Gamble, R&D Management No 3. Vol 3. pp333-346.

Doyle, L. Brady, A. M. and Byrne, G. (2009) An overview of mixed methods Research. Journal of Research in Nursing. Vo.14. No. 2. pp175–185.

Dumond, E.J. (1994) Moving toward value-based purchasing. International Journal of Purchasing and Materials Management. Spring. pp3-8.

Dwyer, J. and Slyman, S. (2016) An Introduction to Quantitative Methods for Business Research. London. Algana Publishing.

Dyer, J.H. and Singh, H. (1998) The relational view: Cooperative Strategy and sources of interorganizational competitive advantage. Academy of Management Review. Vol. 23. No. 4. pp660-79.

Eagle, L. Czarnecka, B. Dahl, S. and Llloyd, J. (2021) Marketing Communications. Second Edition. Abingdon. Routledge.

Edh Hasselgård, P. (2017) The Use of Tender Procedures to Exclude State Aid. European Procurement & Public Private Partnership Law Review. Vol. 12, No. 1. pp16-28.

Eglin, I. (2013) Procurement Manager. First Edition. Milton Keynes. Lighting Source UK Ltd.

Ehrlich, G. P. and Garbaunino, L. (2020) Do Secrets Stop Progress? Optimizing the Law of Non-Disclosure Agreements to Promote Innovation. Journal of Law & Business. Vol 16. No2. Spring 2020. New York University.

Ekinci, T. (2105) Designing Research Questionnaires: For Business and Management Students. London. Sage Publications Ltd.

Ellegaard, C. and Koch, C. (2012) the effect of low internal integration between purchasing and operations on suppliers' resource mobilization. Journal of Purchasing and Supply Management. No 18. pp148-158

Ellram, L. and Tate, W. L. (2015) Redefining supply management's contribution in services sourcing. Journal of Purchasing & Supply Management. No 20. pp65-78.

Elsayir, H. A. (2014) Comparison of precision of systematic sampling with some other probability samplings. American Journal of Theoretical and Applied Statistics. Vol 3. No 4. pp111-116.

Elzinga, A. (2004) The New Production of Reductionism in Models Relating to Research Policy. The science-industry nexus: History, policy, implications. pp 277-304.

Ekinci, T. (2015) Designing Research Questionnaires: For Business and Management Students. London. Sage Publications Ltd.

Eriksson, P. and Kovalainen, A. (2008) Qualitative Methods in Business Research. London. Sage.

Eriksson, P. and Kovalainen, A. (2016) Qualitative Methods in Business Research. Second Edition. London. Sage.

Erro-Garcés, A. and Alfaro-Tanco, J. A. (2020) Action Research as a Meta-Methodology in the Management Field. International Journal of Qualitative Methods. Vol. 19. pp1–11.

Essabbar, D. Zrikem, M. and Zolghadri, M. (2016) Power imbalance in collaboration relationships. International Journal of Supply and Operations Management. Vol. 2. Issue 4, pp1021-1034.

Esteves, A. M. and Barclay, M. (2011) New Approaches to Evaluating the Performance of Corporate-Community Partnerships: A Case Study from the Minerals Sector. Journal of Business Ethics, Vol. 103, No. 2 (October 2011), pp189-202.

Etzkowitz, H. (2003) Innovation in Innovation: The Triple Helix of University-Industry-Government Relations. Social Science Information No. 42, pp293-338.

Etzkowitz, H. (2003a) Innovation in Innovation: The Triple Helix of University-Industry-Government Relations. Social Science Information. Vol 42. No 3. pp293-337.

Etzkowitz, H. (2003b) Research groups as “quasi-firms” the invention of the entrepreneurial university. Research Policy. No 32. pp109-121.

Etzkowtix, H. (2004) The evolution of the entrepreneurial university. International Journal of Technology and Globalisation. Vo 1. No 1. pp64-77.

Etzkowitz, H. (2008) The Triple Helix: University – Industry-Government: Innovation in Action. Abingdon. Routledge.

Etzkowitz, H. and Leydesdorff, L. (1997) University and Global Knowledge Economy: A Triple Helix of University-Industry-Government. London. Continuum studies in Higher Education.

Etzkowitz, H. and Leydesdorff, L (2000) The dynamics of innovation: from National Systems and the “Mode 2” to a Triple Helix of university – industry – government relations. Research Policy. No 29. pp109-123.

Etzkowitz, H. and Leydesdorff, L. (2001) Universities and Global Knowledge Economy. London. Continuum.

Etzkowitz, H. Webster, A. Gebhardt, C. Castisanno, Terra B. R. (2000) The future of the university and the university of the future: evolution of ivory tower to entrepreneurial paradigm. Research policy. No 29. pp313-330.

European Commission (2018) PUBLIC PROCUREMENT GUIDANCE FOR PRACTITIONERS: on avoiding the most common errors in projects funded by the European Structural and Investment Funds. European Commission Publication Office.

European Commission (2014) Guidance on Public Procurement of Innovation. https://ec.europa.eu/docsroom/documents/25724/attachments/1/translations/en/renditions/native. Accessed 14th February 2024.

Farquhar, J. D. (2012) Case Study Research for Business. London. Sage Publications Ltd.

Farooq, M. B. (2015). Qualitative telephone interviews: Strategies for success. Paper submitted to the 18th Annual Waikato Management School Student Research Conference 2015 to be considered as a conference paper. 18th Annual Waikato Management School Student Research Conference, Friday 12 June, 2015, Hamilton, New Zealand.

Fayolle, A. and Redford, D. T. (2014) Handbook on the Entrepreneurial University. Cheltenham. Edward Elgar Publishing Limited.

Feilzer, M. Y. (2010) Doing Mixed Methods Research Pragmatically: Implications for the Rediscovery of Pragmatism as a Research Paradigm. Journal of Mixed Methods Research. Vol 4. No 1. pp6-16.

Fee, R. Erridge, A. and Hennigan, S.(2002) SMEs and government purchasing in Northern Ireland: problems and opportunities. European Business Review. Vol. 14 No. 5, pp 326-334.

Feld, L. D. and Shah, N.L. (2021) Connecting During the Virtual Interview Process: Lessons from Experience. Digestive Diseases and Sciences. No 66. pp917–918.

Ferreira, J. Fayolle, A. Ratten, V. and Raposo, M. (2016) Entrepreneurial Universities; Collaboration, Education and Policies. Cheltenham. Edward Elgar Publications Limited.

Fielding, N. G. Lee, R. M. and Grant, B. (2008) The SAGE Handbook of Online Research Methods Hardcover. London. SAGE Publications Ltd.

Fill, C. and Turnbull, S. (2019) Marketing Communications: frame, influences and agility. Ninth Edition. Harlow. Pearson Education limited.

Fitzpatrick, R. (1991) Surveys of Patient Satisfaction: II: Designing A Questionnaire and Conducting a Survey. British Medical Journal. Vol. 302. No. 6785. pp1129-1132.

Florczak, K. L. (2014) Purists Need Not Apply: The Case for Pragmatism in Mixed Methods Research. Nursing Science Quarterly. Vol. 27. No.4 pp278–282.

Forrer, J. J. Edwin, Kee J. and Boyer, E. (2014) Governing Cross-Sector Collaboration. San Francisco. Jossey-Bass. A Wiley Brand.

Foerstl, K. Reuter, C. Hartmann, E. and Blome, C. (2010) Managing supplier sustainability risk in a dynamically changing environment – Sustainable supplier management in the chemical industry. Journal of Purchasing and Supply Management. No. 16. pp118-130.

Foxall, G. R. and Tinerney, J. D. (1984) From CAP1 to CAP2: User-initiated innovation from the user's point of view. Management Decisions Vol 22. No. 5 pp3-15.

Franke, N. and von Hippel, E. (2003) Satisfying heterogeneous user needs via innovation toolkits: the case of Apache security software. Research Policy. No 32. (2013) pp1199-1215.

Fraccastoro, S. Gabrielsson, M. and Pullins Bolman, E. (2021) The integrated use of social media, digital and traditional communication tools in the B2B sales process of internal SME's. International Business Review. No. 30. pp1-15.

Frey, J. H. and Oishi, S. M. (1995) How to conduct interviews by telephone and in person. London. Sage Publications.

Fraenkel, J. and Wallen, N. (1993) How to design and evaluate research in education. London. McGraw-Hill.

Frega, F. and Carreira da Silva, F. (2011) Pragmatism and the Social Sciences A Century of Influences and Interactions, vol. 1. European Journal of Pragmatism and American Philosophy. pp1-6.

Frenz, M. Nielsen, K. and Walters, G. (2009) Research Methods in Management. London. Sage Publications Ltd.

Fukugawa, N. (2006) Science parks in Japan and their value-added contributions to new technology-based firms. International Journal of Industrial Organization. No 24. pp381-400.

Galvagno, M. and Dalli, D. (2014) Theory of value co-creation: a systematic literature review. Managing Service Quality. Vol. 24. No. 6. pp643-683.

Garrett-Jones, S. Turpin, T. Burns, P. and Diment, K. (2005) Common purpose and divided loyalties: the risk and reward of cross-sector collaboration for academics and government researchers. R&D Management. Vol 35. No 5. pp535-544.

Gelderman, C. J. Ghijsen, P. W. T. and Brugman, M. J. (2006) Public procurement and EU tendering directives – explaining non-compliance. International Journal of Public Sector Management. Vol. 19 No. 7. pp702-714.

Ghauri, P. and Grønhaug, K. (2010) Research Methods in Business Studies. Fourth Edition. Harlow. Financial Times/Prentice Hall.

Giannopoulou, E. Yström, A. and Ollila, S. (2011) "Turning open innovation into practice: open innovation research through the lens of managers". International Journal of Innovation Management. Vol 15. No 3. pp505-524.

Gill, J. and Johnson, P. (2010) Research Methods for Managers. 4th Edition. London. Sage Publications Ltd.

Gillham, B. (2000) Case Study Research Methods. London. Continuum.

Gillham, B. (2005) Research Interviewing: the range of techniques. Maidenhead. Open University Press.

Glaser, B.G. Strauss, A.L. (1967) The Discovery of Grounded Theory: Strategies for Qualitative Research. Aldine. Chicago.

Goffin, K. and Mitchell, R. (2005) Innovation Management: Strategy and Implementation using the Pentathlon Framework. Basingstoke. Palgrave.

Goldkuhl, G. (2012) Pragmatism vs interpretivism in qualitative information systems research. European Journal of Information Systems, Vol. 21. No. 2. pp135-146.

Goudt, R. (2016) "Innovation Partnerships? The new procurement procedure; when and how? University of Twente. Netherlands.

GOV.Com (2020) When to run a complaint EU buying process. GOV. Dated Viewed: 4th October 2020. Web Address: https://www.gov.uk/guidance/buying-procedures-and-procurement-law-for-schools/find-the-right-way-to-buy#euprocurementthresholds

Grant, K. Meyer, M. and Kuusisto, J. (2014) Can processes making relationships work? The Triple Helix between structure and action. Promethus. Vol. 32. No4. pp351-368.

Grbich, C. (2007) Qualitative data analysis: An Introduction. London. Sage Publications Ltd.

Grant, R. W. and Sugarman, J. (2004) Ethics in Human Subjects Research: Do Incentives Matter? Journal of Medicine and Philosophy. Vol 29 No.6. pp717-738.

Griffin, A. Price, R. L. and Vojak, B. A. Hoffman N. (2014) Serial Innovators' processes: How they overcome barriers to creating radical innovations. Industrial Marketing Management No.43. pp1362–1371.

Grimaldia, R. and Grandi, A. (2005) Business incubators and new venture creation: an assessment of incubating models. Technovation. No. 25. pp111–121.

Grimpe, C. (2012) Extramural research grants and scientists' funding strategies: Beggars cannot be choosers? Research Policy. No. 41. pp1448– 1460.

Groves, R. M. (1989) Survey Errors and Survey Cost. New York. John Wiley and Sons Ltd.

Grudinschi, D. Sintonen, S. and Hallikas, J. (2014) Relationship risk perception and determinants of the collaboration fluency of buyer-supplier relationships in public service procurement. Journal of Purchasing and Supply Management, No 20. pp82-91.

Grönroos, C. (2007) Service Management and Marketing. Third Edition. Chichester. John Wiley & Sons Ltd.

Guba, E. G. and Lincoln, Y. S. (1981) Effective Evaluation: Improving the Usefulness of Evaluating Results Through Response and Naturalistic Approaches. London. Jossey-Bass Limited.

Guerrero, M. Cunningham, J. A. and Urbano, D. (2015) Economic impact of entrepreneurial universities' activities: An exploratory study of the United Kingdom. Research Policy. No 44. pp748–764.

Gulati, R. Laive, D. and Singh, H. (2009) The Nature of Partnership Experience and the Gains from Alliances. Strategic Management Journal. No 50. pp 1213–1233.

Gummesson, E. (2000) Qualitative Methods in Management Research. Second Edition. London. Sage Publications Ltd.

Gust-Bardon, N. Irena. (2012). "The role of geographical proximity in innovation: Do regional and local levels really matter?". Working Papers "Firms and Region" R4/2012, Fraunhofer Institute for Systems and Innovation Research (ISI).

Haack, S. (2006) Pragmatism, Old and New. Selected Writings. New York. Prometheus Books.

Hair, J. F. JR, Babin, B. Money, A. H. and Samouel, P. (2003) Essential of Business Research Methods: Wiley International Edition. Minion. Wiley.

Hald Sundtoft, K. Cordón, C. and Vollmann, T. E. (2009) Towards an understanding of attraction in buyer-supplier relationships. Industrial Marketing Management. Vol. 38. Issue. 8. pp960-970.

Halpern, S. D. Bioethics, M. Madison, K. M. and Volpp, K. G. (2009) Patients as Mercenaries? The Ethics of Using Financial Incentives in the War on Unhealthy Behaviours. Circulation: Cardiovascular Quality and Outcomes. Vol 2. pp514-516.

Haley, R. (2009) A Framework for Managing Core Facilities within the Research Enterprise. Journal of Biomolecular Techniques. No. 20. pp:226 –230.

