

What Influences the Adoption of Innovations in Healthcare in Wales?

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I. Abstract

In a time of limited resources, but increased complexity and demand, innovation presents a pathway to improve quality and efficiency in the provision of healthcare in the National Health Service (NHS) in Wales. There is little scarcity in the availability of quality innovations to the NHS, but there is a clear gap in the ability of the organisation to effectively adopt and spread these innovations into wider use.

Research into the adoption of innovations across multiple disciplines has been extensive. Numerous influences have been investigated via mainly quantitative approaches that utilise an array of technology adoption theories. This study explored the adoption of innovation in healthcare in Wales via a pragmatic mixed methods approach using the Technology-Organisation-Environment framework as a theoretical basis.

Semi-structured open-ended interviews were conducted with participants experienced in healthcare innovation in Wales. Findings were analysed by a combination coding approach and content analysis.

Forty-four factors of influence were discovered, including sixteen novel factors that were not identified in relevant literature. The high importance of individuals and the interactions between people was easily apparent. Therefore, the conceptual framework of 'People-Organisation-Environment-Technology', or the 'POET' framework, was developed. Theoretical support for this was provided by the Socio-technical systems theory, which acknowledges the importance of people in the social subsystem of an organisation. The POET framework builds upon previous theory by adding the relative levels of importance of and overlap between the four contexts. Second stage analysis assessed the relative importance of factors, their interrelationships, and their propensity to act as barriers or enablers to adoption.

The POET framework embraces the complexity in innovation adoption in Wales and is effective for investigating and analysing cases in this setting, and has the potential for generalisability. The findings indicate that NHS Wales should invest in and investigate the influence of people to support innovation adoption.

II. Declarations and Statements

DECLARATION

This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree.

SignedHarry Bell..... (candidate)

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STATEMENT 1

This thesis is the result of my own investigations, except where otherwise stated. Where correction services have been used, the extent and nature of the correction is clearly marked in a footnote(s).

Other sources are acknowledged by footnotes giving explicit references. A bibliography is appended.

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1. Introduction

1.1. The Context of this Study

Healthcare can be defined as a service operation which has to be performed on-demand with a patient or other clinical professional present as the service user. Unlike private sector services, the health and care setting in the UK is far more complex. In fact, very little similarities exist between banking, insurance, call centre or other type of service and the professional and highly skilled nature of a health and care service. In the UK, health and care organisations can be divided into the primary setting (such as GP practices, community pharmacies) where most of the activity in the UK system happens, specialist secondary organisations (including regional and large-scale hospitals with distinct specialisations) and tertiary delivery (such as care homes or ongoing community support).

These “public” organisations which make up the National Health Service (NHS) have been in existence for over 70 years and were created by the innovations of a Welsh man and Member of Parliament, Aneurin Bevan. The British NHS was established on the 5th of July 1948 and the new service radically transformed relationships between care organisations of the time. Since this time new technologies, computerisation, and breakthrough medicines have continued to innovate and reshape the delivery of care, and its modes, locations, and efficacy. Such new innovations are also challenging as they redetermine relationships between professional staff and the actions taken for patients on their revised care journey.

The complexity of health and care processes means it represents one of the most extreme contexts for the practice of management, and a context where there is a constant flux of change. Innovation, as a process of change, and also as a means of improving the primary goal of the system: to provide care to those in most need of highest quality, is therefore fraught with potential for failure when introducing a new method or technology despite the promises heralded and offered by a new way of working to deliver superior care. Healthcare is therefore a complex and challenging domain to explore as a system (Plsek & Greenhalgh, 2001). It is also an exceedingly important system in which to provide value to end-users (i.e., patients): we have no choice but to use health services in our lives, and therefore addressing challenges and shortcomings is of paramount importance.

Innovation, defined as “a new or changed entity realising or redistributing value”, provides a route to change or introduce new technologies and ways of operating that can address issues and improve outcomes at every level of health systems from a single clinic to the system as a whole. However, as had been noted by previous authors (Blume, 1991; Gelijns and Rosenberg, 1994; Greer, 1988; Plsek and Greenhalgh, 2001; Fitzgerald et al., 2002; Greenhalgh et al., 2004; Consoli et al., 2007; Petkova et al., 2010; Kelly and Young, 2017; Collins, 2018; Rees et al., 2020), there are significant challenges in innovating within health systems, and specifically in introducing new innovations into use. The latter process is known as the ‘adoption’ of innovations and these challenges stem from multiple sources including how the technology itself radically transforms the process and the relationships between those delivering the process.

The term ‘innovation’ is very broad in the extant literatures, and it covers a multitude of forms. In this study, an ‘innovation’ refers to any new method, idea or product that can be implemented which results in a change to existing practice in a healthcare setting. The definition therefore includes material technologies such as medical devices or medicine, as well as non-material innovations such as process innovations, organisational innovations and so on. By taking a broad definition of the term innovation, a more robust and realistic assessment of the impact of innovation and its enablers could be undertaken as a means of building new theory of academic interest and also for pragmatic application by professionals when commencing the introduction of an innovation cycle.

The process of this research commenced with an exploratory review of literature to immerse the researcher within the current debates concerning innovation in the health sector and to identify existing theories which could be used to identify enablers and barriers to innovation success in this context. The overwhelming view of innovation success, as presented by key contemporary authors studying the UK adoption of innovation, was that it was frequently associated with failure and difficulty. Later exploration of the literature found much fewer papers concerning the apparent successes or failures by the health service in Wales and this confirmed the suitability of the Welsh context as a means of exploring this gap in the body of knowledge. There was a number of advantages to selecting Welsh context for this study, including the lack of previous research, reasons of access, and

the fact that Wales has a fully devolved health system with a relatively small, homogenous population.

Even though the study went on to consider adoption of any innovation in healthcare in Wales, initially the research was focused on the specific case and contingencies of ventricular assist device (VAD) innovations. These devices are artificial heart pumps for use in patients suffering from advanced heart failure. The limited nature and unique properties of this technology were well known to the researcher and were the initial motivation to address the gap in the knowledge concerning innovation and healthcare. For a number of reasons, the study's scope was broadened and enriched to include a wider set of technologies and therefore a generalised approach to theory building. VAD adoption, in the UK was retained as an illustrative case of adoption in this study due to the apparent divergence between their therapeutic value versus their rate of adoption and use in the UK which was exposed by leading authors in this field of study (Sharples et al., 2006; Westaby and Taggart, 2012; Westaby 2013; Westaby and Deng, 2013).

Reviewing the literature on technology and innovation adoption identified a key gap in the literature: the lack of model- or framework-based research in healthcare innovation adoption, the lack of development of models and frameworks which focused on the organisation (or higher) unit of analysis, rather than the individual, the lack of generalisability, comprehensiveness and consistency between research findings, and the lack of holistic approaches which embrace the complexity in this field, due in large part to the deductive approaches of empirical research using previously established variables. This gap prompted the study outlined in this thesis, which used the case of VADs in Wales as a starting point to investigate the theories, context, potential enablers, and barriers to adoption of innovations from a greater variety of sources and applications. The wide definition of such innovations for the purpose of this study were used as a basis to form an exploratory qualitative investigation to explore the main guiding research question: "What influences the adoption of innovations in healthcare in Wales?"

1.2. Wales - a Natural Laboratory for Studying Health Innovation in Context

The NHS in the UK, in common with other national healthcare systems, face significant challenges in managing the demands associated with problems including aging populations

with increasingly complex needs, and constraints including higher workforce and technology costs as well as other financial constraints (Pilemalm et al., 2016). Despite government investment in recent years, projected demands continue to outstrip the resources available to meet them (The Kings Fund, 2019). The NHS in the UK is significantly devolved to the regional authorities and is semi-autonomous from government.

The NHS in Wales is independently managed from the rest of the UK. Wales has both similar and different challenges to the rest of the UK. It has a relatively smaller population of around 3.2 million, relatively few cities and urban areas, and more rural areas which are serviced by Wales' seven health boards, which are:

- Aneurin Bevan Health Board;
- Swansea Bay University Health Board;
- Cardiff & Vale University Health Board;
- Hywel Dda Health Board;
- Cwm Taf Morgannwg Health Board;
- Betsi Cadwaladr University Health Board;
- Powys Teaching Health Board.

Contiguous with these health boards are seven Community Health Councils, which are statutory lay bodies that represent the interests of the public in the health service in their district. There are also three NHS Trusts in Wales with an all-Wales focus: the Welsh Ambulance Services Trust for emergency services, Velindre NHS Trust offering specialist services in cancer care and a range of national support services, and the new Public Health Wales.

NHS Wales receives the majority of its funding from the Welsh Government to cover the costs of running health services in Wales. This takes the following forms:

- Revenue allocations to local health boards to secure hospital, community and primary care services for their resident populations (total of £9.8bn, source: Welsh Government draft budget 2022/2023)
- Capital allocations to local health boards and NHS Trusts for operational and strategic capital developments (total of £335m, source: Welsh Government draft budget 2022/2023)

- Targeted funding for health improvement and other Welsh Government initiatives

Wales's relatively smaller, homogenous population, and high incidence of chronic diseases and co-morbidity make it a perfect 'natural laboratory' for studying health policy implementation (Bradley et al., 2014; Davies, Roderick, and Williams, 2018).

Wales has recognised the need for change in its health service to make the most effective use of available resources to ensure high quality and consistent care (Aylward, Phillips, and Howson, 2013) in a time with significant financial constraints on the budget of NHS Wales.

There have been relatively small amounts of research into innovation and its adoption in Wales, but it is recognised as a pathway to improve the health care service at many levels (Bradley et al., 2014). Therefore, the NHS in Wales presents a unique and highly important area in which to investigate the adoption of innovations.

Therefore, Wales was selected as the context of the study for this research, but also because it is a microcosm of the wider UK NHS health service with urban and rural locations operating with technologies and staff of the same professional education as anywhere else in the United Kingdom (Howson & Davies, 2018). In addition, the Welsh Government has promoted innovation in recent years as the solution to the enduring problems of an ageing population, limited fiscal budgets and skills gaps (Aylward, Phillips, and Howson, 2013).

These conditions were considered suitable to the study of the application of innovation to improve professional practice and this study offers a timely insight into such practices and their success. Furthermore, since this study was conducted at Swansea University, which has strong links with the healthcare system in Wales, there were many network links to utilise to aid in recruiting participants for the study, including individuals and organisations involved and experienced in healthcare innovation in Wales.

1.3. Innovation and the Adoption of Innovation in Healthcare

Innovation is a key driver in the aim to balance the containment of costs and the improvement of health care quality for health systems (Omachonu and Einspruch, 2010).

Innovation is a process or cycle that can be defined simply as invention, plus adoption and diffusion. Invention includes the creation of a new technology, process or idea via research and development, after which the innovation may be manufactured and/or marketed. The

next stage is the process by which the innovation is adopted and spread into wider use by its intended users (known as adoption and use, spread, or diffusion).

It is these latter stages of the innovation cycle that are of interest in this research, as they are very important in healthcare. Research and development (R&D) have not been the major issue: many high-quality innovations are developed and made available to the system, but there is a clear issue in adopting and utilising these available innovations, especially in the UK (Kelly and Young, 2017).

This concept of innovation adoption has not been frequently studied in healthcare, and there is a relative lack of literature. However, key authors have noted the difficulty and complexity involved in getting innovations adopted in this setting, which represents a significant challenge to the industry (Gelijns and Rosenburg, 1994; Fitzgerald, Ferlie, Wood, and Hawkins, 2002; Greenhalgh, Robert, Macfarlane, Bate, and Kyriakidou, 2004; Nahta and Esteva, 2007; Petkova, Schanker, Samaha, and Hansen, 2010). Therefore, it is an important area to investigate to improve the effectiveness of the innovation adoption pathway.

1.3.1. How Is Innovation Adoption Studied?

Innovation adoption is a phenomenon which affects any situation in which innovation is practiced, not only healthcare. In fact, it has been far more widely studied in other industries and settings than in healthcare, with the majority of research being conducted into the adoption of information technology innovations. Thousands of studies have been conducted via different approaches, and the field has developed across decades.

Most research utilises technology adoption theories, models, or frameworks, which conceptualise innovation adoption and can be used to empirically investigate adoption for a given innovation. Of these, most attention, research, and development has been given to technology adoption models that model an individual's likelihood to adopt and use a technology based on their perception of the characteristics of the technology. The most widely used of these has been the Technology Acceptance Model (TAM), put forward by Davis (1989).

However, when it comes to the adoption of innovation by organisations, such as in healthcare, there are often more considerations than just that of the innovation and its characteristics. Therefore, researchers also developed theories, models, and frameworks to

understand and investigate innovation adoption at the organisation level. The most utilised of these is the Technology-Organisation-Environment (TOE) framework (Tornatzky, Fleischer, and Chakrabarti, 1990), which also considers the influence of the organisation and environment on innovation adoption. After review, this framework was selected as the base of this study's investigation into innovation adoption.

The researcher initially framed the research challenge in this study by focusing on a current debate and problem, known to him, from the medical device setting: VADs. This subject area was motivational to the researcher but, after reviewing the subject of innovation adoption in healthcare, the research was broadened to address the major gap in extant knowledge concerning general patterns of successful innovation. The latter was considered to be of more contribution to the academic and professional worlds which the researcher sought to provide new insights into and to build theory in this embryonic field of study.

The adoption of VADs into practice was retained as a case study, to illustrate the problem of innovation adoption in health in the UK. An overview of this case is given in the following section.

1.4. Ventricular Assist Devices (VADs) As a Case Study to Understand Innovation and Adoption

Advanced heart failure affects around 90,000 people in the UK per year. These patients have advanced structural heart disease with severe symptoms at rest, are unresponsive to medication, have a usual life expectancy of 6 months to a year, and have very low quality of life (Westaby, 2013). There are two viable treatment options for these patients that can both improve quality of life and extend life. Heart transplantation is one, which is limited due to low numbers of donor hearts. The other option is the implantation of a VAD, which are potentially an 'off the shelf' solution, but remain of limited availability and use in the National Health Service.

For decades, heart transplantation has been established as the 'gold standard' treatment for heart failure for a carefully selected minority of patients (Alraies & Eckman, 2014), leading to extension to and increased quality of life in the majority of cases. However, transplantation itself is not the ideal treatment to meet the needs of the population. There are only of the order of 100 donor hearts available in the UK per annum

(NHS Blood and Transplant, 2015). This means that selection for transplantation has to be very strict and can only benefit a select few.

The other option is VAD implantation. VADs are a technology that have developed since the 1960s from a large, extracorporeal pneumatic device to temporarily support patients coming off cardiopulmonary bypass to small, implantable electrical devices with high durability. This, along with their comparable improvement to quality and length of life made VADs an increasingly attractive alternative or complement to transplantation.

The Interagency Registry for Mechanically Assisted Circulatory Support (INTERMACS), which has a database of over 20,000 VAD patients who have had an FDA-approved device since 2006, survival at 1 year and 2 years post-implantation of continuous-flow LVADs is 81% and 70% respectively (Kirklin et al., 2015; Kirklin et al., 2017). Furthermore, the majority of patients were transplant ineligible at the time of implant. With suitable selection, patients can survive for many years - as long as 7.5 years so far - and the survival curves for VADs and transplants are converging (Boyle et al., 2011; Kirklin et al., 2015; Pagani et al., 2009; Westaby, Banning, Neil, Poole-Wilson, & Frazier, 2010).

Even with the evidence regarding their benefits, the majority of patients, even in affluent healthcare systems, receive only palliative care when in end-stage heart failure (HF), when they could potentially have a VAD implant. This question arises: should VADs always be used to treat suitable advanced HF patients? And if so, why is this not happening widely in UK's National Health Services?

1.4.1. VADs in the UK

The United Kingdom limits funding to “bridge to transplantation” therapy, which means a person can only receive a VAD to *bridge* them until they receive their heart transplantation. This means all patients who are not eligible for a transplant cannot receive a VAD. Although the population of the UK stands at just over 67 million, the heart transplantation numbers (as in other countries) range from below 100 to around 200 per year in the whole of the UK (NHS Blood and Transplant, 2015), which cannot adequately cover treatment for the approximately 90,000 patients with advanced heart failure in the UK.

Other countries such as the USA approve other uses of VADs such as “destination therapy”, which means the implantation of the VAD is intended for lifelong use. Another example is

“bridge-to-recovery”, as some patients who receive the VAD can recover from their heart failure with the VAD support, and subsequently have the VAD removed. Like bridge-to-transplant, these therapeutic rationales have robust evidence to support their use (Boyle et al., 2011; Kirklin et al., 2015; Pagani et al., 2009; Westaby, Banning, Neil, Poole-Wilson, & Frazier, 2010).

A significant number of patients in the UK could benefit from a VAD, but access and availability are currently limited (Westaby & Taggart, 2012).

1.4.2. Questions Raised by the VAD Adoption Case

The previous sections have outlined the barriers that face clinicians and their patients in accessing this potentially lifesaving innovation, and raises the question “why are VADs not adopted and used more widely to address the unmet need in heart failure, given that there is significant evidence concerning their benefits in different areas of use over decades of research”. Was it cost? Was the evidence not good enough yet? Was it that simple? Indeed, it was these points which prompted the investigation into “why there was limited adoption and use in UK?”, which broadened into the study presented in this thesis. The decision to take a more managerial perspective to the subject was taken because many of the specific issues affecting VADs appeared, through the literature search, to be common with other technological and process-based settings for healthcare innovations. The ‘gap’ therefore existed across settings and a more generalist approach to the subject and a parallel increase to the contribution made by this study was duly accepted and undertaken.

1.5. The Gap

The gap in the literature therefore concerns the management of innovation processes within a health and care system. This system covers many levels (national, regional and local/immediate levels) and, despite government policies to promote innovation, professional body support for innovations in practice, and new technology, the subject remains confused and in need of theory building research to explore the elements of the innovation problem and how these can be framed to assist academics and professionals to improve performance across the levels identified earlier. The gap is expressed in the following research question and sub-questions:

1. What influences innovation adoption in healthcare in Wales?

Sub-questions underneath this include

- a. Which factors that have been previously identified in literature will also be identified as relevant in healthcare in Wales?”
- b. Are there factors that have not been identified or adequately explored in healthcare in Wales?
- c. What are the levels of importance and relevance of the factors that influence innovation?
- d. How do these factors influence and relate to one another?
- e. How are these potential factors affected by circumstances, setting and contexts, and what is the importance of these?

1.6. Personal Motivations

The researcher has always been surrounded by discussions of medical practice as the result of living in a family where many members work or have worked in the NHS. In his employment he is also surrounded by academics who study and professionals who practice innovation in the health and care setting as well. As such his goal has always been to understand how innovation can be positively harnessed and what prevents or slows the passage of innovations into practice.

1.7. Structure of the Thesis

This thesis is structured as an incremental narrative which commences with Chapter 1 which has “set the scene” and introduced the reader to the key subject of innovation in health and care, presented the need for contextually rich understanding of the issues and enablers of innovation process management and declared the guiding research questions of this study. These subjects will be returned to later in the thesis.

Chapter 2 provides an account of the debates in the subject of innovation management which have been identified by a traditional literature review drawing from established repositories of academic and other publications. The review includes a review of innovation management and adoption of innovation within healthcare, previous studies into innovation using technology adoption models, and a review of those models. The literature review is used to show the gap in the body of knowledge and to articulate the contribution sought by the researcher.

Chapter 3 provides the answer to 'how' the study was designed and how the methodology can be defended in terms of traditions of theory building and context-rich accounts of how systems and practices enable or inhibit innovation management. The chapter will defend the methods used (and their selection) as well as declare the limitations and ethical considerations of the study.

Chapter 4 presents the results and analysis of the qualitative interviews undertaken by the researcher and uses data displays of the interviews to show common and outlier views of the subject from purposively selected expert informants.

Chapter 5 presents the analysis and discussion of the thesis and its new insights that both conform the relevancy of the existing literature and how this study adds to this body of knowledge with new insights and also an explanation, using background theory, as to why this socio-technical system is sub-optimised.

Chapter 6 brings the doctoral journey and contribution of the study to a conclusion. The chapter will present a summary of the findings, the resultant contributions to theory, a reflection on the research journey, and the implications of the study for stakeholders that include lecturers, researchers, policymakers, and professionals. The chapter will end with the identification of future research projects that both extend the work in this thesis and counter the limitations present in this study.

The remaining elements of this thesis present the References and Appendices in order to provide a quality-assured audit trail of supporting evidence.

[1.7.1. Important note on the Appendices](#)

The Appendices contain substantive work which supports the work in the main body of the thesis, particularly the Results and Analysis (Chapter 4). Each time the reader should refer to an Appendix it is referenced in the text of the thesis. Most Appendices are referenced multiple times in the text, but are usually associated with one chapter and/or section most significantly. Table 1 below indicates the main chapter and section(s) that each Appendix corresponds with.

Table 1. Main Section in the thesis that each Appendix corresponds to.

Appendix	Main Section	Referred to in:
8.1. Appendix A – Theoretical basis for the Technology-Organisation-Environment framework (pages 232-257)	2.2.4 The Technology-Organisation-Environment framework	Chapters 2 and 5.
8.2. Appendix B – Table of examples of empirical technology adoption studies that utilise the TOE framework or related theoretical basis (pages 258-267)	2.2.4 The Technology-Organisation-Environment framework	Chapters 2, 3 and 5.
8.3. Appendix C – Interviewee participants' career history and experience (pages 268-269)	3.4.5. Final Data Collection Method – Semi-structured interview	Chapters 3, 4, and 5
8.4. Appendix D – Interview Questionnaire Framework: Adoption of Innovation in Healthcare in Wales (pages 270-273)	3.4.5. Final Data Collection Method – Semi-structured interview	Chapter 3.
8.5. Appendix E – Table of Codes Discovered via Interviews – First Cycle Coding (pages 274-279)	4.1.1. Codes discovered via interview – First Cycle Coding	Chapters 3, 4 and 5.
8.6. Appendix F – POET Context Coding Display - Second Cycle Coding (pages 280-282)	4.2. People, Organisation, Environment, Technology – the four types of context encountered in this study	Chapters 4 and 5.
8.7. Appendix G – POET Contexts Coding Interrelationships Matrix Display (page 283)	4.2.4. POET Context Coding Interrelatedness Matrix	Chapters 4 and 5.
8.8. Appendix H – Analysis of all Factors by Context (pages 284-415)	4.3 Detailed analysis of all 44 factors in each context	Chapters 4 and 5.
8.9. Appendix I – Master Data Capture Display (page 416)	No main section	Chapters 3, 4 and 5
8.10. Appendix J – Relative Importance of Factors (pages 417-426)	4.4. Relative importance of factors	Chapters 4, 5 and 6.
8.11. Appendix K – Interrelationships of Factors (pages 427-433)	4.5. Factor interrelatedness	Chapters 4, 5, and 6.
8.12. Appendix L – Barriers and Enablers - Number of statements recorded for each factor with enabler and barrier codes (pages 434-436)	4.6. Enablers and Barriers	Chapters 4, 5 and 6.
8.13. Appendix M – Comparing factors found in this study to literature (pages 437-454)	5.3. The influences on adoption of health innovation in Wales – the 44 factors	Chapters 5 and 6.

2. Literature Review

This chapter reviews the relevant literature for this study. Section 2.1 and its subsections explores healthcare innovation and adoption literature. Section 2.2 and its subsections reviews the theories, models and frameworks that have been used to study innovation adoption in any field, with particular focus on the Technology-Organisation-Environment (TOE) framework. Section 2.3 and its subsections review the Socio-Technical Systems (STS) theory, and then Section 2.4 goes on to compare the TOE framework and STS theory. Finally, Section 2.5 presents the conclusions of the literature review, and Section 2.6 outlines the Research Questions of this study which arose from this review.

2.1. Diffusion of Innovation in Healthcare

The practice of healthcare is one of the world's largest and fastest-growing industries fuelled by demands from an ageing population, co-morbidities, improved detection technology and other factors. It encompasses numerous sectors that all work to provide for the health needs of individuals and populations. Innovation continues to be a key driver in the aim to balance the containment of costs and the improvement of health care quality for health systems (Omachonu and Einspruch, 2010) and also to exploit the opportunities of new technology, new processes and the adoption of best practices that are shared by fellow professionals and professional bodies. In healthcare, an innovation in professional practice may be described as a novel idea, product, service, or care pathway that has clear benefits when compared to what is currently undertaken (improved efficacy, safety, quality and so on).

In the practice of healthcare, the process of innovation introduction refers to the entire process from the conception of the idea of a new technology to its (widespread) adoption and use in clinical practice. The process can be modelled in a simple linear manner, from

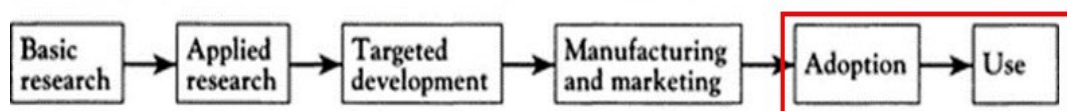


Figure 1. A linear model of medical innovation, highlighting the latter stages ‘adoption’ and ‘use’ as of key interest to this research. Figure adapted from Gelijns & Rosenberg, (1994).

basic research through applied research, targeted development, manufacturing and marketing, adoption and finally its wider use. However, the process is not always likely to be that simple, and is often more dynamic and iterative (Gelijns & Rosenberg, 1994). For the purpose of this research, it is the latter stages of the cycle that is of interest: the 'adoption' and 'use' of innovations where there is less evolution to the process and the innovation is ready for implementation within practice.