Halseth, G. and Ryser, L. M. (2007) The Deployment of Partnerships by the Voluntary Sector to Address Service Needs in Rural and Small Town Canada. International Journal of Voluntary and Nonprofit Organizations, Vol. 18, No. 3, pp 241-265.

Hamberg, K. Johansson, E. Lindgren, G. and Westman, G. (1994) Scientific Rigour in Qualitative Research—Examples from a Study of Women's Health in Family Practice. Family Practice. Vol. 11, No. 2. pp174-181.

Hamel, G. and Prahalad, C. K. (1994) Competing for the Future. Boston. Harvard School Press.

Hänninen, N. and Karjaluoto, H. (2017) The effect of marketing communication on business relationships loyalty. Marketing Intelligence & Planning. Vol 35. No. 4. pp458-472.

Hani, S. and de Marcellis-Warin, N. (2016) Open Innovation and Involvement of End-Users in the Medical Device Technologies' Design & Development process: End-Users' Perspectives. Technology and Investment. No 7. pp73-85.

Hammond, M. and Wellington, J. (2012) Research Methods: The Key Concepts. Abingdon. Taylor & Francis Group.

Harland, C. Nasimbeni, G. and Schneller, E. (2013) The Sage Handbook of Strategic Supply Chain Management. London. Sage Publication Limited.

Harman, G. (2000) Allocating Research Infrastructure Grants in Post-binary Higher Education Systems: British and Australian approaches. Journals of Higher Education Policy and Management. Vol 22. No 2. pp111-p126.

Hardwick, J. Anderson, J. A. and Cruickshank, D. (2013) Trust formation processes in innovative collaborations. Networking as knowledge building practices. European Journal of Innovation Management. Vol. 16 No. 1, pp4-21.

Hathcoat, J. A. and Meixner, C. (2017) Pragmatism, Factor Analysis, and the Conditional Incompatibility Thesis in Mixed Methods Research. Journal of Mixed Methods Research. Vol. 11. No. 4. pp433–449.

Hansom, D. and Stephenson, K. (2012), Public Procurement Law: Buyer Beware. The Impact of the EU Remedies Directive and Risks for Higher Education and Further Education Procurement Activity. 2012 EDUC. L.J. 51. pp51-56

Hanson, R. K. Letourneau, E. L. Olver, M. Wilson, R. J. and Miner, M. H. (2012) Criminal Justice and Behaviour. Vol. 39. No.11. pp1391-1404.

Hartas, D. (2010) Educational Research and Inquiry: Qualitative and Quantitative Approaches. London. Continuum International Publishing Group.

Hara, N. Soloman, P. Seung-Lye, K. Sonnenwald, D. H. (2003) An Emerging View of Scientific Collaboration: Scientists Perspective on Collaboration and Factors that Impact Collaboration. Journal of the American Society for Information Science and Technology. Vol 54. No 10. pp952-965.

Harrison, A. van Heok, R. and Skipworth, H. (2014) Logistics Management and Strategy: Competing through the Supply Chain. Harlow. Pearson Education Limited.

Hartman, L. P. and Dhanda, K. K. (2018) Cross-Sector Partnerships: An Examination of Success Factors. Business and Society Review. Vol. 123. No 1. pp181-214.

Harman, G. (2010) University-industry research partnerships in Australian: extent, benefits, and risks. Higher Education. Higher Education Research. No 38. Vol 1. pp83-103.

Hassan, A. (2012) The Value Propositions Concept in Marketing: How Customers Perceive the Value Delivery by Firms – A Study of Customers Perspectives on Supermarkets in Southampton in the United Kingdom. International Journal of Marketing Studies. Vol 4. No. 3. pp68-87.

Haugbølle, K. Pihl, D. and Gottlieb, S. (2015) Competitive dialogue: Driving innovation through procurement?  Procedia Economics and Finance. No 21 pp555-562.

Heathcare UK, (2013) Public Private Partnerships.UK Trade and Investment. pp1-12.

Haugtvedt, C. P. Herr, P. M. and Kardes, F. R. (2008) Handbook of Consumer Psychology. Hove. Lawrence Erlbaum Associates.

Heijboer, G. and Telgen, J. (2002) CHOOSING THE OPEN OR THE RESTRICTED PROCEDURE: A BIG DEAL OR A BIG DEAL? JOURNAL OF PUBLIC PROCUREMENT. VOL 2. ISSUE 2. pp187-215.

Hennink, M. Hutter, I. and Bailey, A. (2011) Qualitative Research Methods. London. Sage Publications Ltd.

Hill, S. N. Bartol, M. K. Tesluk, E. P., and Langa, A. G. (2009) Organizational context and face-to-face interaction: Influences on the development of trust and collaborative behaviours in computer-mediated groups. Organizational Behaviour and Human Decision Processes. No. 108. pp 187–201.

Hill, M. Bleicher, R. and Farma, J. (2020) A How-To Guide: Virtual Interviews in the Era of Social Distancing. Journal of Surgical Education. Vol 78. No. 1. pp321-322.

Hockberger, P. Weiss, J. Rosen, A. and OTT, A. (2018) Building a Sustainable Portfolio of Core Facilities: a Case Study. Journal of Biomolecular Techniques. No. 29. pp79–92.

Hodge, G. A. and Greve, C. (2007) Public – Private Partnerships: An International Performance Review. Public Administration Review. May/June. pp545-558.

Holma, A. M. Vesalainen, J., Söderman, a. and Sammalmaac, J. (2020) Service specification in pre-tender phase of public procurement -A triadic model of meaningful involvement. Journal of Purchasing and Supply Management. Vol. 26. 100580.

Hong, P and Boong Kwon, B. (2012) Emerging issues of procurement management: a review and prospect. International Journal Procurement Management. Vol. 5. No. 4. pp452-462.

Hoppe, E. I. Kusterer, D. J. and Schmitz, P. W. (2013) Public-private partnerships versus traditional procurement: An experimental investigate. Journal of Economic Behaviour and Organization. No 89. pp145-165

Howells, J. Ramlogan, R. and Cheng, S. L. (2012) Universities: in an open innovation system: a UK perspective. International Journal of Entrepreneurial Behaviour & Research. Vol 19. No 4. pp440-436.

Howitt, D. (2016) Qualitative Research Methods in Psychology. Third Edition. Harlow. Pearson Education Limited.

Hughes, A. Kitson, M. Bullock, A. and Milner, I. (2013) The Dual Funding Structure for Research in the UK: Research Council and Funding Council Allocation Methods and the Pathways to Impact of UK Academic. Cambridge. UK Innovation Research Centre at Cambridge and Imperial College (UK~IRC).

Huang, Y. Han, W. and Macbeth, D.K. (2020) The complexity of collaboration in supply chain networks. Supply Chain Management. Vol. 25. No. 3. pp. 393-410.

Ind, N. and Coates, N. (2013) The meanings of co-creation. European Business Review Vol. 25. No. 1. pp86-95.

Iiniluoto, I. | Sintonen, M. and Woleński, J. (2004) Handbook of Epistemology. London. Springer.

Inzelt, A. (2004) The evolution of university-industry-government relationships during transition. Research Policy No. 33 pp975-995.

Ito, T. Kaneta ,T. and Sundstrom, S. (2016) Does university entrepreneurship work in Japan?: a comparison of industry-university research funding and technology transfer activities between the UK and Japan. Journal of Innovation and Entrepreneurship Vol.5: No. 8. Pp1-21.

Ivascu, L. Cirjaliu, B. and Draghici, A. (2016) Business model for the university-industry collaboration in open innovation. Procedia Economics and Finance. No 39. pp674-678.

Jankowicz, A. D. (1995) Business Research Projects. Second Edition. London. International Thomson Business Press.

Janghorban, R. Roudsari, R. L. and Taghipour, A. (2014) Skype interviewing: The new generation of online synchronous interview in qualitative research.

Jamil, F. Ismail, K. and Mahmood, N. (2015) A Review of Commercialization Tools: University Incubators and Technology Parks. International Journal of Economics and Financial Issues. No. 5 (Special Issue). pp223-228.

Jamali, D. and Keshishian T. (2009). Uneasy alliances: Lessons learned from partnerships between businesses and NGOs in the context of CSR. Journal of Business Ethics. Vo. 84. No. 1. pp277–295.

Jawale, K. V. (2012) Methods of Sampling Design in the Legal Research: Advantages and Disadvantages. Online International Interdisciplinary Research Journal. Vol. 2. Issue. 5. pp183-190.

Jones, R. and Abdelfattah, K. (2020) Virtual Interviews in the Era of COVID-19: A Primer for Applicants. Journal of Surgical Education. Vol 77. No 4. pp7733-734.

Johnson, L. M. and Finegood, D. T. (2015) Cross-Sector Partnerships and Public Health: Challenges and Opportunities for Addressing Obesity and Noncommunicable Diseases Through Engagement with the Private Sector. Annual Review Public Health. No 36. pp255-271.

Johnsen, T. E. (2011) Supply network delegation and intervention strategies during supplier involvement in new product development. International Journal of Operations and Production Management. Vol. 31. No.6. pp686-708.

Johnson, R. B. and Onwuegbuzie, A. J (2004) Mixed Methods Research: A Research Paradigm Whose Time Has Come. Education Researcher. Vol. 33. Issue. 7. pp4-26.

Johnson, L. M. and Finegood, D. T. (2015) Cross-Sector Partnerships and Public Health: Challenges and Opportunities for Addressing Obesity and Noncommunicable Diseases Through Engagement with the Private Sector. Annual Review Public Health. No 36. pp255-271.

Johnes, J. (1996) Performance assessment in higher education in Britain. European Journal of Operational Research. No 89 pp18-pp33.

Jolibert, A. Mühlbacher, H. Flores, L. and Pierre-Louis, D. (2012) Marketing Management: A Value-Creation Process. Basingstoke. Palgrave Macmillan.

Jonbekova, D. Sparks, J. Harlety, M. and Kuchumova, G. (2020) Development of university partnerships in Kazakhstan: Innovation under constraint. International Journal of Education Development. No 78. pp1-10.

Jongbloed, B. Enders, J. and Salerno, C. (2008) Higher education and its communities: Interconnections, interdependencies, and a research agenda. Higher Education. No. 56. pp303–324.

Jowett, A. Peel, E. and Shaw, R. (2011) Online Interviewing in Psychology: Reflections on the Process. Qualitative Research in Psychology. No.8. pp354-369.

Kalman, A. and Balomenou, C. (2014) Comparative analysis of the implementation of Triple Helix Theory in Greece and Hungary, its impact on the local entrepreneurship and lessons learned from both cases. 54th Congress of the European Regional Science Association: "Regional development & globalisation: Best practices", 26-29 August 2014, St. Petersburg, Russia. pp1-70.

Kaufman, J. J. (2001) Value Management: Creating Competitive Advantage Canterbury. Financial World Publishing.

Keely, K. Clark, B. Brown, V. and Sitzia, J. (2003) Good practice in the conduct and reporting of survey research. International Journal for Quality in Health Care. Vol 15. No. 3. pp261-266.

Keegan, W. J. and Green, M. C. (2013) Global Marketing. Seventh Edition. Global Edition. Harlow. Pearson Education Limited.

Kelly, L. M. and Cordeiro, M. (2020) Three principles of pragmatism for research on organizational processes. Methodological Innovations May-August 2020: pp1–10.

Khaled Mustafa, M. and Waheed, S. (2019) A governance framework with permissioned blockchain for the transparency in e-tendering process. International Journal of Advanced Technology and Engineering Exploration, Vol. 6, No. 61, pp274-280.

King, N. (2004). Using templates in the thematic analysis of text. In C, Cassell & G. Symon (Eds.), Essential guide to qualitative methods in organizational research. London, UK: Sage.

Knight, W. Folkins ,W. J. Hakel, D. M. and Kennell, P. R. (2011) Administrators' decisions about resource allocation. Journal of Higher Education Policy and Management. Vol. 33. No.4. pp325-336.

Kolehmainen, J. Irvine, J. Stewart, L. Karacsonyi, Z. Szabó Altrinta, J. and Norberg, A. (2106) Quadruple Helix, Innovation, and the Knowledge-Based Development: Lessons from Remote, Rural and Less-Favoured Regions. No 2. pp23-42.

Koninck, C. D. Ronse, T. and Timmermans, W. (2015) European Public Procurement Law. The Public Sector Procurement Directive 2014/24/EU Explained through 30 years of Case Law by the Court of Justine of the European Union. Second Edition. Biggleswade. Wolters Kluwer.

Koppelmann, U. (1998) Procurement Marketing: A Strategic Concept. New York. Springer-Verlag.

Kotler, P. Armstrong, G. Harris, L. C. and He,  H. (2020) Principles of Marketing, 8th European Edition. Eight European Edition. Harlow. Pearson Education Limited.

Korstjens, I. and Moser, A. (2018) Series: Practical guidance to qualitative research. Part 4: Trustworthiness and publishing. European Journal of General Practice, Vol 24, Vol.1. pp120-124.

Krefting, L. (1990) Rigor in Qualitative Research: The Assessment of Trustworthiness. The American Journal of Occupational Therapy. Volume. 45. No. 3. pp214-222.

Kvale, S. (2007) Doing Interviews. London. Sage Publications Ltd.

Lancaster, G. (2005) Research Methods in Management: a concise introduction to research in management and business consultancy. Oxford. Elsevier Butterworth-Heinenmann.

Langdridge, D. (2004) Introduction to Research Methods and Data Analysis in Psychology. Harlow. Pearson Education.

Langdridge, D. (2009) Introduction to Research Methods and Data Analysis in Psychology. Second Edition. Harlow. Pearson Education.

Lam, R. H. W. and Chen, W. (2019) Introduction to Biomedical Devices. In: Biomedical Devices. Cham. Springer.

Lambert, S. D. and Loiselle, C. G. (2008) Combining individual interviews and focus groups to enhance data richness. The Authors. Journal compilation 2008 Blackwell Publishing Ltd.

Lasrado, V. Sivo, S. Ford, C. and O'Neil, T. Garibay I. (2016) Do graduate university incubator firms benefit from their relationship with university incubators? The Journal of Technology Transfer. Volume 41. Issue 2. pp 205–219.

Laursen, K. and Salter, A. (2004) Searching high and low: what types of firms use universities as a source of innovation? Research Policy. No 33. pp1201-1215.

Laursen, L. N. and Andersen, P. H. (2016) Supplier involvement in NPD: A quasi-experiment at Unilever. Industrial Marketing Management, No 58. pp162-171.

Lawton-Smith, H. and Bagchi-Sen Sharmistha, S. (2010) Triple helix and regional development: a perspective from Oxfordshire in the UK. Technology Analysis & Strategic Management No. 22. pp805-818.

Lawton-Smith, H. and Glasson, J. (2005) High-Tech Spin-Offs: Measuring Performance and Growth in Oxfordshire. Oxford. Oxford Economic Observatory.

Lawton-Smith, H. (1990) The Location of Innovation Industry: The Case of Advanced Technology Industry in Oxfordshire. Research paper 44. Oxford. School of Geography, University of Oxford.

Lawton-Smith, H. (2006) Universities, Innovation, and the Economy. Abingdon. Routledge.

Lawther, W. C. and Lawrence, L. M. (2005) Innovation practice in public procurement partnerships: the case of the United States. The Journal of Purchasing and Supply Management. No 11. pp212-220.

Le Masson, P. Weil, B. and Hatchuel, A. (2010) Strategic Management of Innovation and Design. Cambridge. Cambridge University Press.

Lee, J. H and Hwang, J. (2011) Luxury marketing: The influences of psychological and demographic characteristics on attitudes toward luxury restaurants.

Lee, N. and Lings, I. (2008) Doing Business Research: A Guide to Theory and Practice. London. Sage Publications Ltd. International Journal of Hospitality Management. No. 30. pp658-669.

Lee, Y. S. (1996) "Technology transfer" and the research university; a search for the boundaries of university-industry collaboration. Research Policy. No 25. pp843-863.

Letherby, G. and Bywaters, P. (2007) Extending Social Research Application, Implementation and Publication. Maidenhead. McGraw Hill/Open University Press.

Lewis, B. and Pendlebury, M. (2002) Surplusor Deficit – Who Cares? Cross-subsidy in Colleges of Higher Education. Financial Accountability and Management. Vol 18. No 1. February 2002. pp25-p38.

Leydesdorff, L. (2001). Knowledge-Based Innovation Systems and the Model of a Triple Helix of University-Industry-Government Relations. Paper presented at the conference "New Economic Windows: New Paradigms for the New Millennium", Salerno, Italy.

Leydesdorff, L. (2006). Knowledge-Based Economy: Modelled, Measured, Simulated. Universal Publishers, Boca Raton.

Leydesdorff, L (2010) Knowledge-Based Innovation Systems and the Model of a Triple Helix of University-Industry-Government Relations. Cornell University. Accessed 13th October 2019 URL: https://arxiv.org/abs/1001.1308

Leydesdorff, L. and Deakin, M. (2011) The Triple-Helix Model of Smart Cities: A Neo-Evolutionary Perspective. The Journal of Urban Technology. Vol 18. No 2, pp53-63.

Leydesdorff, L. and Ivanova, I. (2016) "Open Innovation" and "Triple Helix" Models of Innovation: Can Synergy in Innovation Systems be Measured? Journal of Open Innovation. Technology, Markets and Complexity. Vol. 2. No. 1. pp1-12.

Leydesdorff, L. and Myer, M. (2006) Triple Helix indicators of knowledge-based innovation systems. Research Policy. Vol 35. pp1-21.

Lichtenthaler, U. (2011) Open Innovation: Past Research, Current Debates, and Future Directions. Academy of Management Perspectives. Vol 25. No 1. pp75-93.

Liefer, I. (2003) Funding, resource allocation, and performance in higher education systems. Higher Education. No 46. pp469–489.

Ling, P. D’Alessandro, S. and Winzar, H. (2015) Consumer Behaviour in Action. Oxford. Oxford University Press.

Ling, P. Liu, Z. and Zhang, Y. (2009) Do Chinese domestic firms benefit from FDI inflow? Evidence of horizontal and vertical spillovers. China Economic Review. No. 20. pp667-691.

Lingard, L (2019) Beyond the default colon: Effective use of quotes in qualitative research. Perspect Med Educ. 2019 Dec. Vol 8. No: 6: pp360–364.

Lincoln, Y. S. and Guba, E. G. (1985) Naturalistic Inquiry. Newbury Park. CA: Sage Publications.

Linstone, H. A. (2010) Comment on "Is Open Innovation a Field of Study or a Communication Barrier to Theory Development?", Technovation, 30, 556-556.

Lowe, C. U. (1982) The Triple Helix - NIH, Industry, and the Academic World. The Yale Journal of Biology and Medicine. No. 55, pp239-246.

Lüthje, C. (2003). Customers as Co-Inventors: An Empirical Analysis of the Antecedents of Customer-Driven Innovations in the Field of Medical Equipment. Proceedings from the 32nd EMAC Conference 2003 (Glasgow, Scotland).

Luzzini. D. Amann, M. Caniato, F. Essig, M. and Rochi, S. (2015) The path of innovation: purchasing and supplier involvement into new product development. Industrial Marketing Management. No 47. pp109-120.

Lysons, C. K. (1993) Purchasing. Third Edition. London. The M+E Handbook Series.

Lysons, K. and Farrington, B. (2016) Procurement and Supply Chain Management. Ninth Edition. Harlow. Pearson Education Limited.

Maguire, M. and Delahunt, B. (2017) Doing a Thematic Analysis: A Practical, Step-by-Step Guide for Learning and Teaching Scholars. Journal of teaching and Learning in Higher Education (AISHE-J). No 3. (Autumn 2017) pp3351-33514.

Main, S. A. (1996) Assessing value-added contributions of university technology business incubators to tenant firms. Research Policy. No 25. pp 325-335.

Malin, J. R. and Hackmann, D. G. (2019) Integrative Leadership and Cross-Sector Reforms: High School Career Academy Implementation in an Urban District. Educational Administration Quarterly. Vol. 55. No. 2. pp189–224.

Mann, C. and Stewart, F. (2000) Internet Communication and Qualitative Research: A Handbook for Researching online. London. Sage Publications Ltd.

Mansor, Z. D. Mustaffa, M. and Mohd Salleh, L. (2015) Motivation and Willingness to Participate in Knowledge Sharing Activities Among Academics in a Public University. Procedia Economics and Finance. No. 31. pp286 – 293.

Martin, M. (1994) Managing Innovation and Entrepreneurship in Technology-Based Firms. Chichester. John Wiley & Sons Inc.

Martin, B. (2016) Twenty challenges for innovation studies. Science and Public Policy. Vol. 43, Issue 3. pp432-450.

Markman, A. B. (2016) Chapter Title: The Process of Open Innovation. Book Title: Open Innovation: Academic and Practical Perspectives on the Journey from Idea to Market. Oxford. Oxford University Press.

Marks, D. F and Yardley, L. (2011) Research Methods for Clinical and Health Psychology. London. SAGE Publications, Ltd.

Markman, G. D Gianiodis, P. T. Phan, P. H. and Balking, D. B. (2005) Innovation speed: Transferring university technology to market. Research Policy. No. 34. pp1058–1075.

Marshall, G. (2004) The purpose, design and administration of a questionnaire for data collection. Radiography. No11. pp131-136.

Mas-Verdú, F. Ribeiro-Soriano, D. and Roig-Tierno, N. (2015) Firm survival: The role of incubators and business characteristics. Journal of Business Research. No 68. pp791-796.

Maser, M. S. and Thompson, F. (2013) Dispelling Fear and Loathing in Government Acquisition: A Proposal for Cultivational Governance in Dod Source. Journal of Public Procurement. Vol. 13. Issue. 3. pp289-314.

Matthyssens, P. Bocconcelli, R. Pagano, A. and Quintens, L. (2016) Aligning Marketing and Purchasing for new value creation. Industrial Marketing Management. No 50. pp60-73.

Matheson, J. F. (2007) The Voice Transcription Technique: Use of Voice Recognition Software to Transcribe Digital Interview Data in Qualitative

Research. The Qualitative Report. Vol. 12. No 4. pp547-560.

Margues, J. P. C. (2014) Closed versus Open Innovation: Evolution and Combination? International Journal of Business and Management. Vol 9. No. 3. pp196-203.

Marques, P J. (2014) Closed versus Open Innovation: Evolution of Combination? International Journal of Business and Management. Vol 9. No 3. pp196-203.

May, M. Koessl, G. Scott, M. and Slater, I. (2014) Chapter Title: Conflict and competition versus collaboration and planning. Book Title: Access to justice for disadvantaged communities. Bristol University Press, Policy Press.

May, T. (2011) Social Research: Issues, Methods and process. Maidenhead. Open University Press.

Maylor, H. Blackmon, K. and Huemann, M. (2017) Researching Business and Management. Second Edition. London. Plagrave.

Mayo, M. Koessl, G. Scott, M. and Slater, I. (2014) Chapter Title: Conflict and competition versus collaboration and planning. Book Title: Access to justice for disadvantaged communities. Bristol. Bristol University Press.

McBurney, D. H. (1998) Research Methods. 4th Edition.  Pacific Gove. Brooks/College Publishing Company.

McDonald, M. Smith, B. and Ward, K. (2006) Marketing Due Diligence: Reconnecting Strategy to Share Price. Oxford. Butterworth-Heinemann.

McDonalds, M. and Wilson, H. (2016) Marketing Plans: How to prepare them, how to profit from them, 8th Edition. Chichester. Wiley and Sons Ltd.

McKenzie, G. Powell, T. and Usher, R. (1997) Understanding Social Research; Perspectives on Methodology and Practice. London. Falmer Press.

Mcneill, P. and Chapman, S. (2005) Research Methods. Third Edition. Abingdon. Routledge.

McInnes, S. Peters, K. Bonney, A. and Halcomb, E. (2017). An exemplar of naturalistic inquiry in general practice research. Nurse Researcher. Vol. 24. No. 3. pp36-41.

Meehan, J. Menzies, L. and Michaelides, R. (2017) The long shadow of public policy; Barriers to a value- based approach in healthcare procurement. Journal of Purchasing and Supply Management. No 23. pp229-241.

Melese, T. Lin, S. M. Chang, J. L. and Cohen, N. H., (2009) Open Innovation networks between academia and industry; an imperative for breakthrough therapies. Nature. No 15. Vol 5. pp502-507.

Mendel, S. C. and Brudney, J.L. (2018) Partnerships the Nonprofit Way. Bloomington. Indiana University Press.

Mendel, S. C. and Brudney, J. L. (2018) Chapter Title: The Point of Partnering. Book Title: Partnerships the Nonprofit Way. Bloomington. Indiana University Press. pp78-100.

Meyer, A. D. and Pruthi, S. (2011) Academic entrepreneurship, entrepreneurial universities, and biotechnology. Journal of Commercial Biotechnology. No 17. pp349-357.

Mercado Kierkegaard, S. (2006) Going, Going, Gone! E-Procurement in the EU. Vol. 4. No. 1. International Journal of Computing & Information Sciences. pp30-39.

Menezes, M. A. J. and Quelch, J. A. (1990) “Leverage Your Warranty Program.” Sloan Management Review Vol 31. No. 4. pp69–80.

Mesquite, L. F. (2016) Location and the Global Advantage of Firms. Global Strategy Journal. No 6. pp3-12.

Miller, F. A. Sanders, C. B and Lahoux, P. (2009) Imagining value, imagining users: Academic technology transfer for health innovation. Social Science and Medicine. No 68. pp1481-1488.

Miller, K. McAdam, R. Moffett, S. Alexanfer, A. and Puthusserry, P. (2016) Knowledge transfer in university quadruple helix ecosystems: an absorptive capacity perspective. R&D Management. No 46. Vol 2. pp383-399.

Miller, H. T. (2005) Residues of Foundationalism in Classic Pragmatism. Administration and Society. Vol. 37 No. 3. pp360-374.

Miller, S. A. (2018) Developmental Research Methods. Fifth Edition. London. SAGE Publications Ltd.

Ministry of Justice (2010) The Bribery Act. 2010: Guidance. London. Ministry of Justice.

Mitchell, A. (2018) A Review of Mixed Methods, Pragmatism and Abduction Techniques. Journal of Business Research Methods. No. 16. Vol. 3. pp103-116.

Miyata, H. and Kai, I. (2009) Reconsidering Evaluation Criteria for Scientific Adequacy in Health Care Research: An Integrative Framework of Quantitative and Qualitative Criteria. International Journal of Qualitative Methods 2009, Vol 8. No. 1. pp65-75.

Mohnen, P. and Hoareau, C. (2003) What Type of Enterprise Forges Close Links with Universities and Government Labs? Evidence from CIS2. Managerial and Decision Economics. Vol 24. No 2/3. pp133-145.

Mohr, J. and Spekman, R.(1994) Characteristics of Partnership Success: Partnership Attributes, Communication Behaviour, and Conflict Resolution Techniques. Strategic Management Journal. Vol. 15. pp135-152.

Morris, P. W. G. and Pinto, J. K. (2007) The Wiley Guide to Project Technology, Supply Chain & Procurement Management. Hoboken. John Wiley & Sons Inc.

Morse, J. M. Barrett, B. Mayan, M. Olson, K. and Spiers, J. (2002) Verification Strategies for Establishing Reliability and Validity in Qualitative Research. International Journal of Qualitative Methods. Vol.1. Issue 2. pp13-22.

Morrish, L. and Sauntson, H. (2013) Business-facing motors for economic development: an appraisal analysis of visions and values in the marketized UK university. Discourse Studies, Vol 10. No. 1. pp61-80.

Morse, J. M. (2008) “What’s your favourite colour?” Reporting Irrelevant Demographics in Qualitative Research. Qualitative Health Research. Vol.18. No. 3. pp299-300.