At this stage of the innovation process there is less modification to the innovation, the scope and specification of the technological innovation is known, and professionals can (and are permitted to) apply the technology in practice. This is also known as the 'diffusion of innovations' (among other terminology) and can differ across the numerous fields that this concept has been studied under, and this will be discussed in this section.

The importance of these latter stages of the innovation process (adoption and use), is highly significant. There are myriad technologies and innovations that have been invented, developed, and tested globally but the health and care industry has been slow to adopt and utilise all that is available and that could improve outcomes for patients and/or efficiency for health systems. This is especially true for the UK's NHS, which has historically led the world in inventing and testing new innovations but has struggled with adoption and diffusion of innovations (Kelly and Young 2017). This has been a widely studied issue across numerous sectors including healthcare, with thousands of studies being conducted via different approaches across decades of development (Greenhalgh et al 2004). Yet the issue of innovation adoption remains, especially in the UK (Kelly and Young 2017). This is why the focus of this study concerns innovations which are available and "practically ready" for implementation, adoption, and use (such as VADs), and this literature review will review the key research in this field focused on healthcare.

2.1.1. Key Papers in healthcare innovation adoption

During the literature review, the researcher reviewed his extractions from various publication databases and repositories (including the Swansea University iFind technology platform). Google Scholar was also used as a search engine to determine the most cited and influential publications (reports or journal papers by leading organisations/academics).

Presented and explored in this section are the key papers in the healthcare innovation literature that had most relevancy to this study, were most widely cited and of highest quality. These papers most strongly helped shape the research questions, methodology and approach of this study. The reason for including these papers here at the beginning of the literature review is to highlight the numerous potential influences on innovation adoption in healthcare, its complexity and variety, and other important relevant concepts. The following sections under 2.1 (2.1.2-2.1.6) then expand further on healthcare innovation and adoption.

2.1.1.1. Petkova, Schanker, Samaha, and Hansen, 2010

In 2010, the world health organisation (WHO) published a paper which highlights and discusses the barriers to innovation in healthcare and also gave some potential avenues to investigate with respect the adoption of innovations in healthcare (Petkova, Schanker, Samaha, & Hansen, 2010).

Amongst some of the questions these authors asked in their review those relevant to consider in innovation adoption for this study, are ‘what are the barriers reported in the literature?’, ‘Why are medical devices available on the market not being used more widely in healthcare?’, ‘What are the barriers to diffusion?’ (Petkova, et al., 2010). Many other aspects were raised by the paper were relevant but less important for the *adoption of innovation* stage of the process because they pertain more to the innovation process as a whole (such as ‘trends in development of medical devices’, ‘barriers to innovation’, ‘stakeholders in innovation’, ‘innovation lifecycle’).

This paper was an early find in this review of literature and helped identify further avenues for investigation as well as begin framing this study by noting the challenges and complexities in innovating in healthcare as well as identifying a number of barriers that can inhibit the successful adoption of innovations.

The “innovation diffusion” or “technology adoption” research discussed in the paper and its literature foundation crosses multiple academic disciplines – from sociology, to medicine, psychology, communication studies, economics, political science, information and communications technology (Petkova, et al., 2010). The approach is therefore holistic and addresses technology adoption from a systems perspective. Each discipline has tended to conceptualise the topic differently and subsequently different terminology is also used. For

example: ‘dissemination’, ‘implementation’, ‘adoption’, ‘adaptation’, ‘use’, ‘reach’, ‘uptake’, ‘spread’, ‘translation’, or ‘transfer’ of new ideas, knowledge, technology, systems and so on (Petkova, et al., 2010). Different areas also use different criteria to assess the success and/or quality of the diffusion, or extent to which a technology has ‘diffused’ into practice.

Sometimes the mechanisms that innovation spreads by are differentiated between diffusion (passive adoption by individuals and organisations) or dissemination (active attempt to influence the rate and success of adoption) (Greenhalgh et al., 2004).

Health care is an interesting context in which to explore the development of technology for a number of reasons which can be grouped under three broad assertions:

1. Medical innovation often occurs differently than in other industries/sectors due to emotional factors attached to the concept of health and illness and the political commitment to offer citizens the latest advancements in medicine (Roberts, 1981).

2. Novel biomedical technologies often have the two major features: representing the promise of longer and/or higher quality of life, while being associated with prohibitive cost of care and services. As mentioned, in the context of limited/scarce resources and attempts to reduce expenditure, health policy- and decision makers must prioritise and therefore some technologies may ‘diffuse’, and others do not (Petkova et al. 2010).

3. There is perceived to be a gap between the ‘best evidence’ and ‘evidence-based practice’. Technology with reported clinical validity in initial studies and clinical trials often fail to subsequently integrate into medical use, thus preventing patients from benefiting from the best scientific advances (Lang et al. 2007). This raises questions of why clinical evidence alone appears to be insufficient to ‘push’ forward innovation, and what other factors may exist that act as barriers to the ‘diffusion’ or ‘adoption’ of medical device technology (Petkova, et al., 2010).

2.1.1.2. Fitzgerald, Ferlie, Wood and Hawkins, 2002

In 2002, a research paper by Fitzgerald et al., found that *“health care is an interesting and complex domain containing a diverse set of groups who have a role to play in the decision-making processes around new innovations in healthcare”*. The authors highlight the medical profession as highly interactive involving decisions to adopt an innovation at the local level; achieved mainly via inter-professional alliances and networks for change, which may either

facilitate or inhibit diffusion (Fitzgerald, Ferlie, Wood, & Hawkins, 2002). They also note the ambiguity and contention surrounding new scientific knowledge as a barrier to diffusion, and that successful diffusion depends on highly interactive analysis and collaboration between professionals and involves 'active adopters' who serve as 'role models' and 'go to see' sites where the innovation can be seen in practice. Upon reflection by the researcher, no evidence from the literature shows that innovation is a linear process where there is a single 'adoption decision' in that process, rather the science is socially mediated, and the features of the context (e.g., attitude to new technology, controversy, evidence base) and the actors (e.g., medical professionals) interlock to influence diffusion. The latter insight into the dynamics of the innovation process emphasises the role of people in process and potentials for conflict which would prevent adoption if social interactions failed or generate concerns/conflict.

Fitzgerald and colleagues (2002) reviewed and discussed the diffusion processes of eight different healthcare innovations in the United Kingdom. The study focused on two sectors of healthcare: acute and primary admissions settings. It should be noted that the eight innovations also varied in the strength of the scientific evidence supporting them. The aim of the researchers was to deduce the extent to which scientific proof would affect diffusion as an influencer which could persuade participants in the innovation process to introduce the innovation. However, the study found little correlation between strong scientific evidence and opportunities for widespread adoption of medical innovation which implies that successful introduction is context and actor specific.

One case example cited in the research was the use of heparin (anti-coagulant) following surgery. Although there was much supporting evidence concerning its use, it was surrounded by continuous controversy, and thus at the time of their publishing they asserted that it remained in the "debated" stage (Fitzgerald, et al., 2002). The use of the term 'debated' summarised a set of differences and identifies that there could be a reluctance to adopt an innovation where there is controversy surrounding an innovation, regardless of the source and regardless of the quality of evidence supporting it. This again shows the strong influence of factors unrelated to an innovation's evidence or cost affecting its actual adoption and use. Data alone was not enough to persuade actors that they should

engage with the innovation, with their potential fears being risk to the patient or their own professional standing.

Another example case from their research paper concerned an innovation that failed to diffuse widely due to a lack of convincing clinical evidence: computer support systems. In this application the technology was to be applied to diabetes treatment in primary care setting. The latter finding suggests that innovation which are perceived to fail to meet scientific justification and robustness will be rejected by professionals in practice. The finding supports the view that innovations which do not support superior decision-making or fails to pass a 'personal risk assessment' conducted by the professional may fail. In this case example, the St. Vincent Declaration (1989) set out a directive outlining the standard of care for diabetes which was supported by robust evidence. However, many general practitioners thought the evidence was irrelevant to their primary care patients and believed that the standard was mainly applicable to acute cases of diabetes and context-specific to the engagement of those with specialist skills concerning the condition. Due to this, the standard did not reach wide acceptance. This has implications for the adoption of such innovations (concerning the same condition) in different settings. This again highlights the problem of the ambiguity surrounding new knowledge, and how it can be interpreted differently depending on its context, which ultimately affects how well the innovation is adopted into daily use (Fitzgerald, et al., 2002; Petkova, et al., 2010). The latter finding has significant influence on this study and the need for a contextually rich understanding of the innovation implementation process especially in the latter two stages of the linear process.

2.1.1.3. Gelijns and Rosenberg, 1994

In a different vein, a health-economics study exploring the impact of technological innovations on rising health care spending showed that the rate of innovation is sensitive to changes in the financing and delivery of healthcare, such as the level of reimbursement that new interventions are able to obtain (though this is only relevant in systems where insurance companies reimburse physicians for using certain procedures, i.e., the United States). If there are higher reimbursement rates, then the technology is more likely to be adopted and undergo further innovation (Gelijns & Rosenberg, 1994).

The same study also discusses other key factors related to the diffusion of technological innovation in healthcare. For example, the extent to which a technology or medical device

undergoes competition over price and operating costs. They suggested that research and development into 'cost-increasing' (but quality-increasing) technologies, such as artificial organs (such as VADs) would become less attractive (Gelijns & Rosenberg, 1994). However, that was in 1994, and there has been more improvement and development in VAD technology for the past 20 years than in any decades previously (though this may not be the trend for all artificial organs, and they do mention the difficulty in predicting the eventual success or failure of medical innovations).

Another factor that Gelijns and Rosenberg (1994) discuss is the competition between different medical specialties and its effects on technological or medical care funding. The behaviour of practitioners tends to be shaped by the way in which medicine is divided into specialties and subspecialties. This is increasingly pertinent in a medical condition that can be treated by multiple specialties which may want to use alternate or competing treatments. Take heart failure for example, cardiologists may lean toward medical treatment, surgeons toward surgery), and if all else fails the patient will be sent to transplant specialists if deemed appropriate or palliative care physicians if they are not. Or they could receive a VAD, but who carries this out? This raises another important point concerning the specialisation and training of clinicians in carrying out VAD implantation.

In one example they cite, Gelijns and Rosenberg discuss the treatment of gallstones. Briefly: the treatment was almost entirely dominated by surgical procedure (developed and improved over time): removing the gall bladder. In the 1970s, this began to change when a key figure in the field of gastroenterology urged an increase in research into gallstone-dissolving drugs, which eventually resulted in a drug that looked like it could threaten the surgical treatment seen as the 'gold standard' (lithotripter, mid-1980s). However, this drug wasn't good as potentially thought, but it did serve to increase competitive pressure on the surgical field. They responded by adopting and adapting laparoscopic tools used by gynaecologists for decades. Videos were then shown of the first new procedures by surgeon-innovators and device companies at surgical society meetings in 1989, and subsequently the procedure underwent a breathtakingly rapid rate of diffusion with over half of general surgeons in the US acquiring the skills in 18 months. (Gelijns & Rosenberg, 1994). This example highlights how competitive pressure within the field can also affect diffusion of innovations. The main three mechanisms for adoption Gelijns and Rosenberg

identify in their paper are ‘variations in intensity of use’, ‘introduction of new technologies’, ‘expansions of indications of use’ (Gelijns & Rosenberg, 1994).

2.1.1.4. Nahta and Esteva, 2007

Nahta and Esteva (2007) identified other social forces and/or contingencies (accidents) that also affect the decisions concerning technology adoption and its accepted use. This includes cases where robust evidence may confirm (or reject) the need for an innovative approach. However, these authors found it is not sufficient for diffusion to take place unless the innovation was reviewed within the context to which the innovation was to be applied. Another cited example was the use of Trastuzumab® – a drug for the aggressive Her2 form of breast cancer – in the UK (Nahta and Esteva, 2007). This case attracted negative media attention due to a series of legal contestations and appeals over the restricted availability of the drug through the NHS. Initially, the medication was only licensed for the treatment of advanced breast cancer that had spread in the breast (or to one other organ only). Based on clinical evidence on the drug’s efficacy provided by the National Institute for Health and Care Excellence (NICE). NICE is an executive non-departmental public body of the UK Department of Health and Social Care in England which publishes guidelines in the use of new and existing health technologies (e.g., medicines, procedures, practice). As a result of the issues with this drug’s availability, many patients in the early stages that could benefit from the drug of this type applied for breast cancer were refused access to the medication. Even in cases where their cancer specialist had recommended it, the drug was not approved for use. Cancer charities criticised this restrictive policy and the “postcode lottery- like” provision of the drug, where it was given to 90% of early-stage patients in some areas of England and only 10% in others. Due to the sustained pressure of clinicians, patients and patient groups, politicians and the public, NICE issued its final guidance on the drug in 2006, extending its approval to early-stage patients as well as advanced (Nahta & Esteva, 2007; Petkova, et al., 2010).

This drug case study example highlights the issues associated with the diffusion of medical innovations, even where leading clinical specialists have accepted the innovation as the option they wish to use, can be a highly contested area of decision-making. As such it would appear that factors (some hard and scientific and some softer interrelationship based) are broad in number and it is not entirely clear which (or which combination of factors such as

clinical evidence, technical attributes, and available data on cost-effectiveness) really and directly influence innovation adoption, and directly or partially influence actual implementation. It suggests diffusion is affected also by a broader context, such as stakeholders' interests, the political climate (temporal), and public expectations.

The sad reality is, as Petkova, et al., (2010) argue, relatively few technological innovations actually accomplish their intended use, as originally meant by the designer and others 'drift' into other applications or rapidly become legacies where work-arounds are introduced. The latter finding is a shocking result and one that expresses and frames the research gap – even the most logical and beneficial innovations could fail to be introduced.

There are other empirical studies that identify many cases where a technology/treatment with validated evidence fails to reach widespread implementation (e.g., Meyer and Goes, 1988; Champagne et al., 1991; Hughes et al., 2002; Lang, Wyer and Haynes, 2007). For example, the case of the Ottawa Ankle Rules: a highly sensitive bedside diagnostic method for appropriate referral for X-ray (first derived in early 1990s). Despite systematically reported diagnostic accuracy of this method (98% sensitivity, 32% specificity) and high acceptance by patients and healthcare staff, the clinical uptake of the method was inconsistent and the use in clinical practice remained low (Lang, Wyer, & Haynes, 2007; Petkova, et al., 2010). This type of example, like those of Fitzgerald and colleagues (2002) described previously, reinforces the point that a clinical evidence base alone is often insufficient to achieve widespread use of a technology (or other treatment). As such the logical scientific model which is implied in most works (outside of the health and care context) does not appear to be as influential as suggested.

2.1.1.5. Greenhalgh, Robert, Macfarlane, Bate, and Kyriakidou, 2004

Greenhalgh is a prolific author and researcher and in another very important and informative key paper, she addressed the adoption of innovation in UK healthcare (and other service organisations). Greenhalgh et al., (2004) presented an extensive and systematic literature review of hundreds of empirical studies in the subject area, stratified by design and approach, as well as scientific quality. Their research led to an extensive list of influences on the diffusion of innovations in service organisations which, along with theoretical underpinning, they used to develop a parsimonious and evidence-based model to consider this concept (see Figure 2). There are numerous influences identified by the

study that influence the adoption of innovations, grouped under a number of 'components' or 'bundles'. These include 'the innovation' (factors directly related to the innovation and its characteristics), 'adoption by individuals' (factors related to the characteristics of the individual adopter), 'assimilation by the system' (how organisations adopt innovations), 'Diffusion and Dissemination' (factors related to whether adoption happens 'naturally' or is actively influenced/planned), 'System antecedents for innovation' (factors related to how characteristics of organisations influence adoption), 'System readiness for innovation' (factors related to how ready or willing an organisation is to adopt an innovation), 'Outer context: Interorganizational Networks and Collaboration' (how external influences affect organisations adoption of innovations), 'Implementation and Routinization' (factors that influence how organisations move from initial adoption to routine use of innovation), and 'Linkage among components of the model' (how links between different components of their model can influence innovation). The contribution of the Greenhalgh et al (2004) study

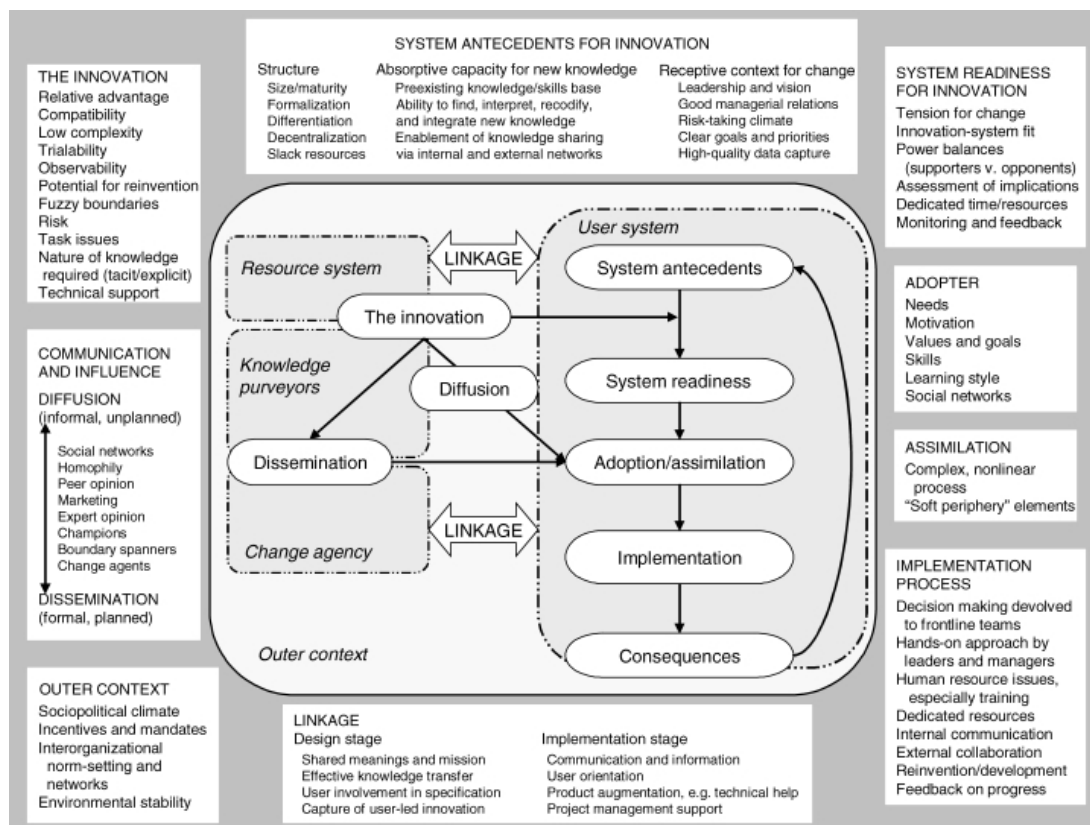


Figure 2. Conceptual Model for Considering the Determinants of Diffusion, Dissemination, and Implementation of Innovations in Health Service Delivery and Organization, Based on a Systematic Review of Empirical Research Studies. From Greenhalgh et al., 2004.

offered a number of new dimensions that help to frame the process and pitfalls of innovation in the NHS. It continued a rich vein of studies that have tried to explore the contingencies and dysfunctions of innovation in the health care context.

As can be seen by Greenhalgh and colleagues' review, there are potentially numerous influences on the adoption of innovation in healthcare organisations, which go far beyond the simple influences suggested at the start of this review. This gives further credence to the need for researching this complex and complicated domain from a holistic point, as the authors themselves state, their model should "be seen as "illuminating the problem and raising areas to consider" rather than "providing the definitive answers"". They go on to say that the components of their model do not represent a comprehensive list of the influences of innovation adoption but are rather the areas on which research has been undertaken and findings published. They note gaps in the literature in areas such as "adopter traits", "internal politics", and "Power relations" which have the potential to be critical to successful adoption and use (Champagne et al. 1991; Hughes et al. 2002; Greenhalgh et al. 2004).

Greenhalgh et al. (2004) also clearly identify the limited number of studies that acknowledge, let alone empirically research, the complexities of spreading and sustaining innovation in healthcare organisations. The majority of studies, the researcher concludes, concentrate on relatively few components, and fail to account for interactions between components or their contextual and contingent features. The latter represents a significant gap in the body of knowledge to which previous empirical research and rich case studies have failed to close. The reason for this gap found by previous researchers is usually that it is difficult to identify and scientifically control for 'confounding variables' to improve the objectivity of any research. Using hypotheses and a traditional positivistic approach would appear a blunt way of studying a subject that is dynamic and evolving. Further, the use of case studies without generalisation means common patterns between settings and new 'outliers;' of very high or very low performance concerning innovation adoption are largely discounted or absent from the literature. In this manner studies have not used the outcomes of previous research and their calibrated methods to apply to new or groups of new cases for the purpose of theory building and generalisation. This current state of knowledge is a problem because context and confounders are inextricably linked to adoption and the use of complex innovations in a dynamic health setting. From the previous

published research, it was seen that influences are likely to interact in numerous and often unpredictable ways in different settings and contexts, and that this dynamism should be a part of the research process and not controlled for. Greenhalgh et al., (2004) concurred and recommended that future research, to extend their own, should be:

- Theory-driven.
- Process rather than 'package' oriented - (i.e., avoid questions framed in terms of causal inferences, and instead framed so as to illuminate a process) for example ask, "what factors influence successful innovation adoption in this setting?" rather than "does X innovation work?", "does Y strategy have this effect?".
- Ecological – understand and explore the effect of setting.
- Addressed using common definitions, measures and tools.
- Collaborative and coordinated – so that impact of place, setting and context can be studied systematically.
- Multidisciplinary and multimethod: recognise the inherent limitations of experimental approaches to researching open systems and embrace a broad range of research methods emphasising interpretive approaches.
- Meticulously detailed: document all aspects of different innovation adoptions to capture everything relevant including contextual and setting-specific information.
- Participatory: engage "on the ground" healthcare and other service practitioners and other relevant stakeholders in innovation adoption processes.

These points were duly noted and accepted by the researcher in his later approach to this study and its methodological design (covered in Chapter 3). The findings of the Greenhalgh et al., (2004) study also showed that a few factors that were present or absent from an adoption and implementation of innovation would be insufficient explanators as to success or failure of that implemented innovation. However, Greenhalgh et al., (2004) did not offer an exhaustive list of such powerful drivers but instead call for more research in this subject area.

In summary, the seminal studies of pragmatic innovation adoption practice show significant variance and conflict in terms of what the process is and how influencing factors (and combinations of factors) explain adoption or a failed attempt to engage in such change. The

next section will explore more of the elements of medical innovation now that the ‘scene’ has been set.

2.1.2. Changing Composition of Users of Medical Innovations

Medical professionals are not the only important participants in the process of the diffusion of innovations in the health sector. Various stakeholders exist and exert influence on ‘the process’ of innovation, for example: patients, health economists, government officials, managers, insurers (in the private care sectors), and regulators have all become increasingly important in identifying demands for new technologies, in deciding which services will be integrated into mainstream care, and how those services will be used, distributed, financed, evaluated, and monitored. Consequently, there has been a shift in the determinants of the diffusion of innovation from factors including clinical evidence and rational decisions made by doctors and scientists, to factors like economic cost-efficiency and socio-political considerations, such as equality of access, and involving non-clinicians in the decision-making process of adoption (Petkova, et al., 2010). The time where “*an extreme information asymmetry between physician and patient*” (Gelijns & Rosenberg, 1994) was the norm is largely an historical account, and the power of clinical professionals in determining the success of and demand for novel techniques has reduced, whereas patients have now become active participants in decisions about health and access to state-of-the-art services and their relative power has increased – especially in the private medical setting and the role of the regulator/procurement bodies has also increased (Petkova, et al., 2010).

However, even in light of these changes, it was found that medical professionals do still retain their “*medical mode of control*” (Blume, 1991) and have powers to facilitate or block innovations especially by presenting questions concerning the efficacy of any proposed innovation.

For many clinicians, innovation is seen as a way to achieve higher quality of care, but also as a source of prestige, status or distinction (Petkova, et al., 2010). These qualities in a medical professional, scientist (or group thereof) can attract research grants – particularly in public care systems such as the NHS, but also in private systems (e.g., where a private facility could try to increase its market share by offering ‘customers’ more state-of-the-art technologies). As such pioneers of different successful innovations are littered throughout NHS history

(such as transplant surgeons, early clinicians involved with pacemaker technologies, fertility and many other applications that have been led by charismatic and dogmatic clinical innovators). These individualistic leadership (even rogue and risky) personal behaviours cannot be removed from any study or innovation, therefore.