Murray, J. G. (2009) Towards a common understanding of the differences between purchasing, procurement, and commissioning in the UK public sector. Journal of Purchasing & Supply Management. No 15. pp198-202.

Myer, M. D. (2013) Qualitative Research in Business and Management. 2nd Edition. London. Sage Publications Ltd.

National Centre for University Business (2015) State of the Relationship Report 2015: Collaboration Between Universities and Business in UK. London. National Centre for Universities and Business.

Newby, P. (2010) Research Methods for Education. First Edition. Harlow. Pearson Education Limited.

Njuguna, J. (2020) What is the purpose of research-intensive universities? Research Gate. Available at: https://www.researchgate.net/publication 344300462_What_is_the_purpose_of_research-intensive_universities. Accessed: 6th April 2021.

Nobel, C. H. Durmusogly, S. S. and Griffin, A. (2014) New Product Development Essentials from the PDMA. Open Innovation. New Jersey. Wiley.

Nowell, L. S. Morris, J. M. White, D. E. and Moules, N. J. (2017) Thematic Analysis: Striving to Meet the Trustworthiness Criteria. International Journal of Qualitative Methods. Vol 16. pp1-13.

Novick, G. (2008) Is There a Bias Against Telephone Interviews in Qualitative Research? Research Nursing Health. Vol 31. No. 4. pp391–398.

Ntayi, M. J. Namugenyi, I. and Eyaa, S. (2010) Supplier Delivery Performance in Ugandan Public Procurement Contracts. Journal of Public Procurement. Vol. 10. Issue, 4. pp479-511.

Obwegeser, N. and Müller, S. D (2018) Innovation and public procurement: Terminology, concepts, and applications. Technovation. 74–75. (2018). pp1–17.

O'Connell, D. (2011) Harvesting External Innovation: Managing External Relationships and Intellectual Property. Farnham. Gower Publishing Limited.

OECD (2020) PUBLIC PROCUREMENT IN THE EUROPEAN UNION: PRACTICAL GUIDE ON REMEDIES. European Commission. Date Accessed 8th October 2020. Web Address: http://www.sigmaweb.org/publications documents/35027835.pdf.

Ogawa, S. and Pongtanalert, K. (2013) Exploring Characteristics and Motives of Consumer Innovators. Community Innovators vs Independent Innovators. Research Technology Management. May-June 2014. p 41-48.

Okamuro, H. and Nishimura, J. (2013) Impact of university intellectual property policy on the performance of university-industry research collaboration. Journal of Technology Transfer No. 38. pp273–301.

O'Leary, R. and Vij, N. (2012) Collaborative Public Management: Where Have We Been and Where Are We Going? The American Review of Public Administration. No 42. Vol 5. pp507-522.

O'Leary, Z. (2010) Researching Real-Word Problems: A Guide to Methods of Inquiry. London. Sage Publications Limited.

Osborne, R. D. (2006) Cross-Border Higher Education Collaboration in Europe: Lessons for the 'Two Irelands'? European Journal of Education, Vol. 41, No. 1, Attitudes, Choice, and Participation: Dimensions of the Demand for Schooling (Mar. 2006), pp115-129.

Osei-Afoakwa, K. (2014) How Relevant is the Principle of Transparency in Public Procurement? Developing Country Studies. Vol. 4, No. 6, pp140-146.

Oshri, I. Kotlarsky, J. and Willcocks, L. P. (2007) Global software development: Exploring socialization and face-to-face meetings in distributed strategic projects. Journal of Strategic Information Systems. No .16. pp25–49.

Padilla-Meléndez, A. and Garrido-Morena, A. (2012) Open innovation in universities: Whatmotivates researchers to engage in knowledge transfer exchanges? International Journal of Entrepreneurial Behaviour and Research. Vol. 18. No 4. pp417-439.

Palmarudi, M. and Hastanb. (2012) Core Competence and Sustainable Competitive Advantage of Small Silk Weaving Industries (SIs) In Wajo District, South Sulawesi. Procedia Economics and Finance No 4 pp160-167.

Parker, I. (2005) Qualitative Psychology: Introducing radical Research. Maidenhead. Open University Press.

Parker, L. (2002) It’s been a pleasure doing business with you: A Strategic Analysis and Critique of University Change Management. Critical Perspectives on Accounting. Vol 13 pp603-pp629.

Patton, M. Q. (2002) Qualitative research and evaluation methods. 3rd Sage Publications. Thousand Oaks. CA.

Payne, F. A., Storbacka K., Frow P. (2008) Managing the co-creation of value. Journal of Academy of Marketing Science.  No. 38. pp83–96.

Perkmann, M. Neely, A. and Walsh, K. (2011) How should firms evaluate success in university–industry alliances? A performance measurement system. R&D Management. No 41. Vol 2. p202-216.

Pfeffer, J. and Salancik, R. G. (1974) Organizational Decision Making as a Political Process: The Case of a University Budget. Administrative Science Quarterly. Vol. 19. No. 2. pp135-151.

Phan, P. H. Siegelb, D.H. and Wrigh, M. (2005) Science parks and incubators: observations, synthesis, and future research. Journal of Business Venturing. Vol. 20. pp165–182.

Pihlajamaa, M. and Merisalo, M. (2021) Organizing innovation contests for public procurement of innovation – a case study of smart city hackathons in Tampere, Finland. European Planning Studies. VOL. 29. NO. 10. pp1906–1924.

Piterou, A. and Birch, C. (2014) The role of Higher Education Institutions in supporting innovation in SME's: university-based incubators and student internships as knowledge transfer tools. The Journal of Innovation Impact: Vol 7. No 1. pp72-77.

Pole, C. and Lampard, R. (2002) Practical Social Investigation: Qualitative and Quantitative Methods in Social Research. Harlow. Prentice Hall.

Polsa, P. (2010) The crossover-dialog approach: The importance of multiple methods for international business. Journal of Business Research. No. 66. pp 288–297.

Porter, M. E. (1985) Competitive Advantage: Creating and Sustaining Superior Performance. New York. The Free Press.

Porter, S. (2007) Validity, trustworthiness, and rigour: reasserting realism in qualitative research. Journal of Advanced Nursing No. 60. Issue. 1. pp79–86.

Powell, T. C. (2001) Competitive Advantage: Logical and Philosophical Considerations. Strategic Management Journal. No. 22. pp875–888.

Power, J. B. and McDougall, P. P. (2005) University start-up formation and technology licensing with firms that go public: a resource-based view of academic entrepreneurship. Journal of Business Venturing. No. 20. pp291–311.

Prigge, G. W. (2005) University-industry partnerships: what do they mean to universities? A Review of the literature. Industry and Higher Education. Vol 19. No 3. pp221-229.

Preuss, L. (2000) Should You Buy Your Customer's Values? On the Transfer of Moral Values in Industrial Purchasing. International Journal of Value-Based Management. No 13. pp141-158.

Pugh, R. (2017) The Good, the Bad, and the Ugly; Triple Helix Policies and Programmes in Wales. Regional Studies. Vol 51. Issue 7. pp982-993.

Punch, K. F. (2005) Introduction to Social Research: Quantitative and Qualitative Approaches. Second Edition. London. Sage.

Quayle, M. and Quayle, S. (2000) The impact of strategic procurement in the UK further and higher education sectors. The International Journal of Public Sector Management. Vol. 13. No. 3. pp260-284.

Quinlan, C. and Zikmund, W. (2015) Business Research Methods. Andover. Cengage Learning EMEA.

Quinlan, C. Babin, B. Carr, J. Griffin, M. and Zikmund, W. G. (2018) Business Research Methods. Second Edition. Andover. Cengage Learning. EMEA.

Quinlan, S. (2011) Business Research Methods. Andover. Cengage Learning EMEA.

Ragatz, G. L. Handfield, R. B. and Peterson, K. J. (1997) Success factors for integrating supplier into new product development. Journal of Product Innovation Management. Vo, 14. No. 3. pp190-202.

Rahman, R. (2015) Comparison of Telephone and In-Person Interview. Interdisciplinary Undergraduate Research Journal. (Spring 2015) pp10-12.

Rahman, S. (2017) The Advantages and Disadvantages of Using Qualitative and Quantitative Approaches and Methods in Language “Testing and Assessment” Research: A Literature Review. Journal of Education and Learning. Vol. 6. No. 1. pp102-112.

Rangus, K. Drnovšek, M. Di Mini, A. and Pithovern, A. (2017) The role of open innovation and absorptive capacity in innovation performance: Empirical evidence from Slovenia. JEEMS. Vol. 22. Vol. 1. pp1-24.

Rangus, K. and Etzkowitz, H. (2013) Triple Helix Systems: An Analytical Framework for Innovation Policy and Practice in the Knowledge Society. Vol. 27 Issue 4, pp237-262.

Ray, S. Fitzpatrick, S. Golubic, R. Fisher, S. and Gibbings, S. (2016) Oxford Handbook of Clinical and Healthcare Research. Oxford. Oxford University press.

Rehme, J. Nordigården, D. Ellström, D. and Chicksand, D. (2016) Power in distribution channels — Supplier assortment strategy for balancing power. Industrial Marketing Management. No 54. pp176-187.

Reijonen, H. (2008) Understanding the small business owner: what they really aim at and how this relates to firm performance. A case study in North Karelia, Eastern Finland. Management Research News. Vol. 31. No. 8. pp.616-629.

Rieu, A. M. (2014) Innovation today: the Triple Helix and research diversity. Triple Helix. No 1. Vol 8. pp1-22.

Riley, M. Wood, R. C. Clark, M. A., Wilkie, E. and Szivas, E. (2000) Researching and Writing Dissertations in Business and Management. Holborn. Thomson Learning.

Riley, G. Wang, J. Park, K. Karimzada, M. Seqeira, N. O'Sullivan, P. and Alseidl, A. (2023) Virtual Interviews: Assessing how Expectations Meet Reality. Journal of Surgical Education. Vol 80. No 2. pp200-207.

Riggs, W. and von Hippel, E. (1994) Incentives to innovate and the sources of innovation: The case of scientific instruments. Research Policy No 23. pp459-469.

Rodriquez Cano, C. Boles, J.S. and Bean, C.J. (2005) Communication Media Preferences in Business-To-Business Transactions: An Examination of the Purchas Process. Journal of Personal selling and Sales Management. Vol 25. No. 3. pp283-294.

Roehrich, J. K. Lewis, M. A. and George, G. (2014) Are public-private partnerships a healthy option? A systematic literature review. Social Science and Medicine. No. 113. pp1100-1119.

Rolfstam, M. (2013) Public Procurement of Innovation. The Role of Institutions. Cheltenham. Edward Elgar Publishing Limited.

Rondinelli, D. A. and London, T. (2003) How Corporations and Environmental Groups Cooperate: Assessing Cross-Sector Alliances and Collaborations. The Academy of Management Executive. Vol. 17, No. 1. pp 61-76.

Rosa, M. J. and Mohnen, P. (2007) Knowledge Transfers between Canadian Business Enterprise and Universities: Does Distance Matter? Spatial Econometrics, Innovation Networks and Growth. pp303-323.

Russell Group (2017) Benefits of the research-intensive learning environment at Russell Group universities. Russell Group. Available at: https://www.russellgroup.ac.uk/media/5515/research-intensive-learning-briefing-may-2017-revised.pdf. Accessed: 6th April 2021.

Sábato, J. and Mackenzi, M. (1982) La Producción de Technologia. Autónoma o Transnacional. Nueva Imagen, Mexico.

Sadler, G. R. Hau-Chen, L. Seung-Hwan, L. and Fullerton, S. (2010) Recruitment of hard-to-reach population subgroups via adaptations of the snowball sampling strategy. Nursing and Health Sciences, No 12. pp369-374.

Sadeghi, J.K. Azadegan, A. Ojha, D. and Ogden, J. A. (2022) Benefiting from supplier business continuity: The role of supplier monitoring and buyer power. Industrial Marketing Management. No 106. pp432–443.

Salkind, N. J. (2012) Exploring Research. Eight Edition. International Edition. New Jersey. Pearson.

Salminen-Karlsoon, M. and Wallgren, L. (2008) The interaction of academic and industrial supervisors in graduate education: an investigation of industrial research schools. Higher Education. Vol. 51. No 1. pp77-93.

Sans Pinillos, A. (2022) Neglected Pragmatism: Discussing Abduction to Dissolute Classical Dichotomies. Foundations of Science. No. 27. pp1107–1125.

Sanchez Graells, A. and Gideon, A. K. (2016). When are Universities Bound by EU Public Procurement Rules as Buyers and Providers? English Universities as a Case Study. Ius Publicum Network Review, Vol 1, No1 Issue 4. Date: 28/09/2020. Web Address: http://www.ius-publicum.com/repository/uploads/14_03_2016_9_04-Gideon_SanchezGraells_DEF.pdf

Santoen, T. Kavivo-Oja, J. and Suomala, J. (2014) The Next Steps in Developing the Triple Helix Model: A Brief Introduction to National Open Innovation System (NOIS) Paradigm. Systemics, Cybernetics and Informatics. Vol 12. No 7. pp74-82.

Sampson, H. (2004) Navigating the waves: the usefulness of a pilot in qualitative research. Qualitative Research. Vol. 4 No. 3. pp383-402.

Saputra, I. W. Sutop, W. and Zararia, R. (2018) A business strategy formulation for commercializing university-created technology: A university spin-offs. AIP Conference Proceedings No 1931. Issue 1. pp030020-1030020-8.

Sapsford, R. and Jupp, V. (1996) Data Collection and Analysis. London. Sage Publications Ltd.

Saunders, L. W. Kleiner, B. M. McCoy, A. P. Lingardb, H. Mills, T. Blismas, N. and Wakefield, N. (2015) The effect of early supplier engagement on social sustainability outcomes in project-based supply chains. Journal of Purchasing and Supply Management. No. 21. pp285-295.

Saunders, M. (1997) Strategic Purchasing and Supply Chain Management. Second Limited. London Pitman Publishing.

Saunders, M, Lewis, P. and Thornhill, A. (2000) Research Methods for Business Students. Second Edition. Harlow. Financial Times/Prentice Hall.