Another key determinant of the diffusion of innovations is the mechanism of payment for medical services in different health care systems. In countries such as Germany for example, where insurance companies act as third-party payers of services, patients and medical practitioners are separated, to an extent, from the financial implications of their decisions. This has changed over time because costs increased and more of that cost was shared by patients, in the form of co-payments (Lungen et al., 2004). There was also a reduction of the number of reimbursable services as part of compulsory care. This relationship between innovation in care and the financing of services will be dependent on the way the health care system is organised in that country. In this manner, an innovation may be available and exploitable but the “approval to purchase” process may well be limited by financial actors in the healthcare system. Organisations that use competitive tendering or will procure only from existing suppliers are therefore likely to block the innovations of smaller companies and even spin-out companies that have been established by professional clinicians to make and sell or disseminate their own innovations to practice. The researcher reflected that these ‘hidden’ influences were present in most previous studies but had been largely ignored because most studies focused on the role of the clinician in determining the innovations they were prepared to accept to their practices. The omission of these broader influencers therefore severely limits the utility of previous studies and gives only a partial account of the reality of sources of barriers to healthcare innovation adoption. The implication was that a truly systems approach would need to be adopted if meaningful progress was to be made to close the current knowledge gap.

Key stakeholders, those regarded as having the greatest influence on adoption, involved in the innovation process include medical professionals: general practitioners, specialists (e.g., surgeons, anaesthetists), allied health professionals (e.g., nurses), professional societies; patients: individuals or organisations; family members, caregivers, academic researchers, biomedical researchers. All of the previous stakeholders could come under the definition of

‘users’ of the technology, other stakeholders include manufacturers; vendors/distributors; international regulators; national/domestic regulators; health ministry.

2.1.3. Costs Associated With Medical Devices and Other Innovations That Can Affect Their Adoption and Wider Use

The previous section has identified persons and organisational collectives that have a bearing on innovation adoption, but they do not have exclusive determination of adoption. All innovations have costs associated with their implementation and use which may influence adoption, but medical device innovations have some unique issues related in addition to those that other types of innovation may face.

The cost involved in purchasing a medical device can be a barrier to their adoption and use. However, the one-off capital cost of purchasing a device is often not the only cost associated with that device. Other costs can include service contracts, spare parts, depreciation, consumables (e.g., accessories such as needles), training, etc (Cheng, 2007). These costs can often be recurrent and add up considerably. This section will discuss them and their possible effect on innovation adoption.

When devices are first put into operation most will function effectively, but after a certain period some components may need replacing. If these spare parts are prohibitively costly, or are no longer produced, or if the part is difficult to replace, then they can potentially act as a barrier to adoption – especially if there were any concerns over the reliability of the device in the first place (Malkin, 2007; Free, 1992). In the case of VADs, any component of the internal pump mechanism needing replacing would be both difficult and costly (and risky) as it would require a second surgery to remove the pump. In any case, the standard procedure is to replace the VAD for an entirely new one, so a large emphasis was placed on increasing the durability of VADs, which has been achieved as the technology improved (Westaby and Deng 2013). However, the external components of the VAD, the controller and the batteries and controller could be more easily replaced and less costly. Therefore, in the case of VADs, spare part cost could be less likely to be a barrier compared the cost of device.

Consumables are required for the appropriate use of some medical devices. These can vary in their recurrent costs, for example intravenous (IV) infusion pumps require replacement IV

sets (Cheng, 2007; Petkova, et al., 2010), which are likely to be more expensive than the replacement dressings needed in the case of VADs, for the area where the percutaneous power lead exits the body.

Relevant training, skills, expertise, and knowledge are also another source of cost related to adoption, as well as being a barrier to adoption in their own right. Of course, the two go hand-in-hand because any gap in skills will need to be filled with training, which costs money to implement (Dankelman, 2010).

2.1.4. Healthcare and Innovation Landscape in the UK

The context of an innovation has been identified as an important element in determining whether adoption would occur or not. The UK has a distinct form of healthcare system and delivery process which is funded by taxpayers as a nation and focuses largely on the value for money extracted by spending budgets rather than profitability. Healthcare is provided by the NHS generally free at the point of care. It differs from many other healthcare systems as it is wholly funded through taxation rather than health insurance. Each devolved government of the UK operates its own NHS - in Wales there is NHS Wales. There is also a smaller private healthcare sector in the UK which people can choose to use if they wish. Each NHS in each devolved region of the UK are complex and complicated group of organisations and sub-organisations which all serve different purposes and roles.

The latest healthcare expenditure statistics in the UK estimated expenditure at £269 billion in 2020, 12.8% of the UK's Gross domestic product (Office for National Statistics, 2021).

NICE are the body in the UK that provides evidence-based guidance on medicines and interventions (and their cost-effectiveness) that can be used in the NHS – they do not decide on funding but do suggest where and how procedures should be carried out. The organisations within the NHS that plan, secure, and deliver healthcare services use this guidance, their specific clinical demands, and their expertise to decide which procedures are funded in their region. They also take cost into account and since there is normally not enough money to fund all effective procedures and medicines, they must make the tough decisions on which clinically effective treatments will be funded, and which will not. In England this is done by regional clinical commissioning groups and in Wales by the seven local health boards (LHBs).

Innovating in healthcare, whether it is by a novel idea, product, service, or care pathway is a way to improve outcomes or provide clear benefits over what is currently done. As mentioned, the NHS and its academic partners have historically been world leading in inventing and testing innovations but struggles to adopt and use innovations across the healthcare system. Essentially the problem is not lack of technology or innovations, but lack of or poor adoption and use of available technologies or innovations.

Kelly & Young (2017) outline a number of key challenges that the NHS faces in innovating, which includes the fact that budgets are limited, demand is increasing (due to ageing population, often with multiple co-morbidities), staff under increasing pressure, public expectation rising. It also suffers from lack of acceptance of failure as part of innovation process – if a clinician, trust, or commissioning group tries to make an innovative change and fails, the repercussions can be considerable. Further issues are outlined in Kelly and Young (2017).

It should also be noted that the trend in purchasing and supply chains of large healthcare providers is to buy existing product and material needs from large-scale retailers of such products. Purchasing from number of different innovators (as new companies) would necessitate new working relationships with small and often start-up businesses, or businesses that do not offer a range of products but just one innovation. Modern purchasing departments are often ill-equipped to manage such suppliers or ensure they meet the contractual standards expected of a 'mainstream' NHS supplier of more 'commodity-like' products (Department of Health, 2013; Boulding and Hinrichs-Krapels, 2021).

As mentioned, the NHS budget is estimated to be at £269 billion in 2020 (Office for National Statistics, 2021). The latest annual spending on research, development, and knowledge transfer (i.e., innovation) was just over £1.2 billion in 2019 (Office for National Statistics, 2021), this means less than 1% of total expenditure on NHS is on innovation. Furthermore, even less of that is spent on the adoption and spread of innovation: the approximate annual spend to support adoption and spread of innovation in the NHS through the Academic Health Science Networks was £50 million from 2013 to 2018 (NHS England, 2017). This is just over 4% of the annual expenditure on innovation. It is likely that if the NHS continues to set aside such low percentage of available resources for adoption and spread of innovation,

the NHS's operating units will struggle to adopt large numbers of innovations. As a comparison, some private multi-nationals which set aside up to 25 % of their turnover to promote their innovations, sometimes more than they commit to research and development (Collins, 2018).

Thus, this section has confirmed that the supply chain of innovative products is a potential area of significant challenge for innovations to be adopted even if there is an economic case (and extended quality of life years for the patient) for the technology to be accepted by a willing group of clinical professionals. This supply chain aspect of study adds another dimension to the holistic approach to innovation that is needed or should be included in order to ensure the procurement of such devices and materials does not inhibit adoption.

2.1.4.1. Innovation and Adoption in Healthcare in Wales

The NHS in Wales is independent from the rest of the UK (Greer, 2016). Wales has both similar and different challenges to the rest of the UK. It has a relatively smaller population of around 3.2 million, relatively few cities and urban areas, and more rural areas (Longley et al., 2012).

Wales has recognised the need for change in its health service to make the most effective use of available resources to ensure high quality and consistent care (Aylward, Phillips, and Howson, 2013) in a time with significant financial constraints on the budget of NHS Wales.

There have been relatively small amounts of research into innovation and its adoption in Wales, but it is recognised as a pathway to improve the health care service at many levels (Bradley et al., 2014). The NHS in Wales presents a unique and highly important area in which to investigate the adoption of innovations because it represents a microcosm of all the influences and technologies needed to ensure a modern service is effective in care and efficient in its delivery. The next section will provide an account of the VAD innovation application case study in the UK and Wales to highlight the experience of VADs in “the Welsh innovation system” and professional practice.

2.1.5. Ventricular Assist Device adoption and use in the UK: Case study.

A VAD programme was set up in the UK in the early 2000s in a system which used (>80%) the older, less reliable, and less successful pulsatile pumps. Only a small number of procedures (around 70 between April 2002 and December 2004) were undertaken in a few

transplant centres (Freeman, Harefield, and Papworth) to introduce these implants to patients needing VAD support in the UK (Sharples et al., 2006). When this programme was evaluated, it was decided that it should continue, and more of the newer generation pumps were introduced into wider use. These devices were only legally allowed to be used as a bridge-to-transplant (BTT), bridge-to-transplant candidacy (BTC) or a bridge-to-recovery (BTR) – largely limiting the number of patients that could receive one, i.e., only those eligible for a transplant or those whose hearts were decided were able to recover from their HF with VAD use. Most patients do not fit these criteria and so weren't eligible. Before 2006, the programme was determined as of *"investigational use"* (Sharples et al., 2006). It was only in 2006 that the regulator NICE, who examined the evidence, recommended the procedure for use only in the applications of BTT or BTR and in this limited sub-group of patients (NICE, 2006). It wasn't until 2015 that NICE recommended "destination therapy" (DT) status for the innovation (NICE, 2015). The award of DT status permitted patients implanted with the intention to keep the VAD for the rest of their extended life. This greatly increases the potential patient population who could be eligible for a VAD in the UK, and Wales. However, there are still only around 80 implants a year annually (British Heart Foundation, 2017) and roughly 60,000 people in the end-stage of heart failure, a significant portion of whom could be potential recipients for the technology.

It could have been expected that, since NICE recommended VAD implantation for all the established 'intention to treat' categories (BTT, BTC, BTR and DT) the number of implants conducted would increase. However, there are other factors to consider in order to meet the NICE protocols and implementation guidelines. Firstly, the procedure needs to be done by 'surgeons, anaesthetists and intensive care specialists with special training and regular practice in performing this procedure and caring for these patients. Subsequent care should be provided by a multidisciplinary team including staff with the expertise to deal with patients' medical and psychological management, and with the maintenance of their left ventricular assist devices.' (National Institute for Health and Care Excellence, 2015). In practice this has limited VAD implantation to transplant centres in the UK due to these demanding constraints imposed on professional practice.

The vignette of VADs is presented here because it was the original pragmatic focus of this study, which was later expanded to include other forms of innovation as the complexities of

the subject of healthcare innovation was explored. The vignette does expose the ability of a system regulator to impose conditions on the last two stages of the innovation process which, up to that point, may not have been known or accounted for with any degree of certainty. The major learning point at this stage of thesis is that from the practical experience of innovation and the writings of key research authors in this field who have identified the exponential issues of a multiple stakeholder and 'high propensity to fail' contextual environment. The VAD vignette will be continued in the next section to illustrate more processual factors that positively or negatively influence innovation adoption.

2.1.5.1. Factors Affecting Decision to Implement a Treatment Like VADs

The authorisation, issued by the NICE regulatory body, shows that within the healthcare innovation system, the regulator has the power to select what innovations are worthy of funding and endorsement. These system actors make decisions based on regulatory guidance, clinical need, clinical expertise, and cost as inputs into a complex series of reviews and an ultimate decision to support an innovation and 'list it' for use (subject to the conditions stated previously concerning training and competence levels of the staff involved). Since the UK's regulatory body recommend the procedure, that covers regulatory guidance. The clinical need for advanced heart failure is approximately 60,000 patients across the whole UK per year which is projected to increase ("European cardiovascular disease statistics - 2012 edition," 2012), proving there is a large clinical need (NB only around 1% (≈ 80) are treated by VAD and around 2% (≈ 130) by heart transplant per year). It should also be noted that these numbers contain duplicate patients due to the fact that some patients treated with VAD are bridged-to-transplant.

The mandatory compliance with NICE decisions means that competence of the clinical teams must be audited and reviewed. In terms of clinical expertise to implement and take the innovation to its last stage in the adoption process, there is a relatively small quantity of such staff across the whole UK. The majority the VAD innovation and implantation services is conducted at highly specialised transplant centres. The achievement of BTT status was initially the main treatment intention aim by the innovating organisation, so these centres would be appropriate and now actually conduct the most VAD implant procedures. Ironically, in terms of surgical difficulty VAD implantation is simpler than transplantation and can be done more quickly and less invasively as well (Mohite et al., 2018), suggesting that,

for this illustrative case, with large-scale training, the procedure could spread more widely. The training would thus assure the proper understanding of all the relevant factors of a procedure. This procedural imposition is therefore a stage in the literature which is absent from most studies and the researcher reflected that this omission provided further support for a holistic study of the innovation system in Wales using a multi-stakeholder perspective.

2.1.5.1.1. Cost of Innovations like VADs

Having covered regulatory guidance, clinical need, and clinical expertise, the next remaining subject area is the impact of the cost of an innovation. To better understand the full costs of a procedure or intervention, it must be broken down into parts:

- Firstly, in the case of medical devices, there is the cost of the device itself. Currently, each device will in general cost around £100,000 (Westaby and Deng, 2013). This may seem expensive but medical devices tend to be rather costly in general, but range greatly depending on numerous factors including: the cost of materials, the design and technology costs and the manufacturing costs to name a few. In the case of VADs, a large part of the cost could be reduced by increasing and optimising manufacturing output because they are currently not produced on a large scale. The technology itself is relatively simple, with the only moving part of current devices being the impeller, although magnetic levitation systems on some newer devices makes them slightly more complicated. The materials are relatively expensive (e.g., titanium) and this area of cost is not easily reduced.
- Another vital component of the cost is the costs surrounding the actual clinical care, including the surgery and post-operative care, as well as any subsequent care after the patient is discharged home with their VAD. These are also considered when deciding procedures to fund. It is not likely that the surgery and immediate post-operative care costs can be influenced and will probably remain relatively constant. However, any subsequent care costs, including outpatient visits and rehospitalisations depend on numerous factors, and could be influenced to reduce costs. If this is achieved VADs could overcome QALY (quality-adjusted life year) cost-effectiveness barriers (Baras Shreibati, Goldhaber-Fiebert, Banerjee, Owens, & Hlatky, 2017; Clarke et al., 2014).

The costs of an innovation are relatively fixed and there are few ways of influencing the ongoing costs of technology usage from the initial adoption stage. The ways of influencing these costs would include reducing adverse events, which is in part due to device design and technology – but also affected by patient and clinician expertise on the treatment. For example, to what extent could rehospitalisations and/or outpatient care be reduced by further training of both the patient and clinician in the use of the devices? If the technology is used correctly and well understood, a recipient can be discharged home and remotely monitored (with data collection software available with most current VADs), and outpatient visits need only be done at larger intervals or if small to medium problems arise. The same with readmission to hospital – which incurs significant costs, which should only be done in the case of a medical emergency. Several rehospitalisations could probably be avoided if better training and remote support was available. Many more could be reduced with the reduction of significant adverse events such as power cable infection, stroke, or embolism – but this is a clinical issue associated with the technology, which all medical treatments will have to some extent in one way or another. These will improve with time through increased experience and development of the technology. However, if we focus purely on the human/social elements surrounding VADs, such as improving the knowledge and experience of clinicians and patients in the use of the technology, a significant amount of cost could be saved by reducing outpatient cost and hospital readmission. In addition, more expertise could potentially reduce purely clinical related readmissions and care, by getting better at preventing, identifying and counteracting adverse events before they become severe.

In an editorial by ‘Medpage Today’ on VAD cost-effectiveness, Joseph G. Rogers proposed *“Like the early days of transplant in which nearly all physiological perturbations resulted in hospitalisation, VAD patients are hospitalised with impunity. Clinicians do not yet have the confidence or the tools to manage many of the VAD adverse events in the outpatient setting... [Furthermore]... many of the complications such as mucosal bleeding, stroke, and device malfunction require inpatient care.”* (Medpage Today, 2017). This highlights some of the key issues related to experience and training surrounding VADs as the illustrative case which has been used to assist the reader and contextualise the reader to this unique context for the study of healthcare innovation adoption.

The cost-effectiveness could also be better if implanting as a DT over the BTT patient route, because when the patient on the BTT route receives their transplant (usually within 6 months to 2 years see Kirklin et al., 2015), the LVAD is removed and discarded (unfortunately they cannot be re-used or recycled). However, if implanted as DT and the patient lives for many more years as a direct result, the cost of the device is spread across many more patient life years. However, this potentially means more subsequent care costs as the patient lives longer and requires care for longer. The point being presented here is that costs do underpin innovation adoption and at many levels of the system and from the early to latter stages of the innovation process. Any research study would need to be aware of and sympathetic to this 'shaping influence' because it results in a binary outcome (approval or rejection) by the stakeholder at that point in the linear process and there are many points where such commissioning decisions are undertaken.

It is also important to consider that the only other life-altering treatment for heart failure: heart transplantation, is also an expensive treatment with high subsequent care costs (including lifetime immunosuppression). However, since it is limited to the number of available donor organs, which have remained consistently low in number, it remains affordable. Hypothetically, if there were unlimited donor organs, it is unlikely that it would be regarded as cost-effective and wouldn't be widely funded, as is the case with VADs. The variety of alternative innovations including any established innovation is a means of comparison and innovations by their nature are relatively unique, solve specific problems and have few comparable competitor innovations with proven costs of usage/adoption.

Thus, the innovation can also be considered in the context other comparable costly but lifesaving interventions, to illustrate how difficult it is to decide how to fund treatment. Take renal dialysis as an example; for someone with renal failure, renal dialysis is close to 100% effective, but significantly costly. If a patient is placed on it, they can potentially remain on it for years, so how do you decide who to give it to and who not to give it to, and how do you decide when to stop it? There are criteria to help this decision, but the uneasy ethical dilemma remains. It also does not modify the disease state (i.e., improve the condition), which VADs do have the potential to do.

This issue is almost the same issue for all medicines and treatments and will not be addressed further here. The relevant point raised in this literature review is that just

because an innovation is expensive does not mean it is not a useful treatment. However, if something is too expensive to treat enough patients, even if it is effective, this raises another problem. Therefore, what is interesting, in the current climate of limited resources and budget rationing is the process by which treatments are introduced, adopted, and accepted into use in healthcare systems. The latter concerns the diffusion of innovation of medical devices beyond 'early pioneers'. The diffusion process raises many more concerns and issues, essentially, what are barriers to innovation, acceptance, and adoption of VADs in the UK? What are the factors at play other than the clinical performance of treatments and cost; specifically, what are the social elements of such deployed practice?

2.1.6. Questions That Arise From the Literature Review of Diffusion of Innovation in Healthcare

This review of the diffusion of innovation in healthcare raises five key questions: why is clinical evidence often not enough, or not needed? What are the other factors that can determine the success or failure of an innovation's adoption that have not been identified or adequately explored? What are the levels of importance and relevance of these factors? How are these potential factors affected by circumstances, setting and context? This study will use these questions to help build the design of this research so that they can be answered.

2.2. Theories, Models, Frameworks and Approaches to Innovation and Adoption Research

The previous section of the review highlighted research into the problem of innovation adoption in healthcare, this section will further review the theories, models, frameworks, and approaches to researching innovation adoption, still with a focus on healthcare, while also incorporating other fields since this concept has been widely studied across disciplines, especially in Information technology (IT) adoption. It will review and examine the theoretical basis, positioning, key factors, and their strengths versus limitations of technology adoption research, with the ultimate aim to find a theory (or combination of theories) which can be adequately applied to study the adoption of innovations into clinical practice in Wales and the UK.

2.2.1. Technology Acceptance and Adoption Models focusing on the individual level of adoption

A significant amount of the research into technology adoption focuses on the acceptance and adoption of innovation by individuals (Alomary and Woollard, 2015; Marangunić and Granić, 2015; Taherdoost, 2018). Numerous models have been developed to try to explain, understand and research this (Rogers, 2003; Alomary and Woollard, 2015; Marangunić and Granić, 2015; Taherdoost, 2018). As noted by various authors, these models only reveal a partial account of the innovation as applied to the healthcare context because the ‘adoption and spread’ of innovation is often at higher levels of a team, up to a clinic, organisation, or entire system (Meyer and Goes, 1988; Gelijns and Rosenburg, 1994; Van de Ven 2017; Fitzgerald et al., 2002; Greenhalgh et al., 2004; Petkova et al., 2010). Therefore, these models which tend to focus on a single level in the hierarchy of diffused practice are inadequate when taken with the intention of framing research into the adoption of innovation in healthcare at the organisational levels. In short, the focus of these models limits (by scope) pressures placed on that level by regulators (higher systems level) or skills and competence (team level).

Taherdoost (2017) provides an effective review of technology acceptance and adoption models and includes theories that cover all of these kinds of models (and some others). The research paper discussed the development and use of these dominant models. The models

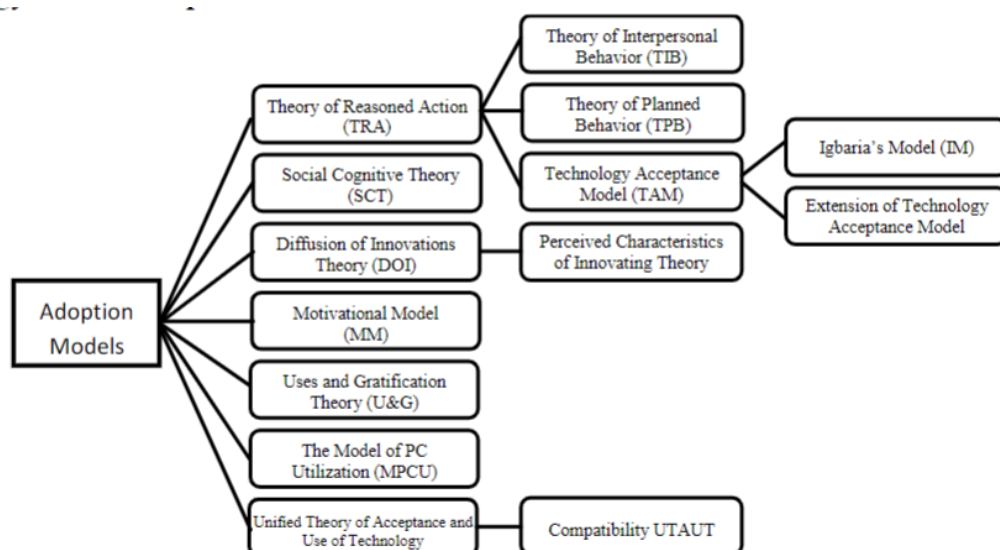


Figure 3. Overview of Adoption / Acceptance Models. From Taherdoost 2017.

and theories are shown in Figure 3 and as can be seen, some theories were extensions or developments from others.

While all models presented in Figure 3 have received significant use and development in research, the Technology Acceptance Model (TAM) is one of the most influential and widely used and so will be described here as an illustrative example of technology acceptance models focused on the individual. It is an extension of Azjen and Fishbein's Theory of Reasoned Action (TRA) (1975) and was developed by Davis in 1989 to model how users come to accept and use a technology.

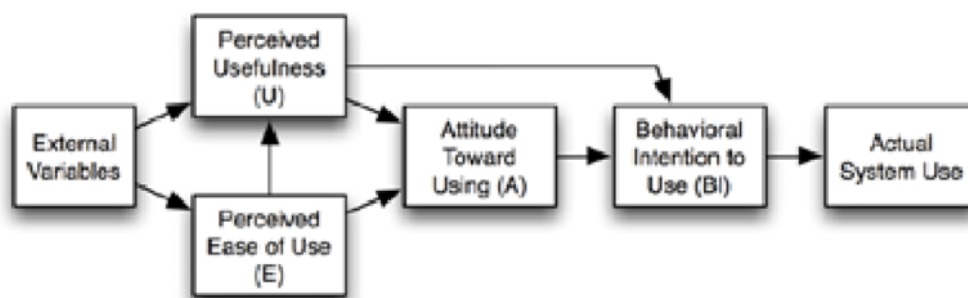


Figure 4. The Technology Acceptance Model. From Wikimedia Commons (2013)

As can be seen by Figure 4, the components of the TAM include 'actual system use' (the end-point where people use the technology), 'Behavioural intention to use', 'Attitude toward using', 'Perceived usefulness' (degree to which a person believes that using a technology would be useful to them), 'Perceived ease of use' (degree to which a person believes that using a technology would be free from effort), and 'External Variables' (such as social influence). The arrows in Figure 4 denote influence.

TAM, like the many other similar models, provides a simple view of innovation adoption at the individual level. It has seen extensive use in research, likely due to its simplicity. However, it is this simplicity and its unit of analysis of the individual which make it unsuitable to study the adoption of innovation in a holistic way in healthcare.

See Taherdoost (2017) and Alomary and Woollard (2015) for concise reviews covering the details of the TAM and other technology adoption and acceptance models (mainly focused on the individual level, and mainly utilised in IT adoption studies).

2.2.2. Rogers' Diffusion of Innovations

Since the 1960s, the work of Everett Rogers (notably the 1995 publication of the book *Diffusion of Innovations*) has been a reference point for many diffusion studies including some mentioned already in this chapter (Fitzgerald, et al., 2002; Greenhalgh, Robert, Macfarlane, Bate, & Kyriakidou, 2004; Meyer & Goes, 1988; Hopkins, 2004). Rogers provides a framework for understanding innovations as new ideas (or practices) adopted over time by members in a social system. He defines diffusion as the process by which an innovation is communicated via different channels over time among members of a social system, following a five-step process: knowledge; persuasion; decision; implementation; and confirmation (Rogers, 2003).

Rogers 'Diffusion of innovations' (DOI) theory suggests that people are influenced by many factors in their decision about whether to adopt an innovation or not. These can include the utility (usefulness) of the innovation, any disruptions that it may cause to existing habits, personal or social values, social status of opinion formers/leaders, and the cultural propensity of individuals to innovate or accept innovation rather than remain the same

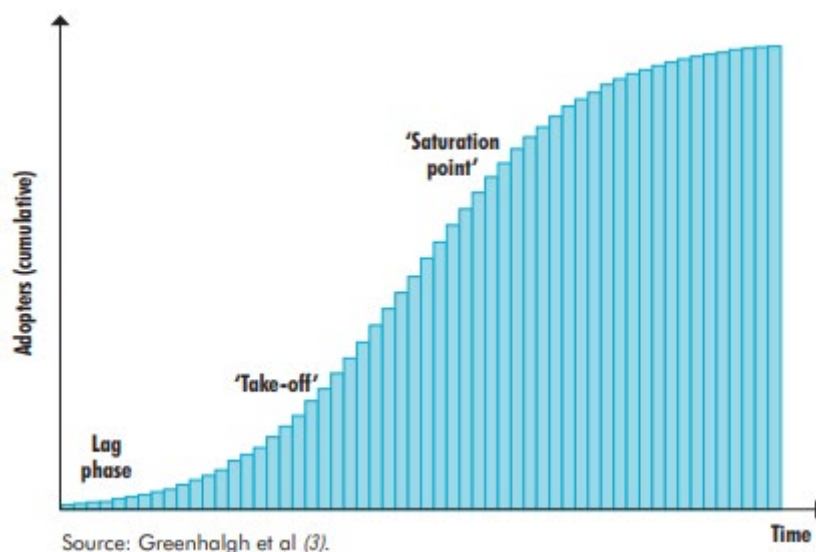


Figure 5. The S-curve, cumulative distribution of adopters over time. From Petkova et al. 2010.

(tolerance or resistance towards change culture) (Rogers, 2003). An innovation that successfully spreads within an area or defined population, tends to follow an S-shaped curve as shown in Figure 5.

He also postulates that within a defined population, there are several subpopulations with different abilities and/or willingness to adopt new innovations. This is often depicted by the well known bell-shaped curve (Figure 6). Individuals who are more than two standard deviations earlier than the mean in adopting an innovation ('innovators' comprising 2.5% of the population); those between two and one standard deviation earlier ('early adopters' comprising 13.5% of the population); those with one standard deviation on either side of the mean ('early majority' and 'late majority', respectively 34% each); and those beyond one standard deviation from the mean ('laggards' making up 16%) (Rogers, 2003).

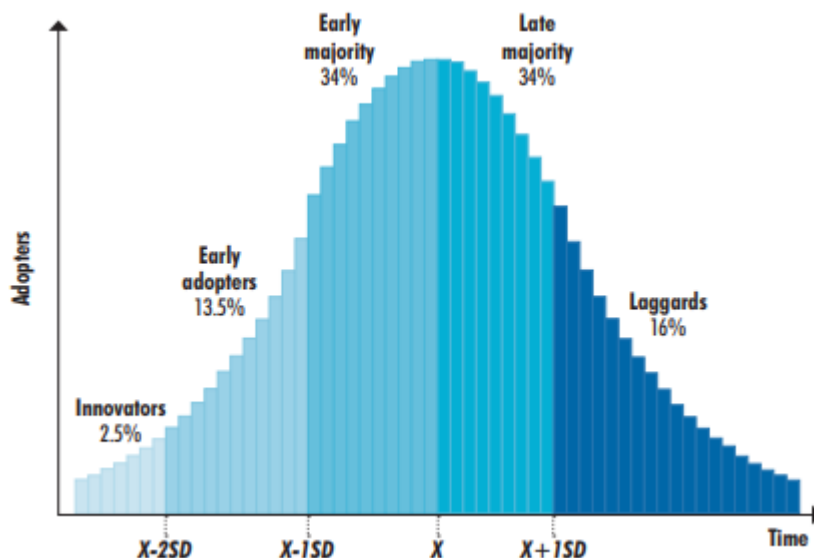


Figure 6. Distribution of new adopters of an innovation against time. From Petkova et al. 2010.

There are three main points to remember when considering this curve. First, the categories (i.e., 'innovators', 'early adopters', etc.) are not a reflection of the personality features of individuals, rather they are mathematically defined cut-offs for the 'adopters' of any particular innovation by a population. Second, the classical S-shaped curve depicting the pattern of innovation adoption is a combined curve of the subpopulations of adopters (i.e., 'early adopters', 'laggards', etc.). If separated, the sub-groups of adopters would each have a respective S-shaped diffusion curve with a longer or shorter lag phase and a great or lesser part of the population that ultimately adopts the innovation. Third, different innovations

introduced into different populations produce a cumulative adoption curve with the same basic S-shape but different gradients on the slope (rates of adoption) and intercepts (proportion of people adopting) as illustrated in Figure 7. Greenhalgh and colleagues contend that curve D (discontinuation) is the most common diffusion curve of all types, and the challenge is to explain the curves, i.e., why do some adoptions succeed, and others fail. This point is directly relevant to this study and in particular the actor and the cause of their action to support or cause an innovation to fail. Greenhalgh et al., do not elaborate on such causes but instead call for greater research to achieve this insight into the behavioural aspects of innovation in healthcare.

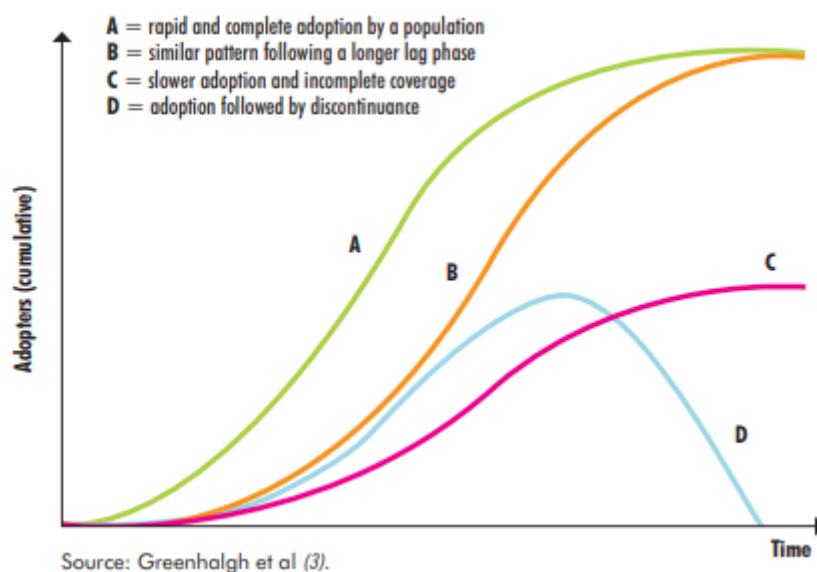


Figure 7. S-curves for different innovations and populations. From Petkova et al. 2010.

The purpose of the diffusion model is to describe the stepwise increases in the number of adopters and predict the development of a diffusion process. For example, in the context of product innovation, the model provides forecast of first-purchase sales of innovations, where the number of adopters defines the unit sales of the product and its growth (Mahajan, Muller & Bass, 1991). The researcher believed the model was a useful way of framing the study of healthcare innovation which reveals the motivations of actors at each stage of the cycle. However, it should be noted that the model is primarily focused on a single product rather than a systems view of innovation. With this caveat in mind, the model was accepted as a means of framing this study, but the limitations of the model were acknowledged in particular the point at which an innovation becomes a mainstream

customary practice and the absence of any discussion concerning the failures that stop the curve from being enacted to its conclusion and the deletion/obsolescence of the innovation. Leadership from ‘opinion leaders’ or ‘opinion formers’ or ‘change agents’ in a particular field are important in the adoption of innovations (Coleman, Katz and Menzel, 1966; Becker, 1970; Rogers, 1995; Fitzgerald et al., 2002). They can act as a mechanism of influence on others via conformity, so that the spread of ideas among individuals occurs by imitation of these important leaders in their specific field (the field of the innovation) (Greenhalgh, et al., 2004; Petkova, et al., 2010). These opinion leaders are therefore important in the diffusion model because they can be agents of change and influence adoption (akin to a professional form of social network analysis of key ‘influencers’ of practice). It is suggested any attempt to influence diffusion would arguably need to address the attitudes of these individuals (Coleman, Katz and Menzel, 1966; Becker, 1970; Rogers, 1995; Fitzgerald et al., 2002; Greenhalgh et al., 2004; Petkova et al., 2010). This may be achieved through mass media and persuasion, or what emerges as a more effective approach: through strong interpersonal ties, via ways such as exchanges about the innovation with peers. These are thought to be more trusted channels to deal with resistance or apathy to an innovation, and to influence strongly held attitudes (Petkova, et al., 2010; Rogers, 2003).

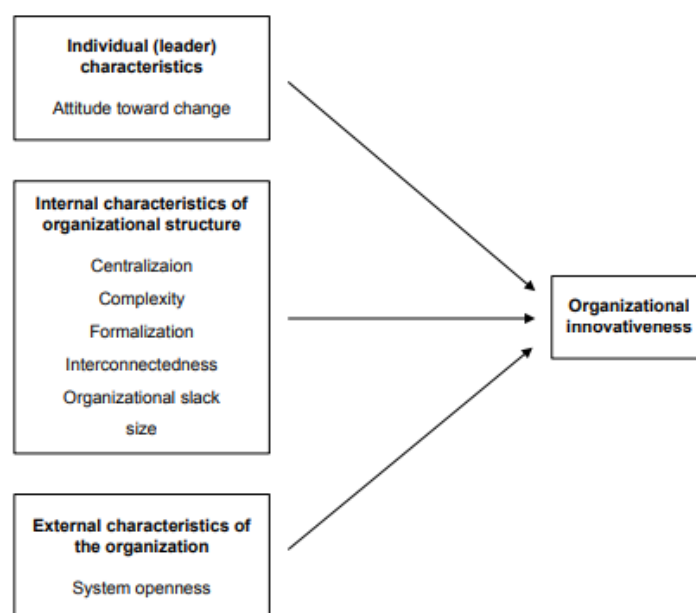


Figure 8. Diffusion of innovations (Rogers 1995). From Oliveira and Martins 2011.

Rogers' diffusion of innovation can also operate at the 'firm' or organisational level. Figure 8 shows the components and variables of this model, which includes 'characteristics of the leader' (their attitude toward change), and the 'internal' and 'external' characteristics of the organisation, all of which influence the 'Organisational innovativeness' (propensity of an organisation to adopt innovations). For a concise review of the details of this model, see Oliveira and Martins (2011).

In summary, this section has presented the dominant innovation models which were presented in the literature and widely cited as seminal works. These models have a long history, and this is a weakness because in the past the time involved with these 'curves' and models could be measured in months or years yet modern technology means that dissemination and diffusion of best practices is often in units of weeks or days. The existing models also do not recognise multiple stakeholders and instead focus on the types of organisations that are at each stage. As previously argued, once an innovation is approved and the conditions of practice have been met, there is potential for very quick adoption into practice specially for those that follow an early pioneer – yet the evidence presented in this literature review is that most innovations fail to be adopted. The criticisms of the models will now be explored in further detail.

2.2.3. Criticisms of the linear model of diffusion of innovations

The linear model of the diffusion of innovation may be useful in its simplicity and general nature but has been critiqued on numerous aspects (often related to these generalisations). For example, Fitzgerald and colleagues (2002) criticise the issue of the simplicity of the model, with its stage-like design, suggesting that it presents the innovation decision process as essentially a choice between accepting or rejecting the innovation, which does not explain why or how the knowledge or evidence is accepted (Fitzgerald, et al., 2002; Petkova, et al., 2010). Their criticisms implicitly accept that many actors with agency will influence any single product innovation's adoption, Others support this view and assert that the reality of innovation and its assimilation is complex, iterative, and frequently complicated by shocks, setbacks or surprises (Van de Ven et al., 1999). The latter would suggest that dynamic processes in the complex setting of healthcare innovation will fail, and this is reflected widely in the literature as previously identified.

Fitzgerald et al., (2002) also question a common premise in health policy – that for many conditions there is (only) one optimal solution, based on scientific evidence (quality and quantity thereof). Using NICE in the UK as an example of body with the aim of disseminating evidence and guidance in a ‘top-down’ pattern to clinical staff (with the assumption there is a single unified body of facts). Though NICE and other health policy bodies do not always suggest a single optimal solution for a specific problem; there is still a point to be made in objection to the vertical model of knowledge translation. This can be forged on the basis that there is rarely agreement among professionals on this ‘one optimal solution’ for a given health problem. Consequently, in practice, a single solution is unlikely to be implemented; and furthermore, interpretations and priorities among adopters (i.e., those who adopt an innovation) affect their willingness to subscribe to innovation diffusion. This suggests that most adopters have a more active role in the dissemination process rather than the more passive function (as receptors of ideas from opinion leaders) that Rogers originally assigns them (Rogers, 2003).

Therefore, the researcher regarded linear models as flawed and imperfect descriptions of reality in that they do not sufficiently account for contextual influences on technology adoption and implementation and the researcher supported the view of Van de Ven et al (1999) that linearity reduces contextual influences to the point of impracticality in application. For example, the multiple professions within the healthcare sector can have differing values on the credibility of evidence and possible biases toward different methods of treatment and care depending on their specific position.

Fitzgerald and colleagues (2002) assert that knowledge is ambiguous, and a constantly contested phenomenon within different schools of professional practice. Widespread acceptance of the particular knowledge must occur before changes to practice can, and usually after a process of debate in local contexts (Fitzgerald, et al., 2002). The researcher believed that any form of innovation will challenge the status quo of customary practice, and such naturally create resistance to change and scepticism – potentially even fear that professionals may lose their licence to practice is errors and unintended consequences were to result from using the procedure. Innovations will therefore have to convince professionals to change and accept an innovation that they did not invent and may not feel sufficiently trained nor competent to deliver.

Consoli et al., (2007) refute the linearity of innovation diffusion models too and propose that the linear progression of 'laboratory bench' to 'patient bedside' is an under-representation of a much more complex process. They adhere to the 'complexity school' and argue that diffusion is more of a dynamic process of overcoming barriers or 'problem sequences' (Consoli et al., 2007; Petkova, et al., 2010). Their arguments would situate knowledge translation on a trajectory of change, which involves identifying clinical problems and discovering answers by generating innovative solutions. It is important to note that often these ideas have the potential create problems for existing practice and have a destabilising or disruptive effect on the established order (e.g. on the pre-existing clinical practice, on the financing and organisation of services) (Metcalf, et al., 2005). This suggests that difficulty in re-organising or re-financing existing practice or services could be a potential barrier to technology adoption or the diffusion of an innovation.

The problem-solution rationale for initiating innovative strategies ties in with Hughes' concept of innovation as a pattern of "reverse salients", which affect technological developments by aiming to correct technical problems in an incremental way (Hughes, 1983). The development and innovation pathway for the intraocular lens for cataracts articulates this logic well (Consoli et al. 2007). This technology diffused into practice and became one of the most frequent routine operations in the developed world. However, to reach this point it underwent a few problem-solution sequences, an initial lack of acceptance of cataract replacement, with preference being given only to removal. Two main events drove the diffusion process: a community of practitioners enthusiastic about intraocular lenses, who developed shared values concerning their use, and the adoption of a new technique which dramatically reduced the incision size for the lens and necessitated the development of smaller, folding lenses. For the next 3 to 4 decades of the technology developed in a stepwise pattern, structured around co-evolution between device invention, medical practice and industrial participation, in a mutually constitutive way. This was a systematic, distributed process where problems were solved by the engagement of multiple actors, including specialist consultants, university departments, firms and state regulators using an "inter-organisational structure" (Blume, 1991) as an interface.

This example, among the others cited (such as the incremental improvement of the oral contraceptive pill to reduce oestrogenic risk, or the refinement of endoscopes through fibre-

optics), highlights that it is a misconception to separate research, development, and technology adoption into discrete categories, as the linear model of innovation suggests. Rather, the development of an innovation can often continue well after its adoption into medical use. Therefore, initial adoption into use can be the beginning of a prolonged process of redesign feedback and adaptation to user demands (Gelijns & Rosenberg, 1994), which may ultimately lead to wider adoption and use of the innovation.

There are also cases where technology that originates from another industry enters the health and care sector (often after further development) and diffuses. It is suggested by Gelijns and Rosenberg (1994) that a high percentage of medical devices have emerged not from clinical research, but through importing of technologies developed elsewhere (e.g., lasers, ultrasound, magnetic resonance spectroscopy and of course: the computer), which are then modified to suit the needs of the healthcare sector, which in turn strengthens the capacity to perform 'upstream' biomedical research. Magnetic resonance imaging for example (MRI) for instance, a technology that originated from basic research on the atom has now been transformed into a major diagnostic tool in medicine, which has in turn improved the ability to research various internal organs and their diseases. This example highlights the non-linear nature of the innovation process (Gelijns & Rosenberg, 1994).

Even after considering these discussed shortcomings of the linear model of innovation diffusion, there are two concepts within it of particular usefulness. One is the delineation of phases in the innovation process, upon which subsequent research has been built, (including the criticism that the neat stages misrepresent a more complex reality). The other is the idea of interpersonal influence through social networks, opinion leaders and change agents, as the dominant mechanism for diffusion (Petkova, et al., 2010; Rogers, 2003). Greenhalgh and colleagues (2004) suggest that adoption decisions occur via patterns of friendship, advice, communication and support existing among members of a social structure, and different groups can have different types of social networks. Doctors, for example, often operate in informal horizontal networks, effective in spreading peer influence. Conversely, nurses have been observed to have more formal, vertical networks, better placed for 'cascading' information and passing on authoritative decisions (Greenhalgh, et al., 2004; Petkova, et al., 2010).

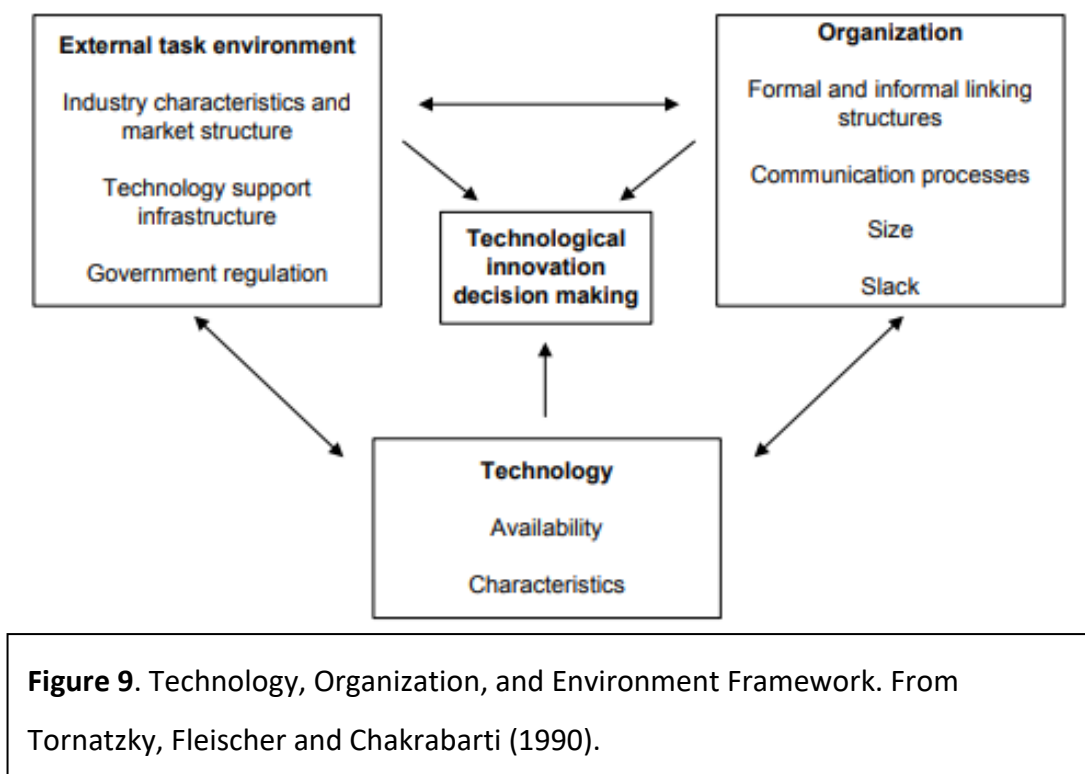
Considering the points raised by the authors in this section of the thesis, translation of knowledge into practice can be a long-term process characterised by continuous exchange of feedback between the developers of medical technology (e.g. research and development laboratories, or clinical practices), and its users (e.g. physicians, regulators, payers, insurers) – which gradually reduces the uncertainty associated with new treatment options (Petkova, et al., 2010). These reverse flows of learning are absent from simplistic linear systems and the academic literature which does not take a full systems approach to understanding the local, organisational and national levels of influence (and their resultant contribution to decision-making and innovation approval).

In medicine, a critical actor is the ‘expert user’ role, which is usually associated with clinicians, acting on behalf of their patients, as sources of information but also as specialists in the field with the skills and knowledge required to turn ideas into solutions to be applied in practice. The medical profession, particularly specialists, are an important driving force behind innovation in the field, but it is also important to note the reciprocal relationship – i.e., that innovation itself drives specialisation. For example, when the new technology of the thermometer was invented in the 1700s it allowed delegation of temperature taking to assistants and the physician to apply diagnostic skills to interpretation of the data collected (Blume, 1991; Petkova, et al., 2010). It could similarly be applied in the case of VADs, where the introduction of that innovative technology would require further training of cardiac surgeons, so they could carry out the procedure. However, VAD implantation is not a highly complicated procedure, so not as much training or specialisation may be necessary.

This section has presented a further dynamic which influences the decision to adopt and that is the willingness of the user of the innovation (not the patient who is the consumer) and the behavioural issues that are associated with seemingly illogical behaviour and the personal deliberations concerning competence, professional gains, and risks. These latter dynamics are often ‘bundled’ under the term clinical engagement in studies of process improvement, and they are not typically areas of review for innovation adoption but remain relevant decisions at the latter stages of the innovation adoption linear model(s).

2.2.4. The Technology-Organisation-Environment Framework by DePietro, Wiarda and Fleischer, in Tornatzky, Fleischer and Chakrabarti, 1990

The Technology-Organisation-Environment framework, also known as the TOE framework, is a theoretical framework to explain and explore technology adoption in organisations that is widely cited in the field of management research, engineering, and information systems. The framework was originally published by DePietro, Wiarda and Fleischer as a chapter in Tornatzky, Fleischer and Chakrabarti's book *Processes of Technological innovation* (1990).



The framework identifies three elements of a firm, enterprise, or organisation's context that influence process by which it adopts and implements technological innovations: the Technological context, Organisational context, Environmental context (see Figure 9). The Technological context is defined in terms of both internal and external technologies (i.e., innovations) relevant to the firm, and their availability. The Organisational context is defined in terms of descriptive measures about the organisation such as scope, size, and managerial structure etc and also acknowledges informal linkages between employees within the organisation/firm. Finally, the Environmental context is the 'arena' in which a firm conducts its business or operations – such as its industry, competitors, governmental interaction.

Even though the available technology to an organisation could be considered as part of its 'arena', or environment, De Pietro, Wiarda, and Fleischer separated the Technological context from the rest of the Environment to focus attention on how the features of the technologies themselves can influence both the adoption process and implementation.

The Environmental context is noted to present both barriers and opportunities for technological innovation and adoption. Groups such as Industry members, Knowledge producers, Regulators, Customers, Suppliers are posited to be beneficial by acting as providers of innovation-related information and financial and human resources, or detrimental by constraining innovation activities through government policies and regulations, capital availability, and restrictions on innovation flow. An organisation's links with these environmental actors may be critical to their capacity to make functionally adaptive adoption and implementation decisions (De Pietro, Wiarda, and Fleischer, 1990).

It is acknowledged by the framework that the three contexts link and influence each other. For example, the authors note that organisations can set up 'boundary spanning mechanisms' to communicate with their external environment (De Pietro, Wiarda, and Fleischer, 1990).

The unit of analysis for this framework is intended as "the organisation". While the authors often refer to this unit as a 'firm', they also intend it to mean autonomous corporate division or even a single plant when appropriate, as well as their public sector equivalents, which applies well to healthcare in the UK.

The boundary of the organisation may become more unclear for firms with several subsidiaries, customers, or co-employees residing within their walls, and/or have processes such as simultaneous engineering and co-manufacturing. E.g., project teams consisting of customers and co-employees that reside in an engineering firm could be considered part of the environment or part of the internal organisation. For the purpose of the framework: any person, entity, or process that is managed by the firm is considered to be part of its internal organisation (De Pietro, Wiarda, and Fleischer, 1990).

For more information on the TOE contexts, see Appendix A.