Saunders, M. Lewis, P. and Thornhill A. (2012) Research methods for Business Students. Sixth Edition. Harlow. Pearson.

Saunders, M. Lewis, P. and Thornhill, A. (2016) Research methods for Business Students. Seventh Edition. Harlow. Pearson.

Saunders, M. Lewis, P. Thornhill, A. (2019) Research methods for Business Students. Eighth Edition. Harlow. Pearson.

Savvides, D. (2011) The Effectiveness of the Competitive Dialogue Procedure under the EU Consolidated Public Procurement Directive (2004/18/EC) as an Award Procedure for Public Private Partnerships. European Public Private Partnership Law Review. Vol. 6. No. 1 (2011). p23-37.

Scholten, K. and Schilder, S. (2015) The role of collaboration in supply chain resilience. Supply Chain Management. Vol. 20. No. 4. pp471–484.

Schebesta, H. (2016) Damages in EU Public Procurement Law. Studies in European Economic Law and Regulation 6. London. Springer.

Scheulte, P. (2004) The entrepreneurial university: a strategy for institutional development. Higher Education in Europe. Vol 29. No 2. pp187-191.

Schindler, S. P. (2019) Business Research Methods. Thirteenth Edition. International Edition. New York. Mc Graw Hill.

Schuster, T. and Holtbrügge, D. (2013) Benefits of Cross-sector Partnerships in Markets at the Base of the Pyramid. Business Strategy and the Environment. No. 23. pp188–203.

Seitanidi, M. M. (2010). The politics of partnership. A critical examination of nonprofit-business partnerships. The Netherlands: Springer.

Sekarn, U. and Bougie, R. (2016) Research Methods for Business: A Skill-Building Approach. Seventh Edition. Chichester. John Wiley and Sons.

Selsky, J. W. and Parker, B. (2005) Cross-Sector Partnerships to Address Social Issues: Challenges to Theory and Practice. Journal of Management. Vol. 31. No. 8. pp849-873.

Shane, S. (2004) Academic Entrepreneurship: University Spinoffs and Wealth Creation. Cheltenham. Edward Elgar Publishing Limited.

Sharpe Pritchard (2014) Challenges to procurement decisions: The issues and the pitfalls. London. Sharpe Pritchard.

Sharan, B. M. and Tisdellll, J. E. (2016) Qualitative Research: A Guide to Design and Implementation. Fourth Edition. San Francisco. Jossey-Bass.

Shattock, M. (2003) Managing Successful Universities. Maidenhead. Society for Research into Higher Education and Open University Press.

Shaw, B. (1985) The Role of the Interaction between the User and the manufacturer in Medical Equipment Innovation. R&D Management. Vol 15 No 4. pp283-292.

Shaw, B. (1998) Innovation and new product development in the UK medical equipment industry. International Journal of Technology Management. Vol. 15. No. Issue. 3/5 pp433-445.

Shaw, J. A. Connelly, D. M. and Zecevic, A. A. (2010) Pragmatism in practice: Mixed methods research for physiotherapy. Physiotherapy Theory and Practice, Vol 26. No. 8. pp510–518.

Shenton, A.K. (2004) Strategies for ensuring trustworthiness in qualitative research projects. Education for Information Vol. 22. pp63–75.

Sherman, S. N. (1991) Government Procurement Management. Germantown. Wordcrafters Publications.

Shields, P. M. (1998) Pragmatism as Philosophy of Science: A Tool for Public Administration. Research in Public Administration. Vol 4. pp195-225.

Shinn, T. (2002) The Triple Helix and the New Production of Knowledge: Prepackaged Thinking on Science and Technology. Social Studies of Sciences. Vo. 32. No 4. pp599-614.

Sidwell, A.C. and Budiawan, D. and Ma, T. (2001) The significance of the tendering contract on the opportunities for clients to encourage contractor led innovation. Construction Innovation. No 1. pp107-116.

Smith, J. A. (2015) Qualitative Psychology: A Practical Guide to Research Methods. London. Sage Publications Ltd.

Sinkovics, R. R. Penz, E. and Ghauri, P. N. (2008) Enhancing the Trustworthiness of Qualitative. Research in International Business. Vol. 48, Issue 6. pp689-714.

Singh, S. and Wassenaar, D. R. (2016) Contextualising the role of the gatekeeper in social research. South African Journal of Bioethics and Law. Vol 19. No 1. pp46-pp42.

Sigma (2011) What is a contracting Authority? Public Procurement. Publisher: Sigma. Date: 29/09/2020. Web Address: http://www.sigmaweb.org/

Silverman, D. (2011) Interpreting Qualitative Data. 4th Edition. London. Sage Publications Limited.

Silverman, D. (2013) Doing Qualitative Research. Fourth Edition. London. Sage Publications Ltd.

Smith, D.  (2006) Exploring Innovation. Maidenhead. McGraw Hill Education.

Spekman, E. R. and Carraway, R. (2005) Making the transition to collaborative buyer–seller relationships: An emerging framework. Industrial Marketing Management. No. 35. pp10-19.

Spithoven, A. Vanhaverbeke, V. and Roijakkers, N. (2013) Open innovation practices in SME's and large enterprises. Small Business Economics. Vol 41. No 3. pp537-562.

Stal, E. Andreassi, T. and Fujino, A. (2016) The role of university incubators in stimulating academic entrepreneurship. Innovation and Management Review. No 13. pp89-98.

Stokes, P. and Wall, T. (2014) Research Methods. Business Briefings. London. Palgrave.

Stone, D. H. (1993) Design A Questionnaire. British Medical Journal. Vol. 307. No. 6914. pp1264-1266.

Sullivan, C. and Forrester, M. A. (2019) Doing Qualitative Research in Psychology. A Practical Guide. 2nd Edition. London. Sage.

Sundin, O. and Johannisson, J. (2005) Pragmatism, neo-pragmatism and sociocultural theory Communicative participation as a perspective in LIS. Journal of Documentation. Vol. 61 No. 1. pp 23-43

Szolnoki, G. and Hoffmann, D. (2013) Online, face-to-face and telephone surveys- Comparing different sampling methods in wine consumer research. Wine Economics and Policy. Vol. 2. Issue. 2. Pp 57-66.

Talebi, A. Rezania, D. and Bragues, G. (2022) Developing capabilities to engage start-ups in the context of public procurement of innovation: a template analysis. Innovation: Organization and Management. Vol. 24. No. 4. pp492–521.

Tahar, S. and Boutellier, R. (2013) Resource Allocation in Higher Education in The Context of New Public Management. The Context of New Public Management, Public Management Review Vol. 5 No. 5. pp687-711.

Tanskanen, K. and Aminoff, A. (2015) Buyer and supplier attractiveness in a strategic relationship – A dyadic multiple-case study. Industrial Marketing Management. Vol. 50. pp128-141.

Teichgräber, U. K. and de Bucourt, M. (2012) Applying value stream mapping techniques to eliminate non-value-added waste for the procurement of endovascular stents. European Journal of Radiology No 81. pp47– 52.

Telgen, J. and Sitar-Pop, C. E. (2001) *“Possible kinds of values added by the purchasing department”.* Proceedings of the 10th International Annual IPSERA Conference, 8-11 April 2001, Jonkoping, Sweden. pp 803-813.

Tether, B. S. and Swann, G. M. P. (2003) Sourcing Science: The use by Industry of the Science Base of Innovation; Evidence form the UK’s Innovation Survey. CRIC Discussion Paper No. 64. Centre for Research Innovation and Competition. The University of Manchester.

Tidd, J. and Bessant, J. (2015) Managing Innovation: Integrating Technological, Market and Organizational Change. Fifth Edition. Chichester. John Wiley and Sone Ltd.

Timonen, V. Foley, G. and Conlon, G. (2018) Challenges When Using Grounded Theory: A Pragmatic Introduction to Doing GT Research. International Journal of Qualitative Methods. Vol 17 pp1-10.

Thorne, S. (2020) On the use and abuse of verbatim quotations in qualitative research reports. Nurse Author & Editor. No. 30. pp4–6.

Thorsten, G. Szmigin, I. Reppel, A. E. and Voss, R. (2008) Designing and conducting online interviews to investigate interesting consumer phenomena. Qualitative Market Research: An International Journal. Vol. 11. No. 3. pp256-274.

Torvinen, H. And Ulkuniemi, P. (2016) End-user engagement within innovative public procurement practices: A case study on public–private partnership procurement. Industrial Marketing Management. Vol 58. pp58-68.

Törnudd, A. (1915) Types of Pragmatist Theory of Truth. The Journal of Philosophy, Psychology and Scientific Methods, Vol. 12, No. 18. pp 491-500.

Thune, T. (2011) Success Factors in Higher Education-Industry Collaboration: A case study of collaboration in the engineering field. Tertiary Education and Management. Vol. 17 No. 1 pp31-50.

Tracy, S.J. (2010) Qualitative Quality: Eight “Big-Tent” Criteria for Excellent Qualitative Research. Qualitative Inquiry. No.16. Issue. 10. pp837–851.

Treumer, S. and Lichère, F. (2011) Enforcement of the EU Public Procurement Rules European Procurement Law Series. Vol. 3. pp13-336.

Turner, B. S. (2000) The Blackwell Companion to Social Theory. Oxford. Blackwell Publishers.

Tuuainen, J. (2002) Reconsidering the Mode 2 and the Triple Helix: A Critical Comment Based on a Case Study. Science Studies. Vol 5. No. 2. pp36-58.

Tuzovic, S. Wirtz, J. and Heracleous, H. (2018) How do innovators stay innovative? A longitudinal case analysis. Journal of Services Marketing. Vol. 32. No. 1. pp34–45.

Tyrrell, L. (2015) The rise of the PI end-user: A study into end-user and manufacturer collaboration and the creation of new Scientific Equipment. MRes in International Business. Birkbeck College (University of London).

Ukalkar, S. (2000) Strategic Procurement Management for Competitive Advantage. Oxford. Oxford University Press.

Universities UK (2018) General briefing: funding for higher education. Parliament Briefing. London. Universities UK.

University of Cambridge (2021) Public contract regulations (OJEU) OLD. University of Cambridge. Date Viewed: 8th April 2021. Web Address: https://www.procurement.admin.cam.ac.uk/information/public-contracts-regulations-1-2-3.

University of Cambridge (2023) Research Operations Office. University of Cambridge. Date Viewed: 16th March 2023. Web Address:

https://www.research-operations.admin.cam.ac.uk/research-contracts/introduction-contracts/what-research-contract#:~:text=Research%20contracts%20are%20legally%20binding,conduct%20of%20the%20research%20itself.

UKRI (2022) Better methods, better research. Date Viewed: 17th July 2022. Web Address:
https://www.ukri.org/what-we-offer/browse-our-areas-of-investment-and-support/better-methods-better-research/

Ukalkar, S. (2000) Strategic Procurement Management for Competitive Advantage. Oxford. Oxford University Press.

Urban, Glen I. and von Hippel, E. (1988) “Lead User Analyses for the Development of New Industrial Products.” Management Science 34, No 5. (May 1988): pp569–582.

Vanhaverbeke, W. and Cloodt, M. (2006) Chapter Title: Open Innovation in value networks.  In: Open Innovation: Researching a New Paradigm. Oxford. Oxford University Press.

Vanhaverbeke, W. and Du, J. (2010) Reframing the role of lead users in radical innovations: an open innovation perspective. International Journal Business Environment. Vol. 3. No. 2. pp202-220.

Vaismorandi, M. Turunen, H. and Bondas, T. (2013) Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. Nursing and Health Sciences. No 15. pp398-405.

Van Tulder, R. May, M.S. Crane, A. and Brammer, S. (2016) Enhancing the Impact of Cross-Sector Partnerships, Four Impact Loops for Channeling Partnership Studies. Journal of Business Ethics. Volume 135, Issue 1, pp 1–17.derer

Van Weele, A. J. (2018) Purchasing and Supply Chain Management. Seventh Edition. Andover. Cengage.

Yapraka, A. Yosunb, T. and Cetindamarb, D. (2018) The influence of firm-specific and country-specific advantages in the internationalization of emerging market firms: Evidence from Turkey. International Business Review. No. 27. pp198–207.

Veal, A. J. (2005) Business Research Methods: A Managerial Approach. Second Edition. Frenchs Forest. Pearson Education Australia.

Vecchiato, R and Roveda, C (2014) Foresight for public procurement and regional innovation policy: The case of Lombardy. Research Policy. Vol. 43. pp438– 450.

Vedovello, C. (1997) Science parks and university-industry interaction: geographical proximity between the agents as a driving force. Technovation. Vol 17. No 9. pp491-502.

Ye, Y. Wua, Q. Zhexue Huang, J. Ng, M. K. and Li, X. (2013) Stratified sampling for feature subspace selection in random forests for high dimensional data. Pattern Recognition. No 46. pp769–787.

Yeow, J. Uyarra, E. Edler, J. Gee, S. Georghiou, L. Lember, V. (Ed.), Kattel, R. (Ed.). and Kalvet, T. (Ed.) (2013). UK Public Procurement of Innovation: The UK Case. In Public Procurement, Innovation and Policy: International Perspectives. The University of Manchester. pp233-258.

Yepeng, W. Jiao, Y. Hui, X and Lyu, C. (2022) The more engagement, the better? The influence of supplier engagement on new product design in the social media context. International Journal of Information Management. No. 64. 102475.

Vernis, A. Iglesias, M. Sanz, B. and Saz-Carranza, A. (2006) Nonprofit Organizations: Challenges and Collaboration. Basingstoke. Palgrave Macmillan.

Yin, R.K. (1984). Case Study Research: Design and Methods. Beverly Hills, Calif: Sage Publications.

Yin, R. K. (2014) Case Study Research: Design and Methods. London. Sage Publications Ltd.

Vodonick, J. (2017) Neo-pragmatism: an ethical anticipatory system. European Journal Futures Res Vol 5. No. 5. pp1-7.