The TOE framework provides a useful analytic framework for studying the adoption and assimilation of innovations (Oliveira and Martins 2011) at the organisational level. It has

solid theoretical underpinnings (see Appendix A) and consistent empirical support (see Appendix B, and Oliveira and Martins, 2011). However, the majority of its use has been in IT adoption. Research has also identified or utilised different factors across the three different contexts across different studies.

The TOE framework is also consistent with DOI theory. Rogers (1995, 2003) emphasised individual characteristics and internal and external characteristics of the organisation as influences of organisational innovativeness. These are covered by the technological and organisational context of the TOE framework. However, the TOE framework also adds a new important component, the Environmental context, which as mentioned, can provide constraints and opportunities for innovation adoption. In addition, the TOE framework improves Rogers' DOI theory's ability to explain 'intra-firm innovation diffusion' (Hsu et al. 2006).

This review highlights the TOE framework as a suitable candidate for conducting a study into innovation adoption in healthcare in Wales. This is due to the unit of analysis being the organisation, the fact that the three contexts to explore give it an advantage over DOI theory and because it has solid theoretical underpinning and empirical support.

2.2.4.1. The Importance of Context

The context in which technological innovation takes place can have a significant influence on the outcome of that process according to DePietro, Wiarda, and Fleischer (1990). While "context" almost never *determines the process*, it does serve to *constrain*, or *facilitate* it in terms of a fit between technology and its application/environment for the service provided. For example, while some internal organisation designs can make it easier to innovate, all organisations can (and do) adopt and implement new technologies. Equally, while some industries and some locations are more competitive, or contain more new technology choices, firms in the least competitive industries (Government, Education), and those with relatively few new technologies from which to choose, also innovate. One implication of this is that, while context is an interesting and useful set of variables to help explain and describe innovation processes – knowing about them may not help very much if you are inside an organisation that is trying to change.

Having said that, DiPietro and colleagues assert that it is not always true. For example, managers of organisations are not passive actors in their contexts; rather in some cases they can be designers of them. The strategic choices they make, the structures they create or dismantle, and the communication processes they foster can all influence the permeability of their boundaries and, thus, their propensity to innovate. Similarly, the technological context can be shifted – although rarely by the actions of one firm.

There are many historical examples in which a relatively stagnant technological environment has become dramatically unsettled with implications for the structures of markets, as well as the proclivity of any individual firm to innovate. For example, the US auto industry – true leader in tech in first half of 20th century. The industry had become highly concentrated and extremely un-innovative by 50s and 60s. The introduction of dynamic competition from Japan in 70s made industry one of the more competitive and technologically innovative by the last half of the 1980s. Arguably this is happening again now due to the disruption by the electric car movement, regulation, and so on.

2.2.4.1.1. Implications of the Technological Context to Innovation Adoption

The term ‘technology context’ refers to all technologies or innovations that are relevant to an organisation, this includes technologies already in use in the organisation as well as those available externally and not currently in use (Baker, 2011) and include manual as well as fully automated processes. Relevant technologies or practices in current use by an organisation are important to the adoption process of new innovations because this may limit (or improve) the extent and pace of any change an organisation can undertake (Collins, Hage, & Hull, 1988). The originators of the TOE also place an emphasis on the existing technologies used within a firm (DePietro, Wiarda, & Fleischer, 1990), whereas in research this element hasn’t been focused on in a significant way (Appendix B; Oliveira and Martins, 2011).

One could argue that the variable ‘relative advantage’ (the degree to which an innovation is perceived as providing greater organisational benefits than either the status quo or other innovations – see Kwon & Zmud, (1987)), which is often used in adoption research (e.g. Gangwar, Date, & Ramaswamy, 2015; Grover, 1993), touches on this. However, relative advantage is a comparison of the technology of interest to existing technology or practice,

rather than an evaluation of existing technologies in their own right. In addition, its use was criticised by Tornatzky and Klein (authors whose work led to the development of the TOE framework), in their meta-analysis of innovation-related characteristics in research, because of the “catch-all” nature of the variable. Even so, it has been used as a technology-related factor in research utilising the TOE framework and other models in the past.

Innovations that exist but are not yet in use by the organisation influence innovation by highlighting what technological change is possible and how the technologies could enable them to evolve and adapt (Baker, 2011). Innovations that are not in use by an organisation have been categorised into three groups: incremental, synthetic, or discontinuous (also known as radical) (M. Tushman & Nadler, 1986). Incremental innovations produce the smallest amount of change and carry the least risk. They generally introduce new features or versions of existing technologies. A simple example would be a software or system update. An example from healthcare could be a modest change to protocol in administering a particular drug which is already in use. Synthetic innovations incur moderate risk and change, and can involve existing ideas or technologies combined in new ways. An example could be universities’ delivery of course content via the internet. Another example from healthcare could be changing patient health records to an electronic format. No new technology is used in storing the records as electronic records were/are in use across numerous other sectors, and no change to the content of the records need occur. Discontinuous innovations represent significant departures from current technology or practice, examples can include the change from mainframes to PCs in numerous organisations during the 1980s, or the shift to cloud computing starting in the 2000s. There are numerous examples of technologies that can cause a radical change to practice, especially in healthcare when new medical advances are made. Ventricular assist devices would arguably fall into this category as they represent a completely different mode of treatment to heart transplantation (the current preferred medical practice – essentially a biological technology) to achieve the same goal of improving survival and quality of life of advanced heart failure patients: switching from the complex and intricate process of acquiring and matching donor hearts, performing the surgery, and carrying out post-operative care, to a mechanical technology with inherently different complexities and risks. However, it is important to note that heart transplantation is not likely to be completely

replaced by VAD technology (at least in its current form), it is more likely that VAD adoption and use would be in addition to heart transplantation – likely as a complementary procedure used for patients with different types of heart failure and additional health problems.

When evaluating technologies, that will cause discontinuous change, organisations must also consider whether they are ‘competence-enhancing’ or ‘competence-destroying’ (Tushman & Anderson, 1986). Competence-enhancing innovations enable firms to gradually change as they build on their expertise, while competence-destroying innovations render many existing technologies and many types of expertise obsolete. Again, to refer to the VAD case, the same personnel who deal with transplantation (from any angle, e.g., the surgeon performing the surgery to the GP looking after the patient when they leave hospital) would train and adapt to the new procedure of VAD implantation as it is introduced, and previous expertise or previous practice would not be rendered obsolete but would adapt. Therefore, it is arguably competence-enhancing. A competence-destroying example in healthcare could be the introduction of artificial intelligence, such as in radiological screening.

In summary, research studies show that various organisational employees need to consider the type of organisational changes that will be incurred by adopting a new innovation, potentially even to the point of creating futuristic route maps based on the changes to the wider healthcare environment, predicted disruptive technology introduction and general trends (such as the demand for older persons services within an ageing population – such as is the case for the illustrative case used - VADs). Depending on their characteristics innovations can trend to more dramatic (disruptive) or more minimal impact on the organisation and the industry or sector in which it operates.

2.2.4.2. Weighting of the Contexts

One question that arose while reviewing the TOE framework and research studies that used this model is *“are the three contexts equally or unequally important in innovation adoption?”* and if so *“which contexts are more important, and which are less?”*. At this point there is no weighting for the three contexts of TOE. Therefore, it is assumed that they are weighted equally in terms of importance. This is an assumption that has not been tested and does not receive mention in the extant literature. Therefore, another aim of this study,

to emerge as a gap in the literature, is to investigate the relative importance of the contexts of TOE.

2.2.4.3. Empirical Research Utilising the TOE Framework

Oliveira and Martins provide an exhaustive description of studies that utilise the TOE framework in IT adoption (Oliveira and Martins, 2011), and Appendix B provides a more detailed analysis of key and recent research utilising the TOE framework. Two interesting papers, for different reasons, are presented below.

2.2.4.3.1. Meyer & Goes (1988)

A study by Meyer and Goes (1988) examined the organisational assimilation of innovations. While this study predates the TOE framework, they based their model on work conducted by the authors who went on to develop the TOE model (consequently it resembles the TOE framework closely). This was a longitudinal study and in the healthcare setting in the USA. It looked at 25 hospitals, tracking 300 potential adoptions and interviewing hundreds of healthcare professionals and other hospital staff. Its findings concluded that attributes of the innovation, the context (i.e., organisation and environment) and the interaction between them influence the success of organisational adoption of innovations. This study is interesting as it is likely the only TOE framework-like research which looks at healthcare innovation adoption, not focused on IT.

2.2.4.3.2. Gangwar & Ramaswamy (2015)

The study of Gangwar and Ramaswamy (2015) is an example of the combination of two technology adoption models: TOE and TAM. It used the technological and organisational contexts of the TOE framework as the 'External variables' of the TAM model, but environmental remained separate. It studied cloud computing adoption in Indian IT companies, and found that 'relative advantage', 'compatibility', 'complexity', 'organisational readiness', 'top management commitment', and 'training and education' as important variables for affecting cloud computing adoption, with perceived ease of use (PEOU) and perceived usefulness (PU) (from TAM) as mediating variables. It is reasonable to see TOE and TAM combined in this way as there is similarity and overlap between variables used in either model, and their study found that it was reasonably good at explaining cloud computing adoption. It is interesting to see an example of a study combining two models

and shows that models have potential for further development. Indeed, many of the papers in Appendix B develop or add to the TOE framework in different ways but few actually address healthcare and fewer address issues of weighting the elements of the developed TOE models and therefore to assess the relative importance of each within a complex professional healthcare service adopting a new innovation.

2.2.5. Conclusions regarding the TOE framework, other technology adoption models, and their use in research

Research utilising the TOE framework has spanned numerous technological, industrial, and national/cultural contexts, and in each study the three elements of technology, organisation, and environment were shown to influence the way organisations identify need for, search for and adopt new technologies (see Appendix B and Oliveira and Martins, 2011). This suggests that it has broad applicability and explanatory power.

Studies utilising the TOE model have aimed to explain the adoption of innovations across many industries: including manufacturing, retail, wholesale, financial services, and healthcare. In addition, in terms of different national and cultural contexts, the TOE model has been tested in European, American, and Asian contexts, in both developed and developing countries. However, in research the TOE model has largely only been used to explain the adoption of information technologies, including the adoption of interorganisational systems, e-business, electronic data interchange, open systems, enterprise systems (see Appendix B and Oliveira and Martins, 2011) and a broad spectrum of general information systems (IS) applications. Though the IT innovations looked at in studies using the TOE framework have differed in their contexts somewhat, and there has been broad use of it across industrial, national, and cultural settings, the framework has not seen much (or any) broader use in technologies outside of IT. This is an interesting point to consider in light of the fact that the originators of the TOE framework intended it to be used for any type of innovation, from mechanical technology, to information technology, to innovations in practice or service delivery, or any other innovation that an organisation may adopt (DePietro et al., 1990).

This raises the question of why focus of TOE research has been on these information technologies over others. In addition, a large amount of the technology adoption research

utilising other adoption models has also focused on IT (see Section 2.2.1). So, why has the TOE (and other models) seen underuse in other disciplines of research?

One possibility is that researchers take the lead from others in their field, or the same researcher or group of researchers could use the same model for numerous research studies in their field (e.g., Zhu et al., 2003, Zhu et al., 2004). Therefore, the use of a model may be seen a lot in that field over time because these researchers are more likely to read other studies utilising the model, in this case in the research of IT and IS innovation and technology adoption, thus creating a research 'echo-chamber'.

Researchers in other fields may not be as aware of research utilising these models, or aware of the models themselves (unlikely to read IT/IS focused journals for example). As discussed in the literature review of technology adoption research, the concept has been studied across numerous disciplines, but a lot of the terminology pertaining to it differs across disciplines. For example, in healthcare the term 'diffusion of innovation' is more commonly seen than 'technology adoption' (Petkova, Schanker, Samaha, & Hansen, 2010). While this may seem like a surface level difference, disparities like these between disciplines when researching technology adoption could lead to or be a product of less linkage between research across different disciplines, potentially offering an explanation as to why the TOE model (amongst others) has not been as widely used in other disciplines.

Building on this point, different disciplines/fields are more likely to use different methodologies in their research (not to say there is no overlap). So, while IT and IS theory into technology adoption more often tests *medium to large-scale* models from a positivist point of view, other disciplines which research the concept of technology adoption may have seen less use of these methodologies and tend toward different ways of researching it, often more interpretivist, thus they do not use the same approach or models (see empirical research discussed in Greenhalgh et al., 2004). This is not to suggest that using different methodologies to study the same concept (of the adoption of innovations) is invalid, but it is interesting to note the relative lack of cross-over of theory, practice, and research between disciplines, when one considers that the concept in question: the adoption and use of new innovations into use by organisations (or individuals) is universal to all industries and therefore all disciplines. Of course, as discussed, the context is always very important in

studying technology adoption, and this may in part explain the differentiation in the focus and methods of researching it across fields and disciplines.

Part of the contribution of this doctorate, therefore, is to test the feasibility of utilising the TOE framework to study the adoption and use of innovations into use in the National Health Service in Wales (and the wider UK), which is a public sector organisation (the dominant health care provider in the UK). It is reasonable to approach this study via the TOE framework, as previously mentioned, the originators of the TOE framework suggest that the model should be applicable to researching technology adoption into the public sector (DePietro et al., 1990), not just the private sector (or third sector). However, thus far, the empirical research utilising the framework has only focused on private firms. Therefore, another part of the contribution of this doctorate is to determine the feasibility of studying technology adoption in the public sector context using the TOE framework, because the public sector will inevitably have different goals and determinants of adoption than private firms.

In the empirical studies that test the TOE framework, researchers have used slightly different factors for the technological, organisational, and environmental contexts (Baker, 2011). Researchers appear to have agreed with DePietro and colleagues (1990) that the three TOE contexts influence adoption, but in their studies these researchers have then assumed that for each specific technology or context that is being studied, there is a unique set of factors or measures (see Appendix B). Whether assuming which variables are important in this way is a valid extrapolation or interpretation of the model is debatable. In the studies utilising the TOE framework researchers have justified it by discussing why they choose the variables they do, and by building upon other research in similar contexts (see Appendix B and Oliveira and Martins 2011).

For example, Zhu and colleagues (2004), in their study on e-business use in the financial services industry, decided that the one suitable variable in the technological context is 'technology readiness', which they developed to 'capture the actual usage of the Internet by financial firms' (Zhu, Kraemer, & Dedrick, 2004). Their construct incorporates three dimensions: 'technologies in use', 'Website functionality at the front end', and 'back-office integration within and beyond the firm's boundary'. They go on to justify narratively why and how these factors reflect the 'extent to which the firm's technologies are ready to

create value for conducting financial services' by discussing the industry, how it operates and what firms within it aim to achieve to be competitive. It could be argued that Zhu and colleagues 'technology readiness' is a construct that could nest under the 'availability' factor in the technological context of the TOE framework. Other variables Zhu et al. studied across the other contexts appear very similar to or exactly as they are in the original TOE framework for example: 'firm size', 'financial resources' ('slack resources' in the TOE framework), 'regulatory environment'. Arguably, the remaining variables they use can either be nested under some of the factors of the TOE for example: 'competition intensity' under 'industry characteristics and market structure', or have been studied in other technology adoption literature, for example: 'global scope' (styled as an organisational context variable here).

Other studies which utilise the TOE model take the same or a similar approach to selecting or building variables. Either extracted directly from the TOE, or nested under one of the TOE factors, or found from other adoption literature and placed under what the authors deem the relevant TOE context or constructing themselves using justifications from other literature and/or from directly considering the type of innovation, organisation and industry under study (see Appendix B, Oliveira and Martins 2011).

Baker (2011), when discussing the TOE model's use in research, suggests that because different types of innovations, different national/cultural contexts and different industries that they will have differing factors that influence the adoption of an innovation, then that is why research studies using the TOE model use different factors for the technological, organisational, and environmental contexts (Baker, 2011).

Another issue to consider is that some valuable information could be lost by the researchers leaving out variables from their study without, because they deem them unimportant either with justification or on assumption.

2.3. The Socio-Technical Systems (STS) Theory

Socio-technical systems (STS) theory originates from the field of organisational change/development and is based on the premise that an organisation or a work unit is a combination of social and technical parts and that it is open to its environment. The focus of this theory is that the design and performance of any organisational system can only be

understood and improved if the approach brings together and aims for joint optimisation between the 'social' and 'technical' aspects of that system, which are treated as interdependent parts of a complex system. A socio-technical system can be an individual organisation or organisational unit (such as a company or a hospital) or could be even higher levels: multi-organisational, all the way up to the level of an entire society.

It was originally developed by Trist, Bamforth and Emery based on their work with workers in English coal mines at the Tavistock institute in London in the post-World War II era (Trist and Bamforth, 1951) and has since seen extensive use conceptually and empirically as an approach to work design and other areas of research in various settings and sectors (Appelbaum 1997). Its wide use may be due to its generalisability and so has the capacity to be "adopted with ease to almost any organisational situation... and remains open to continual improvement and revision" (Hackman and Oldham 1980). Often, STS approaches have often been fragmentary or only loosely reminiscent of the original theory (Appelbaum 1997).

STS theory is a theory/approach to creating systems, be that an organisational system, an efficient workflow, a manufacturing system or even information technology systems. This is different to other systems of work because it divides the approach into two areas, 'social'

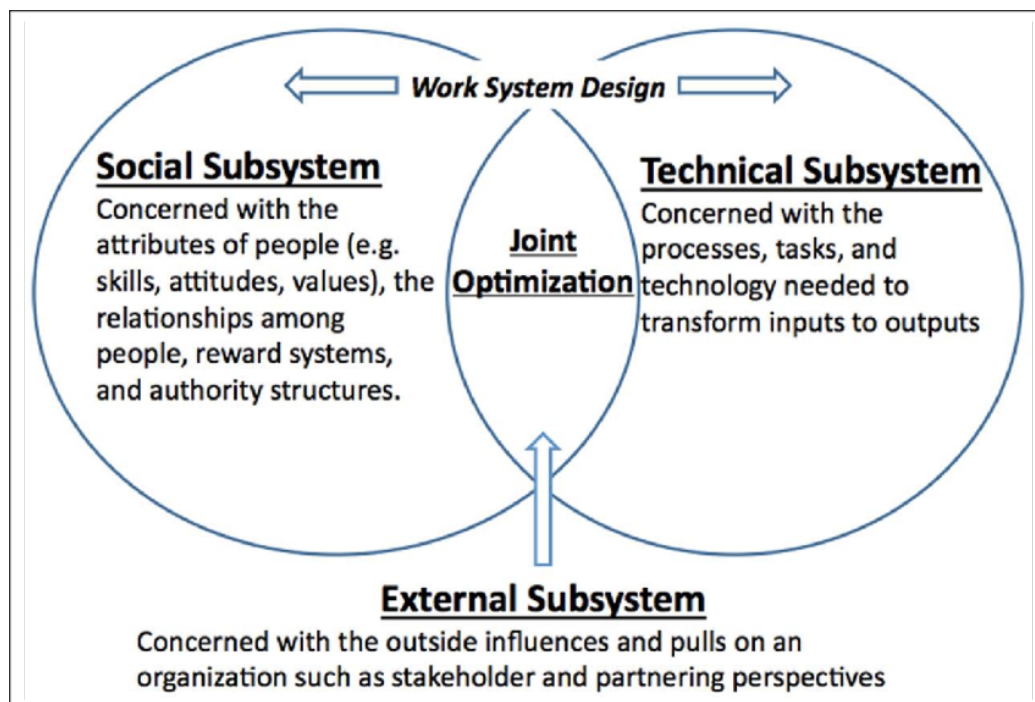


Figure 10. The Sociotechnical systems theory. From Militello et al., 2013

and 'technical': the social aspect being unique in much of operations management theory at the time (Appelbaum 1997) as shown in Figure 10.

The 'social' subsystem of the organisation is concerned with the attributes of people, the relationships between people, reward systems and authority structures. The 'technical' subsystem is concerned with not only technology utilised within and organisation, but also the processes and tasks carried out in the organisation necessary to achieve its goals – which is useful in the field of healthcare as many of the innovations carried out are not material technology, i.e., a medical device or medicine, but are other technical innovations in services or processes etc (Greenhalgh et al. 2004). The theory also acknowledges that the environment or the 'external' subsystem influences the organisation, such as through stakeholder and partnering perspectives.

2.3.1. Socio-technical systems theory in innovation adoption and in healthcare

Socio-technical systems theory originates in the field of organisational development, and not innovation or adoption. However, the socio-technical systems theory does acknowledge and cover the implementation of technology as a part of a change to the organisation that will affect and be influenced by the people within that organisation and the social system. Therefore, it has potential as a theory which could be used to investigate and understand innovation adoption, especially in healthcare, which is highly dependent on people as well as technology.

Indeed, there have been instances of its use in innovation and adoption literature, with one key paper being Geels (2004) which discusses how a 'systems of innovation' approach (which broadens scope of analysis of innovation from artefacts to systems and from individual organisations to networks of organisations) benefits from a socio-technical systems approach by incorporating the user-side into the analysis (which allows a greater focus on the diffusion and use of technology, not just its development); by suggesting an analytical distinction between systems, the actors involved in them, and the institutions which guide actor's perceptions and activities; by making institutions an integral part of analysis (not just used to explain inertia and stability but can also be used to conceptualise the dynamic interplay between actors and structures); and by addressing issues of change from one system to another (Geels 2004). The implications of this for innovation adoption is

that viewing this from a socio-technical systems approach, the technical system highlights more explicitly the importance of not only the creation of innovation, but its adoption and utilisation.

Ulucanlar et al., (2013) explored socio-technical influences in the technology adoption of medical devices in the NHS in the UK. Key findings from their study include: Organisational adoption decisions are influenced within a dynamic 'adoption space' (which transcends organisational and geographic boundaries); technologies acquire socially constructed 'identities' in the adoption space (influenced by industry, healthcare organisations and practice, health technology assessment and policy) which relate to novelty, effectiveness, utility, risks and requirements; and that technologies' identities shape their desirability, acceptability and adoptability. They suggest that health technology policies should embrace this socio-technical perspective.

A number of other studies also use a socio-technical systems approach or lens with which to investigate topics within healthcare innovation and adoption, such as Carayon (2006) which uses STS to look at human factors and ergonomics in healthcare; Marjanovic et al 2020 which uses STS approach to examine conditions that can support and sustain innovating healthcare systems; Braithwaite et al 2009, which uses STS to look at how to promote safer, better healthcare; and Waterson (2014) which looks at how STS affects health information technology adoption in the UK NHS.

2.4. Comparing the TOE Framework to STS Theory

The TOE framework and STS theory cover a lot of the same ground in terms of their components, but they also have few key differences. This section will compare and contrast the two theories.

While the TOE is explicitly a framework to understand innovation adoption at the organisation level, STS theory was not developed for or intended for that particular use. However, STS has seen use in researching innovation adoption, as shown in the previous Section. This may be because, STS is concerned with organisational change and development, and does acknowledge and cover the implementation of technology as a part of a change to the organisation that will affect and be influenced by the people within that organisation and the social system.

Due to the fact that the TOE has more empirical use in adoption studies, as well as having solid theoretical underpinnings it likely has slightly more validity for use in innovation adoption research. However, this is not to say that STS does not have strong empirical use and theoretical basis, indeed far more research has utilised this theory than TOE, spanning decades and a broader array of research topics, it is simply that the majority of this research is not regarding innovation adoption. In addition, much of the TOE framework's use has only been to study adoption of IT (Oliveira and Martins, 2011), whereas STS has seen use across a broader array of research areas, sectors, and settings (Pasmore et al., 1982; Appelbaum, 1997).

With respect to healthcare, the TOE framework has seen relatively low use, with some studies which looked at IT adoption in healthcare (e.g., Cao et al., 2012; Sulaiman and Magaia, 2014; Alharbi et al., 2015) and one study which looked at other innovations (Meyer and Goes, 1988), which actually predated TOE but used same theoretical underpinning that led to TOE. The STS theory on the other hand has seen wider use in healthcare innovation (e.g., Geels 2004; Carayon, 2006; Braithwaite et al., 2009; Ulucanlar et al., 2013; Waterson 2014; Marjanovic et al., 2020)

In terms of the theories themselves, there is potentially a significant amount of overlap. From the perspective of the TOE framework, the components of STS could be grouped into the three contexts. Firstly, technology from the technical subsystem of STS could be grouped into the technological context. Then people, relationships among people, structure (from social subsystem), processes, and tasks (from technical subsystem) could be grouped under the Organisational context. And the external subsystem could be grouped into the Environmental context. For the reverse, grouping TOE framework into STS theory, technological context would come under technical subsystem, organisational context would be split between social and technical subsystems and environmental context would come under external subsystem.

Though neither theory carries an explicit weighting to its components, the way the theories are arranged sheds light on what is viewed as most important. In the TOE framework, technology has its own context and is noted to be split from others due to its importance (DePietro et al., 1990), whereas in STS it is only a component of the technical subsystem. Conversely, people and social factors are a significant part of the social subsystem in STS,

whereas they are only considered to be a factor in the Organisational context of TOE, suggesting STS places higher weight on people. The split of organisational factors between social and technical subsystems in STS is also different to TOE, which keeps all organisational factors in its one context. This is probably just due to the differences in designs of the two theories, and that the social and technical subsystems in STS are what make up the organisation (which are considered to be socio-technical systems by this theory). Environment remains similar between both theories.

2.5. Conclusions of the Literature Review

The literature shows how complex healthcare is as an industry and practice setting and how complex and challenging it is to innovate and support innovation adoption within its processes of decision-making and its multiple actors. Numerous influences on healthcare innovation adoption have been identified and investigated in a variety of settings, and various approaches to research have been explored.

The most suitable theoretical framework on which to base this research has been identified as the Technology-Organisation-Environment framework, due to the fact that its unit of analysis is at the organisational level and that it covers a broad array of the potential influences to innovation adoption in healthcare in Wales due to its three contexts.

However, due to the fact it has seen limited use outside of IT adoption, and limited use in healthcare, as well as the fact it does not consider individuals influence on adoption as strongly, the Socio-technical systems theory will be used to bolster the TOE framework. While STS theory was not originally developed for this purpose, it has seen empirical use in innovation adoption and is easily adaptable to this research paradigm.

2.6. Research Questions

This literature review detected many gaps in the extant body of knowledge and assisted the researcher to describe and articulate the current gap and contribution sought. These were framed as qualitative research questions to be investigated by this study.

The research question under investigation in this study was: *“what influences innovation adoption in healthcare in Wales?”*.

Additional sub-questions that were raised by the literature review, and which also aided in the answering of the main research question, included:

- Which factors previously identified in literature will also be identified as relevant in Wales?
- Are there factors that have not been identified or adequately explored in Wales?
- What are the levels of importance and relevance of these factors?
- How do these factors influence and relate to one another?
- How are these potential factors affected by circumstances, setting and contexts, and what is the importance of these?

Furthermore, from a theoretical and methodological perspective, another sub-question was:

“How effective is using and combining the TOE framework and STS theory for investigating innovation adoption in this setting and sector?”

The next chapter of this thesis will move from the gap in the literature to the development of a methodology which is appropriate and justified as a means of gathering valid knowledge and insights of innovation in the healthcare system and its many stages and perceived dysfunctional outcomes which result in more innovation failures than successes.

3. Research Strategy and Methodology

This research study investigated the influences concerning the adoption and use of innovations in healthcare, using NHS in Wales as the subject of the study, to answer the questions laid out in the previous section (2.6). The review of the literature and the case study of VADs suggested that influences do exist and that there are distinct, differing factors of influence that also differ in the extent to which they affect innovation adoption and use, and that act as either barriers or enablers to successful adoption and use. The initial conceptual framework was formed based on the premises that: there is extensive research into innovation and its adoption across multiple disciplines and settings which has found various factors and contexts of influence; Wales and the wider UK have goals to improve with innovation as the potential mechanism for this improvement - however there doesn't seem to be lack of innovations, rather there seems to be a lack of effectiveness in adopting innovations across the health systems (Greenhalgh et al., 2004; Petkova et al., 2010; Collins, 2018; Kelly and Young, 2017).

To explore this view, a context-rich study was needed which drew data from a systems approach and from individuals identified as having relevant experience, knowledge, and expertise in implementing innovations into use in the health service (influencers), this included individuals with backgrounds such as healthcare professionals, working in the healthcare industry, working in the public sector in healthcare and innovation related activities, in research and academia surrounding innovation and healthcare, and any other relevant experience in innovation and healthcare. Individuals from these groups have views and beliefs regarding the adoption of innovations in healthcare in Wales, based on their experience, which provided evidence to answer the research questions of this study.

This chapter presents a methodology that was able to answer the research questions and develop the conceptual framework in an effective way, using the theoretical lens provided by the TOE framework (combined and founded upon the strengths of a Socio-technical systems theory underpinning). Due to the complexity of the issue under study, the method of the collection of data had to account for complexity and capture all relevant detail, as did the methods of interpretation and analysis.

The purpose of the research was to investigate the influences on the adoption of innovations in healthcare, improve understanding of the reasons why innovations are not being adopted and spread in wider use so these can be mitigated, and understand what enables or facilitates successful adoption so that these can be enhanced. This section has presented a synopsis of the context and justification for this study, the remainder of the chapter will present and defend the decisions that have been undertaken, by the researcher, to generate new and valid knowledge in this contentious subject area.

3.1. Research Paradigm, Ontology, and Epistemology

Technology adoption or the diffusion of innovation has been studied widely across disciplines, and to some extent in the healthcare sector itself. It has been established recognised that there are numerous viable technologies and innovations in healthcare that have the required evidence to support their use, but many struggle for successful adoption and wider use (Meyer and Goes, 1988; Fitzgerald et al., 2002; Greenhalgh et al., 2004; Petkova et al., 2010; Kelly and Young, 2017; Collins, 2018). Sometimes the reverse is true: where an innovation is spread into wider use without the highest level of evidence (Nahta and Esteva, 2007). In the case of VADs, where the evidence is there for their use, but use remains relatively low, some medical practitioners are frustrated with this (Miller and Guglin, 2013; Westaby and Deng, 2013).

Like other innovations, technologies, and treatments in health care - the reason for low VAD use may be significantly linked to and potentially dependent on the beliefs and subsequent decisions made by various groups of people and not on clinical evidence or financial constraints alone; and this is what this doctorate aimed to study. People who may have an influence could include policymakers and board members who decide on potential treatments to fund and the scale of their implementation, healthcare professionals that would be involved in utilising the innovation, innovators, and other representatives from the healthcare industry from small and large organisations, or any other stakeholder in the adoption of innovations into the health service in Wales and the UK.

The knowledge sought by this research was based on the knowledge and beliefs of people outside of and in addition to their objective knowledge on the clinical or other material effectiveness of an innovation. The knowledge is subjective to the individuals and a matter

of perspective, that may change between individuals within the same group or between different groups. What is important about the knowledge is what is useful about it, and how it can be used to answer the research questions.

This research sought to answer and understand the influences on innovation adoption in healthcare in Wales, providing actionable knowledge that can be used to solve the problem of poor adoption and use of available innovation and understand how to facilitate and enhance successful adoption and use of innovation. To achieve this, the methods had to be able to solve the problem by finding out the influences and understanding their importance, which then has the potential to be used to effect change.

With these points in mind, the researcher's ontological position is that reality is constantly renegotiated, debated, and interpreted and therefore the epistemological position is that the best methods for research are the ones that solve problems, giving the research paradigm of pragmatism (Lee and Lings, 2008; Saunders, Lewis and Thornhill, 2009; Creswell and Creswell, 2018; Frey, 2018; Maarouf, 2019; Kelly and Cordeiro, 2020).

The paradigm of pragmatism allows and accounts for the differences in the nature of knowledge that participants may have regarding the questions and served to keep the researcher aware that there is more than one 'reality' in this research (Frey, 2018), due to the perspectives of multiple individuals, but at the same time a consensus can be reached on factors which the group believes to influence adoption and use of innovations in Wales.

Considering the research paradigm and ontological and epistemological positioning, purely positivist approaches were discarded, as there were no measurable or directly quantifiable facts to be researched here (Creswell and Creswell, 2018; Maarouf, 2019). Also, there are no established means of calibrating key concepts and constructs needed for a positivistic study and furthermore the subject of innovation in healthcare is emergent and embryonic within which significant levels of confusion exist. Rather, this study needed to account for the influences and behaviours of multiple (sometimes illogical) actors and therefore this study is concerned with the perspectives of "relevant" influencing or insightful people where there is a high likelihood and potential for individual differences (Kelly and Cordeiro, 2020), and for these attitudes of actors to change with new information and the dynamism of the healthcare environment. Therefore, the researcher determined a more interpretivist/constructivist qualitative approach was required to elucidate the knowledge

needed to close the gap in the body of knowledge (Creswell and Poth, 2016). Having said that, the study design did not have to focus exclusively on methods that are wholly qualitative, and others were explored to see if they could offer a superior insight into the problem and more effectively answer the research questions (Lee and Lings, 2008; Saunders et al., 2009; Frey, 2018; Creswell and Creswell, 2018).

Tools that are traditionally used in one research philosophy can be useful in another to generate valid knowledge, and therefore a mixed method approach may work (i.e., different for data collection and layers of analysis) (Johnson et al., 2007; Shorten and Smith, 2017; Creswell and Creswell, 2018). It is possible to use both qualitative insights to understand a system and quantitative methods to test these insights.

It should be noted that the study did not seek to find deterministic cause(s) for the adoption and use of innovations in Wales, but the knowledge sought by questioning stakeholders in the adoption and use of innovations did allow the building of a consensus on what the possible and probable influences are (Bogner et al., 2009; Trinczek, 2009; Saunders et al., 2009; Creswell and Creswell, 2018), and what the enablers of barriers to adoption are. It also gave insight into areas that need focus to improve or streamline adoption.

3.2. Axiology

From a pragmatic research philosophy, values play a large role in interpreting results (Li and Li, 2015). The researcher can adopt both objective and subjective points of view. The interpretive element of any pragmatic approach introduces bias in that it is the researcher that decides how to interpret data, which can be affected by values (Biddle and Shafft, 2015). This is true for data collection methods where there is interaction between subject and researcher. However, there are parts of the methodology that can be more value-free in a pragmatist approach, including quantitative approaches to further analyse quantitative data (Lee and Lings, 2008; Saunders, Lewis and Thornhill, 2009).

The researcher's values relevant to this research include the core belief, which is the same as the core belief at the heart of healthcare, that healthcare should be designed, organised, and delivered in a way that maximises the value and outcomes for people using it, and in world of limited resource (i.e., the current world), maximises efficiency and allocation of resource to areas of need. What this means is that, while having no strong view on specific

individual innovations, the researcher views the adoption and use of effective and innovations into the health service as important to achieve the aforementioned beliefs. Therefore, these values will not significantly bias the research in a particular direction since the goal of the research is simply to investigate and understand what the factors of influence in innovation and adoption are. For example, a bias that influences the researcher to find one factor more important than another serves no purpose for the researchers' values, as it would artificially inflate importance, which does not serve the goal of ultimately improving healthcare – if anything it hinders.

However, it should be noted that the researchers background, culture, experience, and beliefs can certainly still influence the research in data collection and interpretation phases, but this did not create bias that affected the answering of the research questions in this study. Furthermore, through the effective and transparent presentation of the methodology (in this chapter), every effort was used to minimise any negative biases and pre-assumptions or reflexivity.

3.3. Research Approach – Qualitative Versus Quantitative

The research questions, theoretical perspective, and research paradigm of pragmatism raise the question of which type(s) of research is best to investigate and solve the problem of “What influences innovation adoption in healthcare in Wales”?

For a number of reasons, a mainly qualitative approach proved more effective in this study certainly for the collection and primary analysis of the data (Saunders et al., 2009; Creswell and Poth, 2016; Creswell and Creswell, 2018; Miles, Huberman and Saldaña, 2018; Saldaña, 2021).

Firstly, as Greenhalgh et al., (2004) notes, only a small proportion of studies set out to study the complexity of the adoption of innovation in healthcare because they aim to control for confounding variables and context to make the research objective in more quantitative and positivist approach. The problem with this is that context and these ‘confounders’ “lie at the very heart of the diffusion, dissemination, and implementation of complex innovations”. This study aimed to investigate and understand *all* influences with a holistic approach, and this was better served by a qualitative approach that can capture all nuance and detail in the complex issue of innovation adoption (Maxwell, 2012; Creswell and Poth, 2016; Miles et

al., 2018; Hennink et al., 2020). Furthermore, this makes the research more non-reductionist and subjective, which again are characteristics of qualitative research (Maxwell, 2012).

In terms of inductive and deductive reasoning, this study resembled a combination of both. As discussed, the TOE framework was used as a theoretical basis for the investigation of the research questions in this study, which guided the collection and analysis of data. At the same time, there was the goal to develop a theory that is unique to these circumstances, and therefore there was a degree of using the specific observations in the study to make broader generalisations that helped to answer the research questions and solve the issue of innovation adoption in healthcare in Wales.

A further benefit of beginning with the conceptual framework of TOE, plus the clear and defined research questions, is that this helped to mitigate against overload from the extensive volume of data and information to be analysed (Miles, Huberman, and Saldaña, 2018). The conceptual model therefore framed the subject of study and allowed the researcher to focus on exploring the gap in a meaningful manner. Only a grounded theory approach does not use a literature review at the beginning of the process of study and this was considered to be dangerous and potentially lead to very unusual insights into the performance of a health system and it was a strategy that was unsuited to the objectives of this study (and practical implications of conducting a doctoral study as a lone researcher without significant budgets nor time available) (Maxwell, 2012; Creswell and Poth, 2016; Miles et al., 2018).

3.4. Data Collection Methods

As previously discussed, to answer the research questions in this study the participants in this research needed to have experience with and expertise in innovation in healthcare, preferably with direct experience with Wales but also from the rest of the UK as well.

To obtain data from the participants of this research, there are a few possible methods, such as interviews, focus groups, questionnaires or surveys, observations, ethnographies, or case studies.

The methods of Ethnography, oral histories, case study were excluded, as the data this research sought to collect pertains to individuals' experiences and beliefs but needed to come from a certain number of individuals with a variety of experiences and backgrounds to

provide a holistic view into the influences of adoption and innovation in healthcare, which allows for a consensus of opinions to form, or show there is no consensus (Maxwell, 2012; Creswell and Poth, 2016). Therefore, the methods of interviews and questionnaires were considered.

Table 2. Interviews versus Questionnaires for collecting data in social science research.

Adapted from <https://cyfar.org/collecting-data>.

Method	Key points	Example
Interviews	<ul style="list-style-type: none"> • Interviews can be conducted in person or over the telephone • Interviews can be done formally (structured), semi-structured, or informally • Questions can be focused, clear, and encourage open-ended responses • Interviews are mainly qualitative in nature 	One-on-one conversation with parent of at-risk youth who can help you understand the issue.
Focus groups	<ul style="list-style-type: none"> • A facilitated group interview with individuals that have something in common • Gathers information about combined perspectives and opinions • Responses are often coded into categories and analysed thematically 	A group of parents of teenagers in an after-school programme are invited to informally discuss programmes that might benefit and help their children succeed.
Questionnaires and Surveys	<ul style="list-style-type: none"> • Responses can be analysed with quantitative methods by assigning numerical values to Likert-type scales 	Results of a satisfaction survey or opinion survey.

	<ul style="list-style-type: none"> • Results are generally easier (than qualitative techniques) to analyse • Pre-test/Post-test can be compared and analysed 	
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3.4.1. Interviews (and Focus Groups)

Interviewing is one of the most common techniques in social science research and can be carried out face to face or remotely (e.g., telephone, instant messaging, or email interviewing). Interviews can have varied levels of structure, such as ‘structured’ (or ‘formal’) interviews, where the interviewer asks the same questions in the same way to different respondents. This may typically involve reading out questions from a pre-written and pre-coded structured questionnaire, in that way it is similar to surveying with a questionnaire, receiving a verbal response instead of a written one. ‘Unstructured’ (or ‘informal’ or ‘discovery’) interviews are like a guided conversation. The interviewer has freedom to vary the questions from respondent to respondent and follow lines of enquiry they believe to be most appropriate, depending on the responses given by each respondent. In ‘semi-structured’ interviews there are a list of questions to ask, but the interviewer can ask further, differentiated questions based on the response of the interviewee (Mason, 2002; Brinkmann, 2014; Creswell and Poth, 2016; Creswell and Creswell, 2018).

Interviews can be one-on-one, or they can be in a group. In group interviews, the two or more individuals are interviewing at the same time. They have different strengths and weaknesses to individual interviews. Focus groups are a type of group interview where respondents are asked to discuss certain topics (Gill et al., 2008).

In general, the more structured the interview the more positivist it is (attempting to be, i.e., more quantitative/quantifiable) and the less structured, the more interpretivist (more qualitative). There are advantages and disadvantages to the different types of interviews and to the interviewing methodology itself. For example, interviewing can allow the researcher to gain more in-depth responses to the questions and may uncover potential new lines of questioning or knowledge that the researcher didn’t incorporate into the original interview questions. However, interviews are time-consuming, due in part to the in-depth responses, but also largely due to the issue of transcribing (oral interviews). This can

make it difficult to collect a large sample size of numerous respondents, which may consequently make any later data analyses less robust. Interviewing can also be difficult to subsequently analyse if they are less structured, as different interviews may go in different directions (Gill et al., 2008; Brinkmann, 2014; Creswell and Poth, 2016).

Interviewing was the eventual method selected for this study for a number of reasons including the fact that greater detail can be gathered which can capture all nuance, context and setting-specific information, and also that new information can be discovered (in less structured interviews) This is explored further in Section 3.4.5.

3.4.2. Survey by Questionnaire

Survey research via questionnaire is a common method used for collecting data from a population of interest. There are many types of survey, several ways to conduct them, and many methods of sampling. Two key features of survey research are questionnaires: a predefined set of questions used to collect data/information from individuals, and sampling: a technique in which a sub-group of a population is selected to answer the survey questions. The information collected has the potential to be generalised to the entire population of interest (Babbie, 1990; Sue and Ritter, 2012; Dillman et al., 2014; Fowler, 2014; Creswell and Creswell, 2018)

The two most common types of survey questions are closed-ended questions and open-ended questions. In closed-ended questions, the respondents are given a list of predetermined responses from which to choose their answer. The list of responses should include every possible response to the given question and each response should not overlap in meaning. An example of a close-ended question type could be 'please rate how strongly you agree with <insert statement>' from a scale of "strongly disagree, somewhat disagree, neither agree nor disagree, somewhat agree, or strongly agree". This is known as a Likert scale. Closed-ended questions can be preferred in survey research because of the ease in counting the frequency of each response (Babbie, 1990; Fowler, 2014).

In open-ended questions, survey respondents are asked to answer each question in their own words. The responses can then be categorised into a smaller list of responses that can be counted by the researcher for statistical analysis (Babbie, 1990; Fowler, 2014).

The order of questions is also important, for example easier and more pleasant questions at the start of a survey encourage respondents to complete the survey. In general, any sensitive or difficult questions should be put at the end because the respondent may have built up more trust with the research and are more likely to answer. If they don't then at least the questions beforehand have responses (Babbie, 1990; Creswell and Creswell, 2018).

Double-barrelled questions (which ask two things in one question) should not be used in a survey because respondents must give one answer for two questions. Emotionally loaded or biased wording of questions should also be avoided (Babbie, 1990; Sue and Ritter, 2012; Fowler, 2014).

This method was initially tested with the illustrative case of VADs but was deemed unsuitable to take further due to a number of reasons (see Section 3.4.4).

3.4.3. Methods Used in the Literature

As seen in the literature review, the majority of research into innovation adoption follows a quantitative approach, with either survey via questionnaire or interview as the data collection method and a mixture of statistical data analysis methods such as logistic regression, structural equation modelling, or confirmatory factor analysis. This is especially true for research utilising technology adoption models, or the TOE framework (Oliveira and Martins, 2011) and also seems to be the case for much research in healthcare innovation adoption (Greenhalgh et al. 2004).

However, there are examples of more qualitative approaches in some key studies such as case studies (e.g., Denis et al., 2002; Fitzgerald et al., 2002; Nahta and Esteva, 2007) and also more qualitative interview approaches (e.g., Greer, 1988) or mixed methods approaches (Meyer & Goes, 1988).

It is apparent there are many effective ways to investigate this area, therefore using a pragmatic research paradigm, methods were selected based on what was best placed to answer the research questions specific to this study, after the review of potential methods explored in this chapter.

3.4.4. Early Pilot Testing of Data Collection Approach

Initially, it was considered that the case of VAD adoption in the UK would be investigated. Therefore, an online survey questionnaire method was developed to achieve this and was pilot tested. However, this approach was not taken further mainly due to the decision to broaden the scope of the study to include any kind of innovation in healthcare in Wales. Section 3.4.5. presents the final data collection method used in this study – semi-structured interview – as well as the rationale for its use.

The following section describes the online survey questionnaire approach that was initially tested, and why it was not utilised.

3.4.4.1. Survey Via Online Questionnaire to Investigate VAD Adoption Case -a Quantitative Approach

The approach tested to investigate the influences on VAD adoption in the Wales/UK was more quantitative and positivist and involved the development of an online survey questionnaire which was largely closed-ended questions with some open-ended questions (Babbie, 1990; Sue and Ritter, 2012; Dillman et al., 2014).

The sampling was purposive for groups involved with and knowledgeable about VADs including cardiac surgeons, medical device industry representatives, regulators and policy makers, and researchers (Babbie, 1990; Creswell and Creswell, 2018).

This survey was developed using previous literature utilising the TOE framework, adapting items from their surveys to the setting and circumstances of VADs in the UK (see Appendix B; Oliveira and Martins, 2011). The survey responses were going to be analysed by statistical software after collection in similar methodology to previous TOE research (see Appendix B; Oliveira and Martins, 2011).

However, as the survey began administration it quickly became clear enough responses would not be achieved. This may have been for a number of reasons, principle among which was likely that the COVID-19 pandemic occurred as the survey began administration. Further reasons may be the fact the surveys were too long, detailed, and specific, and the populations trying to be reached are low in number, busy in normal times (i.e., pre-pandemic) and could potentially see this as low priority (Dillman et al., 2014; Creswell and Creswell, 2018).

The decision was taken to revisit the methodology with the aim of researching the question “what influences innovation adoption in Wales?”. The new approach outlined below was exceedingly more successful in terms of data collection and analysis, as is discussed in the Discussion (Section 5.9).

3.4.5. Final Data Collection Method – Semi-structured Interview

Due to a number of advantages, a semi-structured interview protocol was developed for use in this study which entailed a loose structure followed for all interviews, broad, simply framed questions, and example follow-up questions, as well as themes that could also be brought in and explored where necessary. This section will outline the reasoning for choosing this method, and the protocol followed for interviews.

3.4.5.1. *Rationale for Using Method*

Interviewing allows the researcher to gain more in-depth responses to questions and semi-structured or unstructured interviews may uncover potential new lines of questioning or knowledge that the researcher didn’t incorporate into the original interview questions (Dearnley, 2005; Low, 2013; Brinkmann, 2014; McIntosh and Morse, 2015; Creswell and Creswell, 2018). The ability to allow interviewee to participate in the dialogue, and the ability to utilise follow-up questions, probes and comments was ideally suited to this study because it seeks to discover the influences on innovation adoption, especially those not previously identified, and to investigate and understand them in terms of their importance, relationships, and direction, in all relevant nuance and detail, in the circumstances and settings relevant to this study (Dearnley, 2005; Low, 2013; Brinkmann, 2014; McIntosh and Morse, 2015; King et al., 2018).

Further benefits include the fact that greater detail can be covered than other methods, which allows for context, setting and circumstance specific information to be captured – especially important for the holistic approach required, that not only accounts for but embraces the complexity of the issue at hand (Greenhalgh et al., 2004). In addition, the ability to establish trust and a rapport during an interview, which is easier in less structured, face to face interviews, can put interviewees at ease and may produce responses from interviewees that they may not otherwise share (Dearnley, 2005; Low, 2013; Brinkmann, 2014; McIntosh and Morse, 2015; Creswell and Creswell, 2018).

While less structured interviews can be difficult to analyse and compare due to the potential for interviews to go in different directions with different responses, this was not a significant issue in this research, as will be outlined in the data analysis methods (Section 3.5).

Furthermore, having some structure due to it being semi-structured mitigated the amount of variation to a certain degree, and allowed themes to be explored with interviewees (if they did not bring them up naturally) (Dearnley, 2005; Low, 2013; Brinkmann, 2014).

Other issues include the fact that analysis of semi-structured interviews is time-consuming (Saunders et al., 2009; Brinkmann, 2014; Creswell and Creswell 2018), which was an acceptable drawback outweighed by the advantages of this method and the goals of this study as previously outlined. In addition, there is the potential for bias with this type of research method, but as previously discussed in ontology and epistemology (Section 3.1 and 3.2), this was not considered to have an impact on this study that would detriment the research in an unacceptable way.

Another key issue, which was almost entirely mitigated in this study, is the fact that interviews require transcribing, which is usually highly time-consuming (Miles et al., 2018). However, due to the fact that these interviews were conducted via a popular online video conferencing software that had an auto-transcribe feature, this time was greatly reduced. The pilot interview showed that the transcription feature was sophisticated enough to capture the conversation with a high degree of accuracy, with some expected limitations (e.g., had difficulty with uncommon names or places) and relatively smaller amount of time was required to correct the transcripts. Furthermore, it was easier to conduct the interviews from a technical standpoint (Gray et al., 2020)

A further point on using online video interviews was that, as the COVID-19 pandemic had struck a high proportion of people across society began to use video conferencing on a daily basis out of necessity, and tolerance of this method of interviewing was likely raised because of this. Therefore, while face to face would probably be preferable to most people still, interview via video conferencing proved an effective substitute, especially due to auto-transcription.

3.4.5.2. Purpose

The purpose of research interviews is to explore the views, experiences, beliefs and/or motivations of individuals on specific matters. Qualitative interviews as opposed to quantitative and can provide a deeper understanding of the social phenomena under investigation (Silverman, 2013; Brinkmann, 2014). Interviews therefore were appropriate to study the questions in this study where detailed insights from individual participants were sought.

These interviews aimed to gather data on the experiences, knowledge, and opinions of the participants on the influences of innovation adoption in healthcare and to make inferences about how certain factors of influence affect the adoption of innovations, how important the factors are, how they relate and how they depend on context. Furthermore, whether there was consensus between diverse interviewees or not was also investigated. The goal was to develop an understanding of the adoption of innovations of healthcare in Wales which lead to the development of a theory for this phenomenon in this setting, and a framework that can be used to analyse innovation adoption cases in healthcare and other settings, with the goal of enhancing the adoption of effective innovations.