Vogl, S. (2013) Telephone versus Face-to-Face Interviews: Mode Effect on Semi-structured Interviews with Children. Sociological Methodology. Vo. 43. Issue 1. pp133-177.

Young, Sohn S. and Lee, M. (2012) Conjoint analysis of R&D contract agreements for industry-funded university research. Journal of Technology Transfer. No. 37. pp532–549.

Vojak, B. A. Price, R. L. and Griffin, A. (2012) Serial Innovators. Research Technology Management. Vol. 55, No. 6. pp42-48.

von Corswant, F. and Tunälv, C. (2002) Coordinating customers and proactive suppliers A case study of supplier collaboration in product development. Journal. Engineering Technology Management. No. 19. pp249–261.

von Hippel, E. A. (1976) The Dominant role of users in the scientific instrument innovation process. Research Policy (July 1976) pp212-239.

von Hippel, E. A. (1977) Transforming process equipment innovations from user-innovators to equipment manufacturing firms. R&D Management. Vol 8. No 1. pp13-22.

von Hippel, E. A. (1978) Successful Industrial Products from Customer Ideas, Journal of Marketing. Vol. 42. No 1. pp39-49.

von Hippel, E. A. (1986) “Lead Users: A Source of Novel Product Concepts.” Management Science 32, No 7. (July 1986) pp791–805.

von Hippel, E. A. (1988) The sources of innovation. Oxford. Oxford University Press.

von Hippel, E. A. (1988) Appropriability of innovation benefits as a predictor of the source of innovation. Research Policy No 11. pp95-115.

von Hippel, E.A. and Katz, R. (2002) Shifting Innovation to Users via Toolkits. Management Science. Vol 48. No 7. pp821-833.

von Hippel, E. A. Ogawa, S. and De Jong Jeroen, P. J. (2011) The Age of the Consumer-Innovator. MIT Doan Management Review. Fall 2011. Vol 53. No. 1. pp27-35.

Von Tulder, T. Seitanidi, M. Crane, A. and Brammer, S. (2016) Enhancing the Impact of Cross-Sector Partnerships. Journal of Business Ethics. No 135. pp1–17.

Wang, Y. Wang, N. Jiang, L. Yangd, Z. and Cui, V. (2016) Managing relationships with power advantage buyers: The role of supplier initiated bonding tactics in long-term buyer–supplier collaborations. Journal of Business Research. No. 69. pp5587-5596.

Wanat, C. L. (2008) Getting Past the Gatekeeper: Differences Between Access and Cooperation in Public School Research. Journal of Field Methods. Vol 20. No. 2. pp191-208.

Watson, D. and Hall, L. (2015) Addressing the Elephant in the Room: Are Universities Committed to the Third-Stream Agenda. International Journal of Academic Research in Management (IJARM). Vol 4. No 2. pp48-76.

Warner, D. and Palfreyman, D. (2001) The State of UK Higher Education: Managing Change and Diversity. Buckingham. The Society for Research into Higher Education.

Wellington, T. (1996) Methods and Issues in Educational Research. Sheffield. USDE Paper in Education.

Wen-Cheng, W. Chien-Hung, L. and Ying-Chien, C. (2011) Types of Competitive Advantage and Analysis. International Journal of Business and Management Vol. 6. No. 5. pp100-104.

West, J. and Bogers, M. (2014) “Leveraging external sources of innovation: a review of research on open innovation”. Journal of Product Innovation Management. Vol 31. No 4. pp814-831.

Wieteska, G. (2020) The Impact of Supplier Involvement in Product Development on Supply Chain Risks and Supply Chain Resilience. Operations and Supply Chain Management. Vol. 13. No. 4. pp359 – 374.

Wikhamn, B. R. (2013) Creativity and Innovation Management. Vol 22. No 4. pp375-389.

Willig, C. (2013) Introducing Qualitative Research in Psychology. Third Edition. Maidenhead. Open University Press.

Williams, R. and Smellie, R. (1985) Public Purchasing and Technical Change. London. The Technical Change.

Wilson, J. (2010) Essentials of Business Research: A guide to doing your research project. London. Sage Publications Limited.

Wilkins, S. Hazzam, Z. and Lean, J. (2021) Doctoral publishing as professional development for an academic career in higher education. The International Journal of Management Education. No. 19. pp1-13.

Wisner, J. D. Tan, K. C. and Keong Leong, G. (2019) Principles of Supply Chain Management: A Balanced Approach. Boston. Cengage.

West, J. and Bogers, M. (2014) “Leveraging external sources of innovation: a review of research on open innovation”. Journal of Product Innovation Management. Vol 31. No 4. pp814-831.

Wood, M. (2008) The Theory, History and Practice of Resource Allocation Models in UK Universities. The Journal of Finance and Management in Colleges and Universities. pp139-155.

Woodside, A. G. Golfetto, F. and Gibbert, M. (2019) Creating and managing superior customer value. Creating and Managing Superior Customer Value Advances in Business Marketing and Purchasing. Vol. 14. pp3–25.

Wright, M. Clarysee, B. Mustar, P. and Lockett, A. (2007) Academic Entrepreneurship in Europe. Cheltenham. Edward Elgar Publishing Limited.

Wu, J. (2014) Cooperation with competitors and product innovation: Moderating effects of technological capability and alliances with universities. Industrial Market Management. No. 43. pp199-209.

Zikmund, W. G. Babbin, B. J. Carr, J. C. and Griffin, M. (2013) Business Research Methods, International Edition. United Kingdom. Southwestern Cengage Learning.

Zhou, G. and Etzkowtiz, H. (2006) The entrepreneurial university and the future of higher education in China. https://www.researchgate.net/publication/269390186_The_Entrepreneurial_University_and_the_Future_of_Higher_Education_in_China. Accessed 17th October 2019

Zutlevics, T. L. (2016) Could providing financial incentives to research participants be ultimately self-defeating? Research Ethics. Vol 12. No 3. pp137-148.

Zwick, M. E. (2021) Organizing core facilities as force multipliers: strategies for research universities. Journal of Biomolecular Techniques No. 32. pp36–41.

# Appendix 1 - Principal Investigator (PI end-user) Telephone Interview Schedule

| **SECTION A: Buyer Demographics**<br>*(Complete relevant sections)* | | |
|---|---|---|
| **Date:** | | |
| Respondents Number: | | |
| Contact Email: | | |
| Date of Telephone Interview: | | |
| Age: | Under 18 years old ☐<br>25-34 years old ☐<br>45-54 years old ☐<br>65-74 years old ☐ | 18-24 years old ☐<br>35-44 years old ☐<br>55-64 years old ☐<br>75 years or older ☐ |
| Faculty/Division: | Medicine ☐<br>Life Sciences ☐<br>Engineering ☐<br><br>Other (please state): | Chemistry ☐<br>Physics ☐ |
| Role:<br>(Are you a Principle Investigator) | | |
| Qualification Level | BA Hons/BSc Hon ☐<br>Master Degree (Research) ☐<br>PhD ☐<br><br>Other (please state): | Master Degree (Taught) ☐<br>Master of Philosophy ☐<br>Professional Degree ☐ |
| Gender: | Male ☐ Female ☐ Prefer Not to Say ☐ | |
| Scientific Equipment Funded by: | Arts and Humanities Research Council (AHRC) ☐<br>Biotechnology and Biological Science Research Council (BBSRC) ☐<br>Engineering and Physical Sciences Research Council (EPSRC) ☐ | |

| | |
|---|---|
| | Economic and Social Research Council (ESRC) ☐<br>Medical Research Council (MRC) ☐<br>Natural Environment Research Council (NERC) ☐<br>Welcome Trust ☐<br>Cancer Research UK ☐<br>University Funding ☐<br>Private funded ☐<br><br>Other (please state): |
| Scientific Equipment Use: | Research ☐ Teaching ☐<br>Collaboration ☐ Core Facility ☐<br><br>Other (please state): |
| Publications: | Under 10 academic journal articles ☐<br>10 to 25 academic journal articles ☐<br>25 to 50 academic journal articles ☐<br>50 to 75 academic Journal articles☐<br>75 to 100 academic journal articles ☐<br>Over 100 academic journal articles ☐ |
| Book Publications: | |
| Other Publications: | |

| **SECTION B: Summary of the Tender Requirements**<br>*(Complete relevant sections)* |
|---|
| Please can you provide a summary of the reason why you wish to procure this equipment? |

**SECTION C: Context of the Tender Process**

*(Complete relevant sections)*

**Role**

1) Please explain your area of research?
2) Do you undertake teaching and/or research?
3) Do you supervise PhD student in your research? Please explain.
4) Is your field of research competitive? Please explain.

**Previous relationship**

1. Have you purchased this scientific equipment before?
2. Do you have similar equipment in your lab from the same manufacturer?
3. Has this been purchased from the same scientific manufacturers?
4. If so, how long have had a relationship with this supplier?
5. Do you prefer to purchase equipment from this supplier?
6. How does the supplier interact with your department?
7. Do you currently collaboration with this supplier? Please explain.

**Environment**

1. Have you found competitions for grant funding for scientific equipment more competitive?
2. Have you experienced difficult accessing resources to conduct your research? If so, what are the reasons for this competition?
3. Has internal funding for research equipment become more competitive? If so, what are the reasons for this competition?
4. Has your department/university designated a “centre for excellent” for research methods training?
5. Has the university started to reduce your teaching and/or research budget due to financial constraints?

**SECTION D: Value-Added Factors for Collaboration**

*(Complete relevant sections)*

1. What does the term value-added mean to you? Please explain.
2. What kind of value-added factors has the supplier offered to you in tender? Please explain.
3. Are there any specific value-add factors you consider the supplier should have submitted back in their tender return?
4. Did you add any specific added-value factors to the specification form?
5. If so, has supplier’s bid offered these factors?

6. What benefits have you received from the supplier offer?

## SECTION E: Knowledge Transfer

*(Complete relevant sections)*

1) Has the supplier provided any part funding or funding for your research?

2) Does this supplier recruit graduate students from your department?

3) Has the supplier been involved in any of the following in your department:

   - University Research facilities
   - Co-patenting and licensing activities
   - Working with the University Pi to delivery degrees and profession development courses
   - Provide new research equipment for beta testing
   - Signed a co-operation agreement
   - Based staff on the host University site
   - Accessed funding from government for joint collaboration
   -

4) Has the supplier supported any of the following within your department:

   - Supporting student research projects
   - Providing student internships
   - Provided PhD Studentships
   - Provide research topics for undergraduate students
   - Offered technical seminars to the department
   - Provided mentoring to students
   - Offered careers advice to students
   - Offered travel grants

## SECTION F: Cross-Sector Collaboration Success Factors

*(Complete relevant sections)*

**Purpose and Motives:**

1) What are the reasons for your collaborating with this supplier?
2) How would you define your relationship with this supplier? Please explain.
3) Does the supplier share your goals or vision? Please explain.
4) What do you consider the supplier goals to be in this relationship? Please explain.

5) Do you see your relationship with the supplier being short or long term?

**Supplier Section Process and Capability:**

1. What skills does the supplier bring to your relationship? Please explain
2. What type of resource do you have access too during this relationship. Please explain.
3. Have you developed any new skills since working with this supplier?

**Accountability:**

**1)** Is there a conflict resolution process for dealing with issues during your relationship with the supplier?

**Governance structure and communication:**

1) Do you have regular contact with this supplier? Please explain.
2) Do you have a research contract is place with this supplier? Please explain.
3) Who is involved with managing the relationship with this supplier?
4) From the university side, have you had any contact with the University Technical Transfer office?
5) How is knowledge managed through you relationship with the supplier?
6) Does your department encourage you to develop collaborations with suppliers?

**Trust:**

1) Is developing trust important in your relationship with the supplier?
2) How have you created trust between your firm and the supplier?

**Power:**

1) How do you manage power within your relationship? Please Explain.
2) Who in the relationship holds the power?

**Information Technology:**

1) What types of media do you use to communication with the supplier?
2) How do you resolve technical issues with the equipment?
3) Have you managed your relationship with the supplier via these communication methods?

**SECTION F: Specification Design (Tender documentation)**

*(Complete relevant sections)*

Design

1) What changes would you make to the specification form to make the tender more conducive to collaboration?
2) What value-added factors would you expect to see in the specification form that would persuade you to collaborate with this supplier? Explain?
3) Do you think the tender process should be changed?  How would you change the process?
4) How would you manage the relationship with the supplier going forward through the tender specification? Explain.

# Appendix 2 - Scientific Equipment Manufacturer (Supplier) Virtual Meeting (Interview Schedule)

| **SECTION A: Supplier Demographics**<br>*(Complete relevant sections)* | |
|---|---|
| **Participant Number:** | |
| Manufacturer Name: | |
| Age: | Under 18 years old ☐ 18-24 years old ☐<br>25-34 years old ☐ 35-44 years old ☐<br>45-54 years old ☐ 55-64 years old ☐<br>65-74 years old ☐ 75 years or older ☐ |
| Role: | |
| Qualification Level: | BA Hons/BSc Hon ☐ Master Degree (Taught) ☐<br>Master Degree (Research) ☐ Master of Philosophy ☐<br>PhD ☐ Professional Degree ☐<br><br>Other (please state): |
| Gender: | Male ☐ Female ☐ Prefer Not to Say ☐ |
| ` | Atomic Force Microscope ☐<br>BEAM System ☐<br>Confocal Microscope ☐<br>CT Scanner ☐<br>Diffraction Apparatus ☐<br>Dilution Refrigerator ☐<br>DNA Sequencers- Next Generation ☐<br>Environmental Chamber ☐<br>Florescent Microscopes ☐<br>Flow Cytometer ☐<br>Gamma Camera ☐<br>Mass Spectrometer<br>MRI scanner ☐<br>NMR (nuclear magnetic resonance spectrometers) ☐<br>Photon Microscope ☐<br>Scanning Electron Microscope ☐<br>Thermal Camera ☐<br>Transmission Electron Microscope ☐<br><br>Other (please state): |
| Scientific Equipment Use: | Research ☐ Teaching ☐<br>Collaboration ☐ Core Facility ☐<br><br>Other (please state): |
| Turnover: | |
| No Employees: | |

| | |
|---|---|
| Manufacturing Location (s): | |
| Technical Support Location(s): | |
| Engineers Based: | |
| **SECTION B: Summary of the Tender Process** *(Complete relevant sections)* | |
| Please can you provide summary of your experience of the procurement tender process. | |

**SECTION C: Context of the Tender Process**
*(Complete relevant sections)*

**Role:**

1) Please provide an overview of your role within your firm?
2) How long have you worked in this industry?
3) Do you manage any technical teams? Please explain.
4) Please can you provide an overview of your firm's products and markets?
5) How competitive is your market?

**Previous relationship:**

1) Has the PI purchased this type of scientific equipment before?
2) Does the PI have similar types of equipment purchased from your firm?
3) If so, how long have you had a relationship with this specific PI?
4) Do you prefer to working with this PI? Or with the department as a whole.

5) How does your firm currently interact with this specific PI? Please explain.
6) Do you currently have a formal collaboration agreement with this PI?
7) Have you worked with this University PI before?

**Environment:**

**1.** Overall, have you seen any changes in the level of grant funding for the scientific equipment you currently sell? Please explain
**2.** Overall, have you seen a change in the number of tenders being advertised from UK universities wishing to purchase equipment?
**3.** Are University PI's now excepting more offered in the tender submission free of charge than before?

**SECTION D: Value-Added Factors for Collaboration**
*(Complete relevant sections)*

1) What does the term add-value mean to you? Please explain.
2) What kind of add-value factors have you supplied to the University PI for this project?
3) What factors do you think that University PI consider important when buying scientific equipment? Please Explain.

**SECTION E: Knowledge Transfer**
*(Complete relevant sections)*

4) Is your firm part funded or fully funded research with this University PI?

5) Does your firm employ graduate students from this University?

6) Has your firm been involved in any of the following:

- University Research facilities
- Co-patenting and licensing activities
- Working with the University PI to deliver degrees and professional development courses
- Provide new research equipment for beta testing
- Signed a co-operation agreement
- Based staff on the host University site
- Access funding from government for joint collaboration
-

7) Has you firm been supported any of the following:

- Supporting student research projects
- Providing student internships
- Provided PhD Studentships
- Provide research topics for undergraduate students
- Offered technical seminars to the department
- Provided mentoring to students
- Offered careers advice to students
- Offered travel grants

**SECTION F: Cross-Sector Collaboration Success Factors**
*(Complete relevant sections)*

**Purpose and Motives:**

1) What are the reasons for your collaborating with this University PI?
2) How would you define your relationship with this PI? Please explain.
3) Does the PI share your firm's goals or vision? Please explain.
4) What do you consider the PI goals to be in this relationship? Please explain.
5) Do you see your relationship with the PI being short or long term? Please explain
6) Is it important to your firm to develop collaborations with University? Please explain.

**Supplier Section Process and Capability:**

1) What skills does the PI bring to your relationship? Please explain
2) What type of resource do you have access to during this relationship? Please explain.
3) Have you developed any new skills since working with this PI?

**Accountability:**

1) Is there a conflict resolution process for dealing with issue during you relationship with the University PI?

**Governance structure and communication:**

1) Do you have regular contact with the University Pi? Please explain.
2) Do you have a research contract in place with this University PI? Please explain.
3) Who is involved with managing the relationship with this University PI?
4) From the university side, have you had any contact with the University Technical Transfer office?
5) How is knowledge managed through your relationship with the University PI?
6) Does your senior management team support developing a collaboration with your firm?

**Trust:**

1) Is developing trust important in your relationship with the University PI?
2) How have you created trust between your firm and the University PI?

**Power:**

1) How do you manage power within your relationship? Please Explain.
2) Who in the relationship holds the power?

**Information Technology:**

1) What types of media do you use to communication with the University PI?
2) How do you resolve technical issues with the equipment?
3) Have you managed your relationship with the University PI via these methods?

**SECTION F: Specification Design (Tender documentation)**
*(Complete relevant sections)*

**Design:**

1) What changes would you make to the specification form to make the tender more conducive to collaboration?
2) What value-added factors would you expect to see in the specification form that would persuade you to collaborate with a University PI? Explain?
3) Do you think the tender process should be changed? How would you change the process?
4) How would you manage the relationship with this University PI going forward? Explain.

# Appendix 3 - Buyer Consent Form

## INFORMED CONSENT FORM (NON-NHS RESEARCH) (BUYER)

**Title of Project:**
**Exploring open innovation and collaboration in University – Industry Partnerships.**

**Participant identification number for this study:**

**Name of Researcher: Linda Tyrrell**

I, the undersigned, confirm that (**please initial boxes as appropriate**):

| | | |
|---|---|---|
| 1. | I have read and understood the information about the project, as provided in the Information Sheet dated 18th March 2020. | |
| 2. | I have been able to ask questions about the project and my participation and my questions have been answered to my satisfaction. | |
| 3. | I understand that taking part in this study involves undertaking a telephone interview and any information provided will be transcribed into text on a copy of the interview transcript. | |
| 4. | I understand that that a copy of the interview transcript will be uploaded to the University of Worcester's OneDrive which is password protected. | |
| 5 | I understand that once the project is complete and the thesis published all telephone interview transcripts on the University of Worcester OneDrive will be deleted from the drive. | |
| 6. | I agree to my telephone interview being audio-recorded to make sure the information is an accurate record of my thoughts. | |
| 7. | I understand that any audio recording from the telephone interview will be upload as a MP3 file and stored on the University of Worcester OneDrive (which is password protected). | |
| 8. | I understand that any audio-recording of the telephone interview will be deleted from the audio-recording equipment. | |
| 9. | I understand that once the project is completed and the thesis published all audio recordings will be destroyed from the University of Worcester OneDrive. | |
| 10. | I understand that taking part in the study there are no potential risks. | |
| 11. | I understand I can withdraw within 14 days of the interview being conducted without giving reasons and that I will not be penalised for withdrawing nor will I be questioned on why I have withdrawn. | |
| 12. | I understand that the information I provide will be used for both publication in an educational journal and as part of a Doctor of Philosophy thesis for Linda Tyrrell. | |
| 13. | I agree that my information can be quoted in research outputs. | |
| 14. | The procedures regarding confidentiality have been clearly explained (e.g. use of names, pseudonyms, anonymisation of data, etc.) to me. | |

| | | |
|---|---|---|
| 15. | I understand that my personal information collected about me that can identify me, such as my name, or where I live, will not be shared beyond the main researcher Linda Tyrrell. | |
| 16. | I voluntarily agree to participate in the project. | |
| 17. | I know who to contact if I have any concerns about this research. | |
| 18. | I understand that any audio recordings, personal information, consent form and telephone interview transcripts will be stored in the University of Worcester OneDrive (which is password protected) during the data collection and write up of this project. | |
| 19. | I have read and understood the withdraw process, stated in the participant information sheet dated 18th March 2020. I understand that I can withdraw without giving reasons, that I will not be penalised for withdrawing nor will I be questioned on why I have withdrawn from this project. | |

| Name of Participant | Signature | Date |
|---|---|---|

| Name of Researcher | Signature | Date |
|---|---|---|

# Appendix 4 - Supplier Consent Form

## INFORMED CONSENT FORM (NON-NHS RESEARCH) (SUPPLIER)

**Title of Project: Exploring open innovation and collaboration in University – Industry Partnerships.**

**Participant identification number for this study:**

**Name of Researcher: Linda Tyrrell**

I, the undersigned, confirm that (**please initial boxes as appropriate**):

| | | |
|---|---|---|
| 1. | I have read and understood the information about the project, as provided in the Information Sheet dated 18th March 2020. | |
| 2. | I have been able to ask questions about the project and my participation and my questions have been answered to my satisfaction. | |
| 3. | I understand that taking part in this study involves undertaking a virtual meeting (interview) and any information provided will be transcribed into text on a copy of the virtual meeting transcript. | |
| 4 | I understand that that a copy of the virtual meeting (interview transcript) will be uploaded to the University of Worcester's OneDrive which is password protected. | |
| 5. | I understand that once the project is complete and the thesis published all virtual meeting (interview transcripts) on the University of Worcester OneDrive will be deleted from the drive. | |
| 6. | I agree to my virtual meeting (interview) being audio-recorded to make sure the information is an accurate record of my thoughts. | |
| 7 | I understand that any audio recording from the virtual meeting (interview) will be upload as a MP3 file and stored on the University of Worcester OneDrive (which is password protected). | |
| 8. | I understand that any audio-recording of the virtual meeting (interview) will be deleted from the audio-recording equipment. | |
| 9. | I understand that once the project has been completed and the thesis published all virtual meetings (interview transcripts) on the University of Worcester OneDrive will be deleted. | |
| 10. | I understand that taking part in the study there are no potential risks. | |
| 11. | I understand I can withdraw within 14 days of the virtual meeting (interview) being completed without giving reasons and that I will not be penalised for withdrawing nor will I be questioned on why I have withdrawn. | |
| 12. | I understand that the information I provide will be used for both publication in an educational journal and as part of a Doctor of Philosophy thesis (PhD) for Linda Tyrrell. | |

| | | |
|---|---|---|
| 13. | I agree that my information can be quoted in research outputs | |
| 14. | The procedures regarding confidentiality have been clearly explained (e.g. use of names, pseudonyms, anonymisation of data, etc.) to me. | |
| 15. | I understand that personal information collected about me that can identify me, such as my name, or where I live, will not be shared beyond the main researcher Linda Tyrrell. | |
| 16. | I voluntarily agree to participate in the project. | |
| 17. | I know who to contact if I have any concerns about this research. | |
| 18. | I understand that any personal information, consent form and hard copy virtual meeting (interview transcript) will be stored on the University of Worcester University OneDrive during the data collection and write up of this project. | |
| 19. | I understand that when completing the online questionnaire, I must confirm my participant identification number. | |
| 20. | I have read and understood the withdraw process, stated in the participant information sheet dated 18th March 2020. I understand that I can withdraw without giving reasons, that I will not be penalised for withdrawing nor will I be questioned on why I have withdrawn from this project. | |

| | | |
|---|---|---|
| Name of Participant | Signature | Date |
| Name of Researcher | Signature | Date |

# Appendix 5 - Buyer Participant Information Sheet

University of Worcester

## PARTICIPANT INFORMATION SHEET AND PRIVACY NOTICE (BUYER)

**TITLE OF PROJECT:**
**Exploring open innovation and collaboration in University - Industry Partnerships.**

### Invitation

The University of Worcester engages in a wide range of research which seeks to provide greater understanding of the world around us, to contribute to improved human health and well-being and to provide answers to social, economic and environmental problems.

We would like to invite you to take part in one of our research projects. Before you decide whether to take part, it is important that you understand why the research is being done, what it will involve for you, what information we will ask from you, and what we will do with that information.

We will in the course of this project be collecting personal information. Under General Data Protection Regulation 2016, we are required to provide a justification (what is called a "legal basis") in order to collect such information. The legal basis for this project is "**task carried out in the public interest**".

You can find out more about our approach to dealing with your personal information at https://www.worcester.ac.uk/informationassurance/visitor-privacy-notice.html.

Please take time to read this document carefully. Feel free to ask the researcher any questions you may have and to talk to others about it if you wish. You will have at least 14 days to decide if you want to take part.

## What is the purpose of the research?

This project aims to address the identified gaps in the literature concerning the limited understanding of the procurement tender process conducive to Open Innovation and University-Industry collaboration for innovation and knowledge exchange.

The research objectives are:

1) To identify the success and added-value factors that drive new product innovation and University-Industry collaboration for innovation from the cross-sector collaboration literature.

2) To investigate both buyer (University) and supplier (Industry) perceptions toward these successes and added-value factors identified from the literature and ascertain if these factors can be integrated into the procurement tender process.

3) To identify if any improvements can be made to the procurement tender process to make it more conducive to cross-sector collaboration for innovation.

## Who is undertaking the research?

Members of the research team: Linda Tyrrell
Role on the project: Undertaking the data collection, analysis and thesis write up as part of a Doctor of Philosophy (PhD).
University email address TYRL1_17@uni.worc.ac.uk.

## Who is funding the research?

This is a self-funded project.

## Who has oversight of the research?

The research has been approved by the Research Ethics Panel for the College of Business, Psychology and Sport in line with the University's Research Ethics Policy. The University of Worcester acts as the "Data Controller" for personal data collected through its research projects & is subject to the General Data Protection Regulation 2016. We are registered with the Information Commissioner's Office and our Data Protection Officer is Helen Johnstone (infoassurance@worc.ac.uk). For more on our approach to Information Assurance and Security visit: https://www.worcester.ac.uk/informationassurance/index.html.

## Why have I been invited to take part?

You have received this invitation because you have recently been involved in a UCL Tender Process that resulted in collaboration between yourself and a scientific equipment supplier. We hope to recruit 5-15 buyers and suppliers involved in specific collaborative tenders for this project.

## Do I have to take part?

No. It is up to you to decide whether or not you want to take part in this project. Please take your time to decide. You can decide not to take part or to withdraw from the project up till 14 days following the data collection stage.

If you wish to have your data withdrawn or wish to withdraw completely from the project please:

1) The participant should email Linda Tyrrell (Study Researcher) at TYRL1_17@uni.worc.ac.uk and asking to withdraw from the study.

2) Participants do not need to give a reason for withdrawing from the project. However, the participant should state their participant number which will allow the study office to identify the participant's telephone interview transcript, consent form, tender log details and audio recording.

3) The study office will then delete the participant's telephone interview transcript, consent form, tender log details, and audio recording (deleted from the recording device) within 14 days of receiving the request.

If you do decide to take part you will be asked to sign a consent form.

## What will happen if I agree to take part?

If you agree to take part, you will be asked to schedule a telephone interview (at a time that is convenient to you) to discuss the tender process, the reasons why you consider it is important to collaborate with a scientific equipment manufacturer, the benefits of a collaboration with a supplier, the factors you consider are important to making the collaboration a success.