3.4.5.3. Population and Sample

As mentioned, the 'population' this study is aimed to research is people who have experience, knowledge, expertise in innovation in healthcare (Fitzgerald, Ferlie, Wood, & Hawkins, 2002; Gelijns & Rosenberg, 1994; Greenhalgh et al., 2004; Petkova, Schanker, Samaha, & Hansen, 2010; Rogers, 2003).

This criterion is relatively simple but is the key criterion that mattered for this study. The second criterion is to have a diverse set of interviewees that met the first criterion (McIntosh and Morse, 2015). What this meant was to not have people with all the same background and experience but with diverse backgrounds and experience in healthcare innovation.

Groups that meet the first criterion could include healthcare professionals, innovators in healthcare, healthcare industry workers from small to large companies, public sector workers in healthcare and innovation related roles, researchers and academics surrounding innovation and healthcare, and any other group that has relevant experience in innovation

and healthcare, with a focus on Wales (Greenhalgh et al., 2004; Petkova et al., 2010). The reasons these groups were considered were of course because they met the first criterion but also because they were influencers of adoption, or adopters of innovation, or were otherwise stakeholders in the adoption of innovations into Wales and the UK's health services. Therefore, the sampling aimed to capture individuals from each of these groups.

Therefore, the method of sampling designed, adopted, and used in this study was purposive sampling. This method fit this research's design and goals well as it allowed the recruitment of participants who could provide in-depth and detailed information about the phenomenon under investigation (Mason, 2002; Maxwell, 2012). It is a subjective method and participants were determined by the qualitative researcher using the qualifying criteria outlined above (Creswell and Poth, 2016; Creswell and Creswell, 2018). It was also the most practical method.

Since the aim of this study was to engage with a wide range of actors in the Welsh healthcare innovation system, participants were purposively selected with the shared characteristic of having experience and expertise with healthcare innovation, and also to interview diverse range of participants relevant to the particular phenomenon, the sample design was a combination of expert sampling and maximum variation or heterogeneous purposive sampling. This kind of sample design was used to provide as much insight as possible into the phenomenon under examination due to the diversity and expertise of participants (Leonard-Barton, 1985; Bogner et al., 2009; Trinczek, 2009; Leonard et al., 2013).

The researcher utilised their own network as well as those of other academics involved with or with healthcare innovation to find potential participants. After initial interviews, snowball sampling was also utilised to find further participants who met criteria (Saunders et al., 2009; McIntosh and Morse, 2015; Creswell and Poth, 2016). This led to combination of participants who potentially knew each other in a network and those that did not. All had extensive background in healthcare and innovation and a minimum of 5 years was used to ensure that each informant had sufficient expertise and insight.

Purposive sampling is less rigorous than random sampling from a positivistic perspective, which is the most rigorous and enables one to generalise the findings to the entire population (Saunders et al., 2009; Creswell and Creswell, 2018). Random sampling also

removes a source of bias when selecting individuals to participate in the survey. However, it was not feasible to use in this case, for the reasons that expertise in the phenomenon under investigation was an absolute requirement (Bogner et al., 2009).

Characteristics of interviewees other than their career history were not of interest in this study and were not recorded. However, as stated the aim was to have a diverse set of respondents and this included age, gender, etc. where possible, in addition to multiple professional backgrounds, to give better insight into the TOE elements of Welsh healthcare innovation.

The aim of engaging multiple informants was to achieve 'researcher saturation' by interviewing as many people as necessary to determine all potential influences in innovation adoption and reach a point where the next interviewee adds no more new useful knowledge than any previous informant (Guest et al., 2006). Due to time and resource constraints interviewing too many individuals and analysing all of these in depth was unfeasible (Miles et al., 2018). Guest et al., 2006 showed that saturation occurs within the first twelve interviews, with basic elements for metathemes present as early as six interviews. Therefore, in this study 13 participants were engaged for interview and cross-informant evaluation proved a point of saturation had been achieved.

The analysis of these informants will be discussed below (Section 3.5).

Information on the interview participants can be seen in Appendix C.

3.4.5.4. Ethics of Interview Research, Consent, Confidentiality and Anonymity

This study was submitted to and approved by the Swansea University School of Management research ethics committee.

All participants in the study received informed consent before participating in interviews. Interviewees were informed of the study's purpose, content, duration, and potential risks and benefits. They were notified that they do not have to answer all the survey questions, and that they can stop participating in the study at any point.

This study kept participants identities confidential. To ensure confidentiality, participants identifiers were not linked to the data presented in this thesis.

All interviewees who agreed to participate consented to the study.

3.4.5.5. *Interview Framework*

The semi-structured interview framework was developed by drawing on literature and reviewed by other academics to create a loose overall structure, and potential themes to explore where necessary. The goal was to allow interviewees to speak about and discuss innovation adoption in as unguided and unprompted way as possible (Low, 2013; Brinkmann, 2014) and using potential questions from within the themes of 'Individual/personal', 'Peer/social', 'Organisational', 'Environmental', 'Technological/innovation', which were mainly developed from the TOE framework (DePietro et al., 1990; Oliveira and Martins, 2011; see Appendix B), augmented by other literature in healthcare innovation (Gelijns and Rosenberg, 1994; Fitzgerald et al., 2002; Greenhalgh et al., 2004; Petkova et al., 2010).

The framework was tested via a pilot interview with an individual who had both experience of innovation in healthcare in Wales, and in academia, and was able to provide feedback on the interview framework and protocol. The main feedback was the fact that the researcher used the themed questions relatively frequently, which caused the interview to feel less like a conversation, caused assumptions to be made and introduced a higher likelihood that questions could lead interviewee in a certain direction or overly prompt them.

Therefore, the interview framework was modified to avoid the researcher taking the interview in preconceived directions and leading interviewees in questions by overly using preconceived themes. This was to encourage the potential discussion of factors which hadn't previously identified and to allow interviews to discuss what was most important to them in terms of innovation adoption.

The remainder of interviews were conducted with a very loose structure which began with discussing the study, then asking interviewees about their career background and experience, then continued by following a loosely repeating structure, outlined below:

1. Have you got an example of an innovation that you have worked with that was either successfully or unsuccessfully adopted?
2. Follow-up questions asked about their example, such as "why was that successful?", "How did X affect that?" and so on.

3. Allow for other examples to be brought in by interviewee, and discussion to develop naturally.
4. Ask questions about influences of innovation adoption more generally if deemed appropriate: e.g., “what is often a barrier?” “How important is X”?
5. Then when seems appropriate:
 - a. repeat steps 1-4 until no longer useful, then:
 - b. explore themed questions* if any areas felt not to be covered adequately.
6. Finish by asking if there is anything else they want to add they feel is important.

***Note** – themed questions can also be used throughout if deemed appropriate and relevant

Please see Appendix D for the original interview framework. The researcher used this while conducting the interviews, but the majority of the interview followed the loose structure of example → follow-up → discuss topic → repeat, as outlined above.

3.4.5.6. Storing and Processing the Data

The transcripts and recordings of interviews were stored securely by the researcher and password protected, which only the researcher had access to, in compliance with GDPR.

Initial processing of data before analysis entailed “cleaning” the raw auto-transcripts and recordings by correcting errors in the transcript by referencing audio-visual recordings and formatting them for readability (Miles et al., 2018).

3.5. Data Analysis

The analysis of the interview data combined a few methods in line with the principle of pragmatism to find “what worked best”. Many methods were explored and considered to analyse, code, and present the data before the interviews were conducted and, with some refinement during and after data collection was concluded, the methods were finalised. The coding approach included a combination of methods including descriptive, in vivo, simultaneous and magnitude coding. Analysis included the first and second cycle coding and content analysis, utilising the principles of Geertz’s ‘thick description’ (Geertz, 2008). Presentation of the data included presenting the conceptual framework visually (via Venn diagram) and collecting forms of analysis in various data displays. These methods are discussed below.

3.5.1. Analysis During Data Collection

As advised in Miles, Huberman and Saldaña (2018), analysis was conducted concurrently with data collection. As such, during the interviews, notes were taken which concerned key thoughts and potential codes to explore during analysis, which were written-up after the interviews. Then, after the transcript had been prepared for analysis, the transcripts were manually analysed in great detail and first cycle coding was carried out, aided by the interview notes (Geertz, 2008; Miles et al., 2018).

Conducting analysis concurrent with data collection allowed cycling back and forth between thinking about existing data and generating strategies for collecting new, and potentially better data in later interviews (Miles, Huberman and Saldaña, 2018). It also helped identify some clear built-in blind spots in the form of the importance of 'People' as a greater influence in adoption, covered detail in Chapter 4 and 5, and requiring revisits and additions to literature review (Chapter 2).

3.5.2. First Cycle Coding

Coding of data allows for the condensation of data, and also acts as a method of discovery (heuristic) and can help to detect emerging patterns thus itself is a level of analysis (Miles et al., 2018). Saldaña's definition of a code: "most often a word or short phrase that symbolically assigns a summative, salient, essence-capturing, and/or evocative attribute for a portion of... ..data", was used to guide the coding in this study (Saldaña, 2021) but sometimes codes were assigned to larger chunks of data based on the meaning. First cycle coding concerns the codes which are initially assigned to data chunks, the approach to this is outlined in this section.

The research questions informed the coding. The main question "what influences the adoption of innovation in healthcare?", with the modifiers of "in Wales", "in the UK", or "in general", were used as a basis to assign codes to data chunks that were regarding specific influences on adoption.

For example, early on in analysis it became clear that 'leadership' was commonly mentioned by interviewees as an influential factor in adoption of innovation, therefore any chunk of text which referred to leadership was assigned the 'Leadership' code. Please note, all codes are defined in Appendix E.

The approach to first cycle coding combined a number of coding methods, outlined in Saldaña (2013), to best fit the data, the research questions, and the conceptual framework. The primary method of assigning a code was via both 'descriptive' and 'in vivo' coding. Descriptive coding meant assigning labels to data to summarise in a word or short phrase the basis topic of the passage of data (Wolcott, 1994), for example "Alignment of Actors/Objectives" was applied to data which talked about the extent of the alignment between actors or objectives working with an innovation and its adoption, and how this influenced adoption. In vivo coding meant using words or short phrases from participants own language as codes (Corbin and Strauss, 2008), for example "Getting the Right People", "People who get sh*t done". In vivo coding was less common, and descriptive coding was utilised most often.

Additional coding methods which were combined into the approach included magnitude coding, and simultaneous coding. Magnitudes, consisting of alphanumeric or symbolic codes or subcodes, applied to existing coded data can be used to indicate their intensity, frequency, direction, or presence (Miles et al., 2018; Saldaña, 2021). In this case, a '+' or '-' was applied to codes based on whether a coded segment of data indicated a factor that influences innovation adoption as either an enabler or a barrier respectively, and it was neither or both it was left blank. This allowed for analysis to answer the research question regarding whether discrete factors of influence act as barriers or enablers (Section 2.6).

Simultaneous coding is the application of two or more different codes to a single qualitative datum, or the overlapped occurrence of two or more codes applied to sequential units of qualitative data (Miles and Huberman, 2018). This method is appropriate when the data's content suggests multiple meanings. It is also a way for the interrelationship of codes to be assessed (Saldaña, 2021). In this study for example, it allows for the complexity of problem of innovation adoption to be acknowledged and explored in the analysis. Interviewees often mentioned multiple, discrete influences of adoption together in the same or sequential passages of data. Simultaneous coding allowed for all of these to be captured and for later analysis of the interrelationship between codes i.e., analysis of the interrelationships between influences of innovation adoption, which answers this research question (Section 2.6).

The creation of codes was mainly via an inductive process, i.e., they emerged progressively during data collection or analysis (Creswell and Poth, 2016). To a lesser extent there was a deductive use of codes based on the knowledge of the innovation adoption literature, such as 'champions'. However, the main approach was inductive, and emerged from the data with no pre-existence or need to attempt to 'force-fit' data to existing codes. Indeed, even 'champions' emerged directly from the data, with the first interviewee analysed directly discussing them (Interviewee B, see Appendix H).

Codes were revised where necessary (Miles et al., 2018; Saldaña, 2021), but this was an infrequent occurrence. The goal was to find and code each discrete influences on innovation adoption, and if two separate codes were largely indistinguishable, they were combined, such as 'Alignment of Actors' and 'Alignment of Objectives' being combined into 'Alignment of Actors and Objectives'. The reverse was occasionally necessary, where one code required splitting into two codes, for example 'Attitude to Risk' required a code split out from it regarding how individuals regarded their reputation in terms of participating in innovation/adoption, which had a component of risk but was nuanced enough to be split out into 'Reputational'. Relatively few of the codes required revision.

It should be noted that since coding is subjective, a different researcher may have assessed the data and coded differently, but this is an inherent and accepted part of qualitative research (Silverman, 2013; Creswell and Poth, 2016; Miles et al., 2018; Saldaña, 2021). However, the coding made by the researcher in this study was assessed via a confirmatory coding exercise with three other academics after first cycle coding was complete, who agreed with the coding.

3.5.3. Selection of Key Participants for Second Detailed Analysis

After the data collection and initial coding by analysing all interviews was complete when saturation of codes was reached (i.e., no new codes emerging in latter interviews), seven key participants were selected to have a second detailed manual analysis. This meant revisiting these seven participants to check for codes that had emerged or been refined in later interviews, ensure nothing important was missing from first cycle coding, and to apply the other first cycle coding methods as required (i.e., magnitude/simultaneous). The data from these seven participants was then taken forward into secondary analysis.

The reason for selecting seven out of the total thirteen interviewees was due to time and resource constraints: it would not be feasible to analyse all thirteen interviewees' data due to the volume of data to be analysed.

Selection was based upon three main principles. First, the seven chosen must cover all of the discovered codes well. Second, the interviews which had the largest quantity of highest quality data: e.g., the richest, strongest, and most diverse points, were prioritised for selection (Silverman, 2013; Creswell and Poth, 2016; Miles et al., 2018). In the same vein, if two interviews covered very similar ground, one was chosen over the other based on the same criteria (Miles et al., 2018; Guest et al., 2006). Third, a diversity of career background and experience between the seven was desired (McIntosh and Morse, 2015). If two interviewees were from very similar background, the interview which had the richer data was chosen (Miles et al., 2018).

Information on the seven participants chosen (Interviewees B to H) can be seen in Appendix C, along with all other interviewees. Interviewees were assigned from B to N based on the columns they were placed in in the Master Data Display (Appendix I). There was no 'Interviewee A' as column A in that spreadsheet contained the codes discovered.

3.5.4. Second Cycle Coding

Second cycle coding can be used to reorganise and reanalyse data coded through first cycle coding methods.

Pattern coding, as a second cycle coding method is a way to group the data summarised by first cycle coding into a smaller number of categories, themes, or constructs (Saldaña, 2021). Pattern codes are explanatory or inferential, and identify an emergent theme, configuration, or explanation. They pull together material from first cycle coding into more meaningful and parsimonious units of analysis (Miles, Huberman, and Saldaña, 2018). This is similar to thematic analysis.

The approach of this research was to use the TOE framework as the theoretical basis for higher-level contexts which codes could be grouped under (DePietro et al., 1990). Based on previous TOE empirical studies (see Appendix B; and Oliveira and Martins, 2011), it was assumed that codes of discovered factors would fit neatly under the three contexts to a roughly equal degree.

However, as was quickly discovered during the research, several codes emerged which placed an emphasis on the importance of 'People' in a way that was important and distinctly independent from 'Organisational' factors. Furthermore, it was considered that many of the codes could be grouped under more than one context. These points are explored and discussed in detail in Chapter's 4 and 5.

After this was resolved, the codes discovered were assigned to one or more of the four contexts, "People", "Organisation", "Environment", "Technology".

This second cycle coding was confirmed, in addition to the first cycle codes, at a confirmatory coding session with three other academics, who agreed with the coding.

3.5.5. Content Analysis

The analysis method of content analysis was applied to quantify and analyse the presence, meanings, and relationships of the forty-four discovered codes. This gave a further level of analysis in which the goal was to provide an insight into the level of general importance of the codes, as well as the level of interrelationships between pairs of codes, and also the extent to which codes acted as barriers or enablers. This is a technique that blends qualitative and quantitative approaches, as it quantifies some of the qualitative data by counting instances of codes (Saunders et al., 2009; Bryman, 2012; Creswell and Creswell, 2018). It is useful to analyse large amounts of textual data (Stemler, 2000). This data was then easily presentable in data display matrices (described in Section 3.6).

3.6. Presenting, Displaying and Visualising the Data

Raw data from interviews which entails lengthy, unreduced text is cumbersome and difficult to present as a whole (Miles, Huberman, and Saldaña, 2018). Concise delivery of analysed data via a visual format that presents information systematically so that the user can draw conclusions and makes it more presentable and digestible for the reader, was an important goal for this research.

Designing and creating data displays is an effective way to achieve this. They can permit viewing of a full data set in the same location and, when arranged systematically, can be used to answer the research questions of the study (Miles, Huberman, and Saldaña, 2018).

They are used frequently and effectively in qualitative social science research (Verdinelli and Scagnoli, 2013).

In addition to general tabulation of data to present it in an accessible format, two other methods were utilised to present data: matrix displays and area-proportional Venn diagrams, both outlined below.

3.6.1. Matrix Displays

Display matrices are discussed in Miles, Huberman and Saldaña (2018). They are essentially the “intersection” of two lists set up as rows and columns. The matrix is a tabular format that collects and arranges data for easy viewing in one place, permits detailed analysis, and sets the stage for later cross-case analysis with other comparable cases or sites.

A number of matrix displays were created for this study, and some combined qualitative and quantitative approaches. They are all explored and discussed in Chapter 4, 5 and can be viewed in the Appendices.

3.6.2. Area-proportional Venn Diagrams

Venn diagrams have seen frequent use in social science research to indicate shared or overlapping aspects of a concept, category, or process (Verdinelli and Scagnoli, 2013).

Due to the discovery of the overlapping nature of the four contexts of the ‘POET’ framework, a Venn diagram was considered to show the overlap of the contexts.

Using a quantitative approach, it was also possible to indicate the relative importance of the four contexts, as well as the size of the overlap based on the number of factors in each context and in multiple contexts. This is known as an area-proportional Venn diagram.

Two were created which can not only be used to show the POET framework as a conceptual framework, but also indicates the general importance of the four contexts as well as their overlap quantitatively.

3.7. Limitations of the Study

The acknowledged limitations of this study include the focus on Wales as a microcosm of healthcare and the study was conducted during the impact of the COVID-19 virus.

3.8. Chapter Conclusions

This chapter has presented the decisions, design and defence of a qualitative study which uses multiple informants to gain insight into the structure, performance, and weightings of the elements in the TOE framework which were used to establish the focus of the study and the contribution of this work to a body of knowledge. The body of knowledge, explored during the literature review, revealed significant gaps in understanding health care innovations and the adoptive capability of innovations in this multiple stakeholder setting. The methods were deemed appropriate to answer the guiding research questions and accommodate a multiple stakeholder perspective of how the dynamic system works in practice. Specifically, the methodology addresses the calls made by Greenhalgh et al., (2004). Having established the effectiveness of the methodology to meet the demands of the guiding research questions, the next chapter will present the findings of the empirical field research and begin to explore the contribution made by this study to academic and professional practice.

4. Results and Analysis

This chapter presents the results from the field research and the subsequent coded data displays generated as result of primary data collected during the interviews of purposively selected informants. Section 4.1 describes the n=44 codes discovered during the interviews as a result of the first cycle coding, and the subsequent second cycle coding which determined the Contexts, using and expanding the TOE model, as described in Section 4.2. Section 4.2 also illustrates the relationships identified as a result of the analysis of interviews between these higher-level contexts.

Section 4.3 and Appendix H sets out, describes, and explores data for each of the 44 codes and subsequently the factors of affecting innovation adoption identified within each of the contexts. Section 4.4 identifies the relative ‘importance’ of each factor as a result of frequency of mention by interviewees and Section 4.5 shows the factor interrelatedness as determined by the way in which different factors were discussed at the same time by interviewees. Section 4.6 sets out the results of analysis undertaken to determine whether interviewees described factors as enablers or barriers to innovation. The final section concludes in 4.7 with a summary of the key findings discovered throughout the process of analysis.

The majority of the data sets for each section of this chapter are contained in full in one or more tables in the Appendices, and excerpts of these are presented in this chapter. The table below shows which Appendix each section of this chapter corresponds to. This can be used to find and refer to each corresponding full data set as required.

Table 3. The Appendix that each section of this Chapter corresponds to.

Section	Appendix
4.1.1. Codes discovered via interview – First Cycle Coding	8.5. Appendix E – Table of Codes Discovered via Interviews – First Cycle Coding (pages 274-279)
4.2. People, Organisation, Environment, Technology – the four types of context encountered in this study	8.6. Appendix F – POET Context Coding Display - Second Cycle Coding (pages 280-282)

Section	Appendix
4.2.4. POET Context Coding Interrelatedness Matrix	8.7. Appendix G – POET Contexts Coding Interrelationships Matrix Display (page 283)
4.3 Detailed analysis of all 44 factors in each context	8.8. Appendix H – Analysis of all Factors by Context (pages 284-415)
4.4. Relative Importance of Factors	8.10. Appendix J – Relative Importance of Factors (pages 417-426)
4.5. Factor Interrelatedness	8.11. Appendix K – Interrelationships of Factors (pages 427-433)
4.6. Enablers and Barriers	8.12. Appendix L – Barriers and Enablers - Number of statements recorded for each factor with enabler and barrier codes (pages 434-436)

4.1. Codes Discovered Via Interview

Coding of interviews was undertaken using the method identified in Section 3.5. The first stage of coding concentrated on analysed interview transcripts to search for influences on innovation adoption and code the data correspondingly. After saturation was reached with analysis, i.e., no new codes emerged with further analysis of interviews, data collection and the first stage of analysis ceased. Then, the seven key participants' (see Section 3.5.3, Appendix C) interview transcripts were manually analysed line by line in order to search for all codes that contributed to the adoption of innovation. The data chunks which the codes corresponded to were added to the Master Data Display and the methods of simultaneous coding and magnitude coding were applied as described in Section 3.5.

Codes were found through a combination of searching for the presence of previously identified factors that relate to the adoption of innovations (see previous survey work in Section 3.4.4), and mainly from the researcher's inductive analysis (based on pattern matching) while reviewing interview notes and transcripts. The latter was conformant with the process and prescriptions of Miles, Huberman and Saldaña (2018).

When creating data displays large sequences of raw transcribed text is often cut down to a single sentence or smaller passage that referred to a single code. However, any attempt to

do this removed the context and relationships between factors to the detriment of its rich contextual meaning – the latter is a valued and a desired output for this study and as such ‘thick description’ was preferred. In addition, maintaining the wider context of the text, utilising the principles in Geertz’s ‘thick description’ (Geertz, 2008) made it easier to filter for quotes to see all the factors that it related to which was also a desired output, and the reason for utilising simultaneous coding (Saldaña, 2021). An example of the coding process is provided below, using an excerpt of an interviewee’s response to a follow-up question which asked them about the ‘right people’ they had mentioned during the interview:

Asked about characteristics of 'right people': *“I’d say these are people who are experienced, open minded to innovation and trialling [EXPERIENCE WITH INNOVATION] [PERSONALITY] [OPENNESS TO CHANGE/INNOVATION] [GETTING THE RIGHT PEOPLE], but also have a network, both within and outside their own organisation to pull levers, where necessary, or call for help and support where necessary, because what happens to a lot of projects and that's why imagine lots of projects sink, is that people are not keen on sharing collaborative efforts they want to silo it and eventually usually kills it, because innovation is a team sport; adoption of innovation, more than a team sport right it takes many teams to be working together and from experience, a lot of things are slowed down or killed right when they got really nice vision of being embedded in health and care in Wales, but because they were not able to share or work with the right people [NETWORKS AND COLLABORATION] [EMPOWERMENT]*

So, who is the right people? The right people, from this project in particular, it was a clinical academic who held the position at the University and also a position within the health board so they were able to see through both lenses, if you like, or wearing both hats [BOUNDARY SPANNING], how this project might align to both academic research to satisfy the machine for the University, as well as meet the compliance ethics and regs required to navigate the evaluations that you need within a health board [ALIGNMENT OF ACTORS/OBJECTIVES] [CLEAR VISION/CULTURE]. So, somebody with that type of clinical experience. And that's [Redacted Name], who does many things. [GETTING THE RIGHT PEOPLE]

The next challenge was to identify the right funding to get the money, and it was very opportune that Welsh government policy at that point during the pandemic was posting a lot of money adverts/applications for COVID, for solutions to COVID effectively [POLICY/REGULATORY EFFECTS]. So, we found a nice project that developed/evaluating a diagnostic tool/artificial technology tool for COVID 19 using patient’s ultrasounds. Which is great, so we brought the project, there was four of us a part of that group: the University, Respiratory Innovation Wales (set up bit like an arm’s length consultancy from academia and the health board), [Redacted company] (the originator of the technology), and the health board, so

*it was it was a nice, well-rounded multidisciplinary team [TRIALABILITY/TESTING]
[BOUNDARY SPANNING].”*

As can be seen by this excerpted quote, numerous codes can exist simultaneously in the same chunk of data, even the same sentence in many cases. Coding larger data chunks like this, which can contain multiple codes, allowed for the more holistic and detailed view of the interviewee's responses. This in turn made it possible to account for, investigate and show the complexity of the data, as well as the circumstance, context and setting.