The telephone interview will last no more than 60 minutes, the information provided will be transcribed into a script, stored in a safe and used to build theory for this research project.

## What are the benefits for me in taking part?

This project's contribution to knowledge will be to identify the success factors created in cross-sector collaboration leading to new product development (NPD) and enhance our understanding of the motives and value-added factors that drive university academics and scientific manufacturing firms to collaborate, leading to this research contributing to theory and practice.

This research will potentially contribute to enhancing the Chesbrough's (et al 2006) Open Innovation model, by providing real world cases where the buyer (University) and supplier (Industry) exchange knowledge and integrate resources within the partnership as part of the inflow process of the Open Innovation model in the context of public sector procurement.

This research will potentially provide case examples of how Open Innovation can be implemented into the procurement tender process and allow a cross-sector partnership to access and integrate resource and knowledge that it does not possess. This would potentially inform how Industry can collaborate better with Universities in order to create a competitive advantage (Christensen, 2001; Porter, 1985; Powell, 2001; Wen-Cheng et al, 2011) . Additionally, the research can potentially make a practical contribution in relation to enhancing the procurement tender process by integrating the success factors discerned from both practice and theory.

### Are there any risks for me if I take part?

To mitigate any potential risk to participants the identity of buyers will be anonymised during the data collection stage, data analysis, thesis write up and journal publication. To ensure the buyer identity cannot be deduced the buyer will be referred to using the participant number P1 onwards (for each buyer) for each telephone interview. During the telephone interview to protect the anonymity of the participants taking part, the participant number will be used to address the buyer in the telephone interview.

During the write up of the telephone interview transcript, any quotes used will refer to this participant number. Any audio recordings (MP3 Files), consent form and telephone interview transcripts will be stored on the University of Worcester OneDrive (which is password protected) during the data collection and write up of this project. The buyer contact details in the tender logs will be stored in a locked safe. This will make sure that any information will be kept confidential. As there are over 12,000 employees at UCL, this will make it difficult to recognise the identity of the buyers involved in this project.

As the project is based in the past and is designed to improve the tender process to make it more conducive to developing new products. There are no confidentiality issues that would affect the reputations of both UCL, its academics and the suppliers taking part in this project.

### What will you do with my information?

Your personal data / information will be treated confidentially at all times; that is, it will not be shared with anyone beyond the research team for this project.

During the project, all data / information will be kept securely in line with the University's Policy for the Effective Management of Research Data and its Information Security Policy.

We will process your personal information for a range of purposes associated with the project primary of which are:

- To use your information along with information gathered from other participants in the research project to seek new knowledge and understanding that can be derived from the information we have gathered.
- To summarise this information in written form for the purposes of dissemination (through research reports, a thesis / dissertation, conference papers, journal articles or other publications). Any information disseminated / published will be at a summary level and will be fully anonymised and there will be no way of identifying your individual personal information within the published results.
- To use the summary and conclusions arising from the research project for teaching and further research purposes. Any information used in this way will be at a summary level and will be fully anonymised. There will be no way of identifying your individual personal information from the summary information used in this way.

If you wish to receive a summary of the research findings or to be given access to any of the publications arising from the research, please contact the researcher.

### How long will you keep my data for?

Your personal data will be retained until the project has been completed and the thesis published which will be no later than September 2023.

On completion of the project all telephone interview transcripts, consent forms and email correspondence will be destroyed from the University of Worcester systems (OneDrive and Outlook). Any audio recordings (MP3 files) will be destroyed (deleted from the University of Worcester OneDrive. The buyer contacted details in the tender log will be shredded.

### How can I find out what information you hold about me?

You have certain rights in respect of the personal information the University holds about you. For more information about Individual Rights under GDPR and how you exercise them please visit: https://www.worcester.ac.uk/informationassurance/requests-for-personal-data.html.

### What happens next?

Please keep this information sheet. If you do decide to take part, please either contact the researcher using the details below.

## Thank you for taking the time to read this information.

If you decide you want to take part in our project, and we hope you do, or if you have any further questions then please contact: Linda Tyrrell at TYRL1_17@uni.worc.ac.uk

If you have any concerns about the project at this point or at any later date you may contact the researcher (contact as above) or you may contact the Supervisor / Principal Investigator / Project Lead: Dr V Warrren at v.warren@worc.ac.uk

If you would like to speak to an independent person who is not a member of the research team, please contact Michelle Jellis at the University of Worcester, using the following details:

Michelle Jellis
Secretary to Research Ethics Panel for College of Business, Psychology and Sport
University of Worcester
Henwick Grove
Worcester WR2 6AJ
ethics@worc.ac.uk

# Appendix 6 - Supplier Participant Information Sheet

## PARTICIPANT INFORMATION SHEET AND PRIVACY NOTICE (SUPPLIER)

**TITLE OF PROJECT:**

**Exploring open innovation and collaboration in University - Industry Partnerships.**

**Invitation**

The University of Worcester engages in a wide range of research which seeks to provide greater understanding of the world around us, to contribute to improved human health and well-being and to provide answers to social, economic and environmental problems.

We would like to invite you to take part in one of our research projects. Before you decide whether to take part, it is important that you understand why the research is being done, what it will involve for you, what information we will ask from you, and what we will do with that information.

We will in the course of this project be collecting personal information. Under General Data Protection Regulation 2016, we are required to provide a justification (what is called a "legal basis") in order to collect such information. The legal basis for this project is "**task carried out in the public interest**".

You can find out more about our approach to dealing with your personal information at https://www.worcester.ac.uk/informationassurance/visitor-privacy-notice.html.

Please take time to read this document carefully. Feel free to ask the researcher any questions you may have and to talk to others about it if you wish. You will have at least 14 days to decide if you want to take part.

### What is the purpose of the research?

This project aims to address the identified gaps in the literature concerning the limited understanding of the procurement tender process conducive to Open Innovation and University-Industry collaboration for innovation and knowledge exchange.

The research objectives are:

1) To identify the success and added-value factors that drive new product innovation and University-Industry collaboration for innovation from the cross-sector collaboration literature.

2) To investigate both buyer (University) and supplier (Industry) perceptions toward these successes and added-value factors identified from the literature and ascertain if these factors can be integrated into the procurement tender process.

3) To identify if any improvements can be made to the procurement tender process to make it more conducive to cross-sector collaboration for innovation.

### Who is undertaking the research?

Members of the research team: Linda Tyrrell
Role on the project: Undertaking the data collection, analysis and thesis write up as part of a Doctor of Philosophy (PhD).
University email address TYRL1_17@uni.worc.ac.uk.

### Who is funding the research?

This is a self-funded project.

### Who has oversight of the research?

The research has been approved by the Research Ethics Panel for the College of Business, Psychology and Sport in line with the University's Research Ethics Policy. The University of Worcester acts as the "Data Controller" for personal data collected through its research projects & is subject to the General Data Protection Regulation 2016. We are registered with the Information Commissioner's Office and our Data Protection Officer is Helen Johnstone (infoassurance@worc.ac.uk). For more on our approach to Information Assurance and Security visit: https://www.worcester.ac.uk/informationassurance/index.html.

### Why have I been invited to take part?

You have received this invitation because you have recently been involved in a UCL Tender Process that resulted in collaboration between yourself and a UCL academic buyer. We hope to recruit 5-15 buyers and suppliers involved in specific collaborative tenders for this project.

## Do I have to take part?

No. It is up to you to decide whether or not you want to take part in this project. Please take your time to decide. You can decide not to take part or to withdraw from the project up till 14 days following the data collection stage.

If you wish to have your data withdrawn or wish to withdraw completely from the project please:

1) The participant should email Linda Tyrrell (Study Researcher) at TYRL1_17@uni.worc.ac.uk and asking to withdraw from the study.

2) Participants do not need to give a reason for withdrawing from the project. However, the participant should state their participant number which will allow the study office to identify the participant's virtual meeting interview transcript, consent form, tender log details and audio recording.

3) The study office will then delete the participant's virtual meeting telephone interview transcript, consent form, tender log details, and audio recording (deleted from the recording device) within 14 days of receiving the request.

If you do decide to take part you will be asked to sign a consent form.

## What will happen if I agree to take part?

If you agree to take part, you will be asked to schedule a virtual meeting (at a time that is convenient to you) to discuss the tender process, the reasons why you consider it is important to collaborate with a specific PI, the benefits of a collaboration with a university, the factors you consider are important to making the collaboration a success.

The virtual meeting will last no more than 60 Minutes to complete, the information provided will be transcribed into a script, stored in a safe and used to build theory for this research project. A copy of the virtual meeting (interview questions) will be provided to you for review before the virtual meeting takes place. After the virtual meeting has been held a copy of the virtual meeting (interview transcript) for you to comment on.

## What are the benefits for me in taking part?

This project's contribution to knowledge will be to identify the success factors created in cross-sector collaboration leading to new product development (NPD) and enhance our understanding of the motives and value-added factors that drive university academics and scientific manufacturing firms to collaborate, leading to this research contributing to theory and practice.

This research will potentially contribute to enhancing the Chesbrough's (et al 2006) Open Innovation model, by providing real world cases where the buyer (University) and supplier (Industry) exchange knowledge and integrate resources within the partnership as part of the inflow process of the Open Innovation model in the context of public sector procurement.

This research will potentially provide case examples of how Open Innovation can be implemented into the procurement tender process and allow a cross-sector partnership to access and integrate resource and knowledge that it does not possess. This would potentially inform how Industry can collaborate better with universities in order to create a competitive advantage. Additionally, the research can potentially make a practical contribution in relation to enhancing the procurement tender process by integrating the success factors discerned from both practice and theory.

### Are there any risks for me if I take part?

The main risk for participants during this project is keeping the participant's identity anonymised during the date collection stage, data analysis, thesis write up and journal publication. To ensure the participant's identity cannot be deduced, the participant will be referred to using the participant number S1 onwards for each supplier for each virtual meeting (interview). During the virtual meeting (interview) to protect the anonymity of the participants taking part, the participant number will be used to address the participant in the virtual meeting.

During the write up of the virtual meeting (interview transcript), any quotes used will refer to this participant number. Any audio recordings (MP3 Files), consent form and virtual meeting (interview) transcripts will be stored on the University of Worcester OneDrive (which is password protected) during the data collection and write up of this project. The participant contact details in the tender logs will be stored in a locked safe. This will make sure that any information will be kept confidential.

As the project is based in the past and is designed to improve the tender process to make it more conducive to developing new products. There are no confidentiality issues that would affect the reputations of both UCL, its academics and the participants' taking part in this project.

### What will you do with my information?

Your personal data / information will be treated confidentially at all times; that is, it will not be shared with anyone outside the research team for this project.

During the project, all data / information will be kept securely in line with the University's Policy for the Effective Management of Research Data and its Information Security Policy.

We will process your personal information for a range of purposes associated with the project primary of which are:

- To use your information along with information gathered from other participants in the research project to seek new knowledge and understanding that can be derived from the information we have gathered.
- To summarise this information in written form for the purposes of dissemination (through research reports, a thesis / dissertation, conference papers, journal articles or other publications). Any information disseminated / published will be at a summary level and will be fully anonymised and there will be no way of identifying your individual personal information within the published results.
- To use the summary and conclusions arising from the research project for teaching and further research purposes. Any information used in this way will be at a summary level and will be fully anonymised. There will be no way of identifying your individual personal information from the summary information used in this way.

If you wish to receive a summary of the research findings or to be given access to any of the publications arising from the research, please contact the researcher.

### How long will you keep my data for?

Your personal data will be retained until the project has been completed and the thesis published which will be no later than September 2023.

On completion of the project all virtual meetings (interview transcripts), consent forms and email correspondence will be destroyed from the University of Worcester systems (OneDrive and Outlook). Any audio recordings (MP3 files) will be destroyed (deleted from the University of Worcester OneDrive. The participant's contacted details in the tender log will be shredded.

### How can I find out what information you hold about me?

You have certain rights in respect of the personal information the University holds about you. For more information about Individual Rights under GDPR and how you exercise them please visit: https://www.worcester.ac.uk/informationassurance/requests-for-personal-data.html.

### What happens next?

Please keep this information sheet. If you do decide to take part, please either contact the researcher using the details below.

## Thank you for taking the time to read this information.

If you decide you want to take part in our project, and we hope you do, or if you have any further questions then please contact: Linda Tyrrell at TYRL1_17@uni.worc.ac.uk

If you have any concerns about the project at this point or at any later date you may contact the researcher (contact as above) or you may contact the Supervisor / Principal Investigator / Project Lead: Dr V Warrren at v.warren@worc.ac.uk

If you would like to speak to an independent person who is not a member of the research team, please contact Michelle Jellis at the University of Worcester, using the following details:

Michelle Jellis
Secretary to Research Ethics Panel for College of Business, Psychology and Sport
University of Worcester
Henwick Grove
Worcester WR2 6AJ
ethics@worc.ac.uk

# Appendix 7 - Guidelines for using Children in Research (The Society for Research in Child Development)

1) The rights of the child supersede the rights of the investigator no matter what the age of the child.

2) If there are changes in approved procedures that might affect the ethical conduct of the research, consultation with colleagues or experts should be undertaken.

3) The child should be fully informed as to the research process, and all questions should be answered in a way that can be understood. If the child is too young, the child's representative (parent or guardian) should be closely involved in all discussions.

4) Informed consent from parent, teachers, or whoever is legally responsible for the child's welfare must be obtained in writing.

5) Informed consent must also be obtained from others who are involved in the experiment (such as parents) beside the individual child.

6) The responsibilities of the child and of the investigator must be made clear.

7) When deception is necessary, a committee of the investigators' peers should approve the planned methods.

8) The finding from any study should be reported to the participants in a way that is comprehensive to them.

9) Investigators should be especially careful about the way in which they report results to children and should not present the results in the form of advice.

10) If treatments are effective, control groups should be offered similar opportunities to receive the treatment.

11) These ethical standards should be presented to students in the course of their training.

12) Editors of journals that report investigations of children should provide authors space to summarise the steps they took to ensure these standards. If it is not clear such standards were followed, editors should request additional information.

Source: Salkind, 2012, p92