After this first cycle coding was completed, each full quote/response/statement made by the interviewees was captured in the Master Data Display under the relevant participant's column and the code's row. See Appendix I for an excerpt of the Master Data Display.

In addition, each quote for each factor for each participant was assigned as either an enabler or barrier in the quote's specific context, by highlighting the quote with green or red respectively. If the quote was neither a barrier nor enabler or both, it was left clear. This was used as an indicator the extent to which the factor performed as an enabler or barrier to adoption.

Further detail on the method for coding and data analysis is described in the methodology (Section 3.5).

The codes (i.e., factors) discovered are described below (in order of their discovery):

4.1.1. Codes Discovered Via Interview – First Cycle Coding

Forty-four codes of influence on innovation adoption in healthcare were discovered through analysis of the interview transcripts. Please see Appendix E for the definitions of all codes and references to the data assigned to each code (please note that they also appear in order of discovery in the Table).

The forty-four codes, in order of discovery, as originally recorded, including their shorthand code assignments are:

- Motivation (Why Innovate?) [P1]
- View of Other Sector [P2]
- Clear Vision / Culture [PO3]
- Alignment (Actors/ Objectives) [PO4]
- Networks and Collaboration [PO5]

- Leadership [PO6]
- Champions [P7]
- Empowerment [PO8]
- Boundary Spanning [PO9]
- Trust, Reliability, Relationships [P10]
- Demonstration of Value [POT11]
- Identification & Communication of Need [PO12]
- Experience of Innovation [PT13]
- Experience of Technology [PT14]
- Personality [P15]
- Bureaucracy and Admin [O16]
- Finance & Funding [OET17]
- Intellectual Property [T18]
- Organisational Culture and Structure [O19]
- Understanding of Environment [P20]
- Time and Capacity to Innovate [PO21]
- Investment in the System [O22]
- Attitude to Risk [PO23]
- Difficulty to Change Existing Practice / Systems [O24]
- Systems and Processes of Organisations [O25]
- Relationship Between Sectors [PE26]
- Local vs Regional vs National [E27]
- Training & Learning [PO28]
- Trialability & Testing [OET29]
- Co-production [P30]
- Policy & Regulatory Effects [E31]
- Political [POE32]
- Crisis (COVID-19) [E33]
- Measurements / Metrics [T34]
- "People Who Get Shit Done" [P35]
- "Getting the Right People" [O36]
- Reputational [PO37]
- Continuity / Retention of Staff [O38]
- Incentives [PO39]
- Openness to Change/ Innovation [PO40]
- Top-down plus Bottom-up [O41]
- Support & Guidance vs Forcing Implementation [O42]
- Buy-in of a Few Adopters [P43]
- Communication (General) [PO44]

The next step was to assign these discovered codes to one or more of the four contexts, and this is described below in Section 4.2 and can be seen in Appendix F.

4.2. People, Organisation, Environment, Technology – the Four Contexts of Influence in Innovation Adoption in Healthcare

During the interviews, and also during coding and analysis and thus factor discovery (which were being done simultaneously), it became clear that the three contexts of the TOE framework were inadequate to group all of the discovered factors under.

An important group which many factors were related to: “People” was identified, which was distinct enough from Organisation as it was concerned with individuals and their characteristics, regardless of the organisations they worked for or interacted with.

Therefore, a return to literature was done to search for another suitable theoretical framework which considered people strongly in its theory as an influence. The Socio-technical systems theory, which uses people or ‘human resource’ as part of its model, was incorporated into the TOE framework to develop a new framework which included the four overarching groups: People, Organisation, Environment, and Technology. These four contexts give the POET framework for describing the factors which influence innovation adoption. There was precedence for this development from the authors of the TOE framework, who noted that ‘technology’ could be considered under ‘environment’ but it was decided to be split into a separate context due to its discrete importance (DePietro et al., 1990). The same reasoning was applied here to split out ‘People’ as a discrete and important context.

After this, all codes, now referred to as ‘factors’ of influence on innovation adoption, were assigned to the four contexts: P (People), O (Organisation), E (Environment), T (Technology) in the second cycle coding. These were then finalised in a confirmatory coding session with three other academics. The results are in the table in Appendix F.

4.2.1. POET Context Coding Display – Second Cycle Coding

The researcher initially considered that, as with the TOE framework and most other models of innovation adoption, factors would be able to be categorised under one of the four contexts (DePietro et al., 1990; Rogers, 1995; Greenhalgh et al., 2004). However, as the researcher began this second cycle pattern coding, they noted that many (but not all factors) were difficult to place under just one context.

Therefore, the coding approach was modified to assign each factor to as many contexts as was deemed appropriate. If a factor affected or was affected by, influenced, or was related to (in a significant way) people, organisation, environment or technology, then it was coded to that context.

Confirmatory coders performed the same assessment to reach consensus and the full results of this are presented in Appendix F. An excerpt of these results (from Appendix F) is provided below:

Table 4: Excerpt of “POET Context Coding Display – Second Cycle Coding” (from Appendix F).

Factor	People (P)	Organisation (O)	Environment (E)	Technology (T)	Final shorthand code assignment
Champions	✓				P7
Empowerment	✓	✓			PO8
Boundary Spanning	✓	✓			PO9
Trust, Reliability, Relationships	✓				P10
Demonstration of Value	✓	✓		✓	POT11
Identification & Communication of Need	✓	✓			PO12
Experience of Innovation	✓			✓	PT13
Experience of technology	✓			✓	PT14
Personality	✓				P15
Bureaucracy and Admin		✓			O16
Finance & Funding		✓	✓	✓	OET17

If the factor was related to or influenced by an individual and their own characteristics, views/beliefs, and their relationships directly with other people (or views on other people), the factor was assigned the 'P' code.

If the factor was related to or influenced by an organisation (e.g., the NHS, a private company, a third sector organisation): their internal or external characteristics and their relationship between other organisations, then the factor was assigned to 'O' code.

If the factor was related to or influenced by the environment or the context in which the innovation exists, such as the set of regulations it is subject to, or the area in which it is to be deployed or another circumstance which serves as the environment in which the innovation has to operate (such as the COVID-19 pandemic), then the factor was assigned to the 'E' code.

If the factor was directly related to or influenced by the innovation or technology itself and its characteristics, then it was assigned the 'T' code.

It was assumed that the T, O, E codes should be important and roughly equally so, as the TOE framework gave no weighting to the contexts. However, this was seemingly not the case with relatively more factors under O than T or E, and more influential ones at that. Furthermore, the addition 'People' context was highly necessary, as can be seen by this coding, 28 of the 44 factors were assigned the 'P' coding, either alone (9 factors) or when combined (14 PO, 1 PE, 2 PT, 1 POE, 1 POT) (see Table 5). This made People the most frequently assigned context, and during analysis and coding appeared to be the most influential context as well, followed closely by Organisation. This is described further in 4.2.2 below.

The overlap between the contexts was also an interesting and novel discovery in terms of the TOE, now POET framework – a significant number of the factors were considered in confirmatory coding to fit to more than one of the larger contexts. This led to further work to consider both the broad importance of each context and their overlap when it comes to the adoption of innovations in healthcare, and present this visually via displays and area-proportional Venn diagrams, this can be seen below in the remainder of Section 4.2 and in Appendices F and G.

4.2.2. Number of Factors Under Each POET Context Coding

Table 5. Number of factors of each POET context coding type, and representation of each of the four Contexts.

Type of Factor	Number Of That Type
P	9
O	9
E	3
T	2
PO	14
PE	1
PT	2
OE	0
OT	0
ET	0
POE	1
POT	1
OET	2
Total	44
Representation of each context	
P*	28
O*	27
E*	6
T*	7
X* = number of factors that contain X (i.e., including X-only factors and XY or XYZ factors)	

This table records the number of factors which were grouped under each context by confirmatory coding. The first part shows how many of each specific type there was: single-context factors (i.e., P, O, E, T) and dual or multi-context factors (e.g., PO, OT, POT). The second part shows how many times each context was represented by a factor, i.e., how many times was a P, O, E, or T code assigned in total across all 44 factors.

As described previously, the People context is shown to be relatively important as a total of 28 factors were assigned a 'P' code, and 9 of the factors were P-only, and therefore there was a strong case for inclusion in the framework as its own context.

The second most numerous coding was 'O' with 27 factors assigned to it in total and also having 9 O-only factors, which suggest the Organisation context is also very significant when it comes to the influences of innovation adoption in healthcare.

People and Organisation contexts also seem the most strongly linked of contexts, with 14 factors given the PO coding (the most numerous factor type).

Technology and Environment contexts were less represented by number of factors (which was surprising). Technology had 7 factors assigned to it total and only 2 'T' only factors were present. Environment had 6 factors assigned to it in total and only 3 'E' only factors.

These findings were interesting and led to the creation of an area-proportional Venn diagram to show the relative importance of each context based on the number of factors assigned to that context and also the size of overlap between each context pair or triplicate (see Section 4.2.3.).

It is important to note that while number and overlap of factors coded to the contexts is a relatively suitable indicator for the importance and relationship between contexts, it doesn't include information on how important each individual factor is by themselves (and how that relates to the importance of the context it is coded to). This is dealt with below in the Section 4.4. For example, there could be few E-only factors, but those factors may be mentioned many times by respondents.

4.2.3. Area-Proportional Venn Diagram to show relative importance of contexts based on number of factors assigned to the context

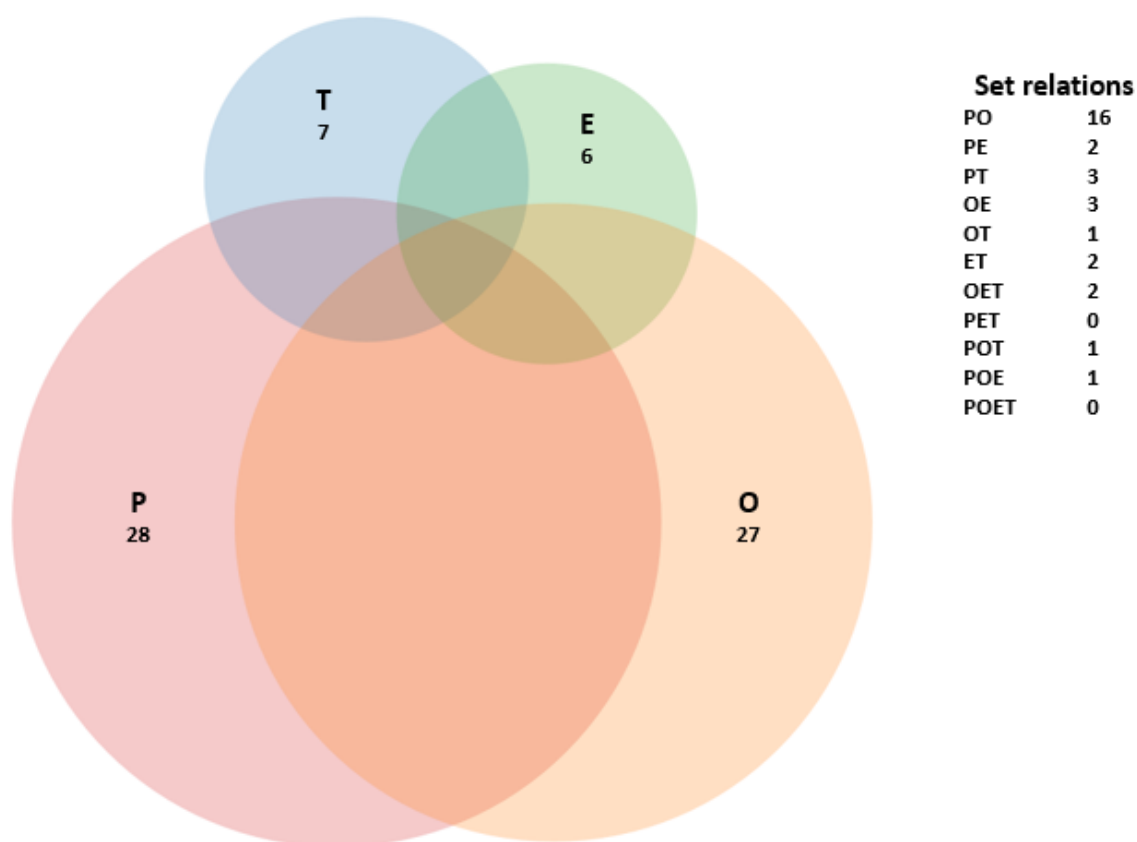


Figure 11. The relative importance of each of the four POET contexts, and the degree to which the contexts are interrelated. Source: The Researcher

This area-proportional Venn diagram shows the relative importance of the four contexts based on the number of factors assigned to each context. The ‘set relations’ values corresponds to the size of the overlap between the contexts in terms of number of factors which have that double or triple context assignment.

As an example of how this data works: since “Demonstration of Value” was assigned P, O and T in context coding, this means one addition is made to the P set (as it was assigned to P), one to the O set and one to the T set, it also means one addition each to the PO set relation and PT set relation, and finally one addition to the POT set relation. This method of creating the area-proportional Venn diagram gives a visual representation of the strength of

the contexts and their overlaps, based on number of factors assigned under single, dual, or multiple contexts.

As a note, some of the set relations (overlaps) have value even though no factors were strictly assigned to that combination, because a higher-level combination that included the first combination did have factors assigned. To illustrate with an example: 'OE', which can be seen to have a set relation value of 3, had no factors assigned under it, but there was one 'POE' and two 'OET' factors, and as those both contain 'OE' they contribute to the 'OE' set relation value of 3.

Another note on this Venn diagram is that even though some of the set relation values are 0 (meaning no overlap), the diagram shows an overlap, this is simply because the Venn has four sets which is difficult to express accurately in two-dimensional space while still being visually useful. Therefore, the overlaps for 'P+E+T' and 'P+O+E+T' should be ignored as the set relations are 0.

As shown by the diagram, all four contexts are noted and mentioned by the interviewees. However, the factors generated through the coding process can clearly be shown to either sit within one context or have a clear overlap with another context.

This diagram shows 'People' as the strongest context in terms of number of factors assigned a P code, followed closely by 'Organisation'. The strongest overlap was also between these two contexts, suggesting they are relatively closely related but still distinct from each other (indeed there were 9 each of 'P-only' and 'O-only' code).

'Environment' and 'Technology' are relatively less significant in terms of number of codes which were assigned to them and also do not strongly overlap with the other two contexts or each other (E and T-only overlap via the two OET factors, 'Finance and Funding' and 'Trialability and Testing').

This Venn diagram gives a suitable and effective way of presenting the conceptual POET framework visually.

4.2.4. POET Context Coding Interrelatedness Matrix

The POET context coding matrix seen in Appendix G is used to calculate the size of relationship within and between each context coding there was at the factor level. This was

done by pairwise comparison of the context code(s) assigned to each of the 44 factors with the other 43. For instance, the pairwise comparison of Motivation and View of other sector were both considered to be 'P' context only, generating a P result. Clear Vision /Culture and Alignment were both PO, generating a PO result. However, Motivation (P) and Vision and Culture (PO) generate a P, because there is only an overlap with P. The data in Table 8.7.1. 'magnitude of context interrelatedness' in Appendix G show the results of calculating these context code relationships, which was used to create the area-proportional Venn diagram in Section 4.3, which is another way to visually represent the importance of contexts and their relationships at the factor level.

It was noted that the P interrelationships were most numerous. Also, the 'triple' codes e.g., P+O+E were very low in number, suggesting that P is not a modifier that just gets added to all the others, but that it is specific to certain factors.

Note that E and T interrelationships were least numerous both individually and together, and that this was an unexpected finding because the aim was to discover how technologies are adopted, but technology appears to be a context of lesser importance.

4.2.5. Area-proportional Venn diagram to show intra and inter-context relatedness

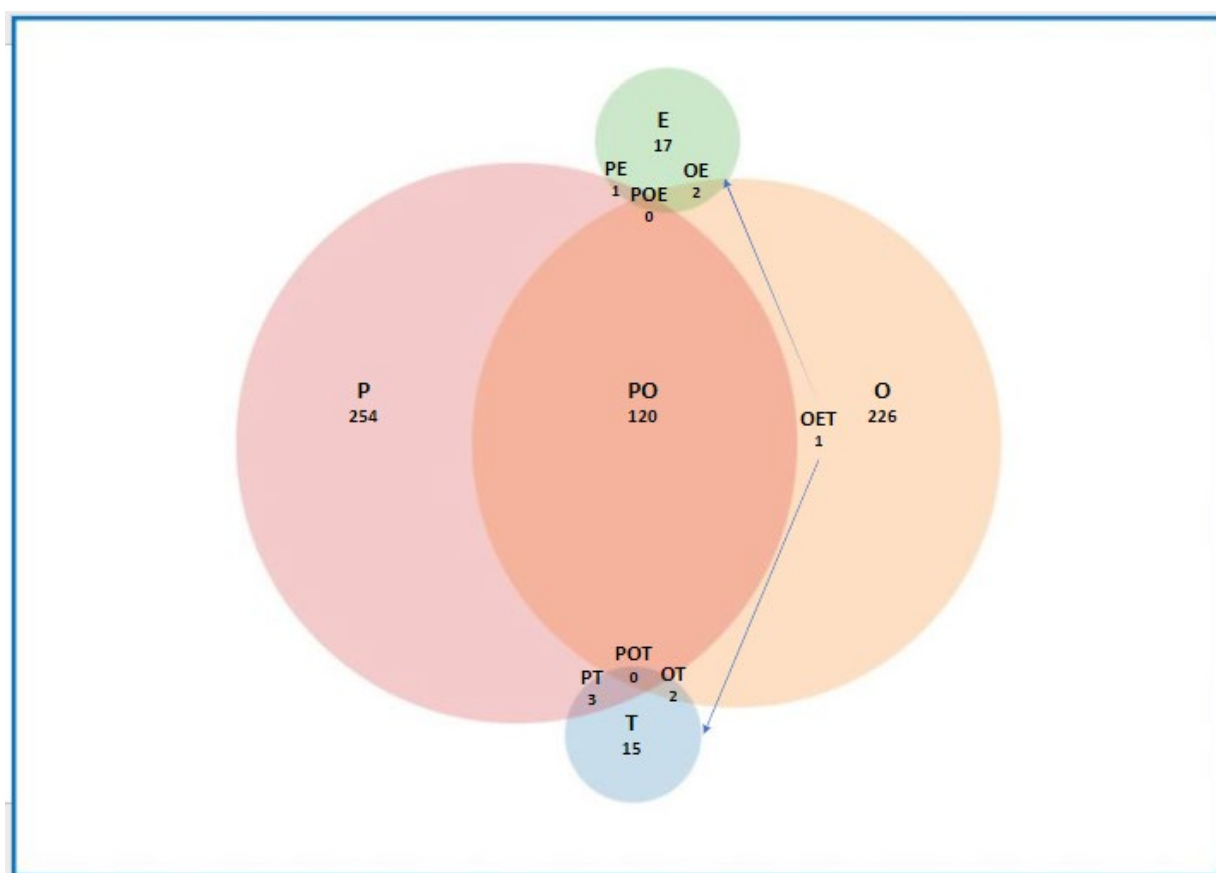


Figure 12. The intra- and inter-context relatedness of the four contexts based on the number of factors sharing the same context(s). Source: The Researcher

This diagram shows the relationships within and between contexts them using the data from the tables in Appendix G (Section 8.7.).

As can be seen by the diagram, the most common relationship between factors was 'P', followed closely by 'O' and then followed by 'PO'. This again reinforces the strength of these two contexts and the relationship between them in terms of number of factors assigned to them.

This diagram also shows the comparatively weaker relationships of E and T, as well as the weakness of any multi-context combination that contains them (e.g., OE, OT, ET, OET, POE, POET etc). This suggests that these contexts are generally less related to each other in terms of influence on innovation in healthcare.

4.3. Detailed Analysis of All 44 Factors in Each Context

Appendix H describes and analyses all 44 factors. Please refer to this Appendix to see key examples of evidence for each of the 44 codes that became factor, and a thorough description and analysis of each factor which provided key findings of this study as described in this chapter (Results and Analysis) and explored in the Discussion (Section 5) and presented as final Conclusions in Chapter 6.

An excerpt of the data from Appendix H is provided below: showing the description, evidence, and analysis for three of the factors: Leadership, Experience with Innovation, and Policy/Regulatory Effects (selected to include examples from each of the four contexts).

4.3.1. Leadership (PO)

This factor was encoded for by statements from interviewees that were concerned with the role leadership in innovation adoption, in both individuals and organisations. A total of 45 statements by interviewees were recorded under this code, making it the second most frequently recorded code. The code was originally recorded as “Focal Leadership” to capture examples where leadership was powerful enough to act as a strong enabler, but was changed to “Leadership” to capture all discussions of leadership whether positive or negative in terms of adoption (i.e., so it is a two-way/non-binary factor)

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B53-B56; C53-C61; D53-D62; E53-E59; F53-F56; G53-G60; H53-H56. The following statement(s) give examples of this code:

*(Asked about key influences in adoption) “I think there's something though, and I think **it probably transcends a few of them: leadership**. And that's the part where, you know, and noting it is a big risk, you know we've seen more locally, you know how you know how leaders can encounter difficulty when trying to do something transformative, putting it mildly. You've got there the whole thing about procurement, and so it chimes a little bit there, but you've got there if you're going to do something creative, disruptive, sort of that paradigm shift, sort of buzzwords, it's not going to be look like what's been done before it's not going to necessarily*

*be done in the way it has been done before so **somebody has to be bold and break that mould**, but do it in a way which doesn't put bars on the windows and so forth.” Quote D58*

*(Discussing leadership) “When you’ve got all the inertia in the system, people have been doing things in the way that they have, that is a lot of change to overcome, and particularly when you’ve got that complex system which quite rightly is trying to focus on an almost impossible challenge, which it is running beyond capacity, it's under resourced, in itself, blah blah blah. That is quite tough as leadership, particularly when you're going to have maybe those difficult conversations with the public and that’s [what’s in that] leadership, you know coming from the First Minister or Prime Minister, whichever you have your landscape is, all the way to down into the organisation, but that **leadership’s got to give that empowerment to everyone below them to say no, you go that, you change things**. And a bit like we saw in the COVID response, where people have been **empowered to get on with things, as long as it's done with work ethic, integrity and applying their intellect** a bit like the [redacted health policy] to have people operating at the top of their licence, and just not getting in their way, while they're doing it - that’s what’s was needed, so I think leadership is the biggest, because, **with leadership, you can then change the processes, you can manage expectations, you can acquire the resource, whether it's out of the exchequer or an internal budget**. That would be the sort of key one.” Quote D59*

*(Asked about why Wales was different in supporting a system-wide healthcare innovation) “Well, I think, it's probably to do with people actually. What I think Wales has been very fortunate about, it's been very fortunate in Wales is that a number of very **senior people with the power to, with the hard power and the soft power, the hard power to actually direct resource in the direction of this type of work and the soft power to be able to influence colleagues and to build up and excitement and***

support for this, I think has been tremendous in Wales. And so there has been that initial, back almost about eight years ago, there has been that initial core group of people who got it going and I think have remained with it actually all the way through. And I think the other reason was that there was, I think the strategy for doing it Wales was a really good strategy. Started off very, very small, in one little area of one health board, a small disease area. That was shown to be successful, and then it has gradually scaled since then, in parallel with, trying not, I think, to force people, but to create this movement almost and I think there has been a movement, and that has created quite a lot of excitement nationally and that has enabled some more top-down, structure and processes to be put in place where, and I think it has actually worked very nice, so the two have, both top and bottom [have come together].” Quote H53.

*(Asked about how leaders can make an impact) “yeah they are definitely diamonds in the rough and every organisation. It comes back...my experiences is there are **two types of leaders: people who lead from the front and delegate, I think or there’s people who just happy being managers and they’re more comfortable just delegating, so they don’t necessarily get the boots to the ground experience.***

*So great example of these, again come back to clinical academics, who have done the groundwork, done the research, are in practice clinically, they know what it’s like to be on the ground, as well as managing people that’s why those, I’d probably refer to them as diamonds in the rough are great examples of leaders, because **they know what it’s like to get stuff done and they give recognition to those they’re working with and say job well done**, whereas you can imagine a very bureaucratic system you can imagine “it’s just as your job, you don’t need any thanks”. Quote G57*

*(Asked about finding individuals within a certain organisation who can support an innovation’s adoption) “I think to be fair to them, they are all very busy doing what they do. What **[Redacted person] was very good at***

was seeing an opportunity and understanding it. He was extremely aware of the real world. And he had an amazing grasp of the real world and academia and the interface between them and where the opportunities arose, and how to fix things. I'm not seeing that replicated, other than his, those of us who were massive supporters of him, people like myself and [Redacted person]. And of course, you can't do that anymore so it's challenging." Quote E55

These statements give examples of how leadership can be influential in innovation adoption. All interviewees discussed how leadership can be a strongly influential factor, many times (45 statements under the code spread quite evenly across Interviewees) across different circumstances. The common thread is that leadership can be a strong enabler when it is good or a significant barrier when it is bad (and good or bad might be relative the specific circumstance of the innovation). Individual leaders and their traits were discussed (e.g. C54, C56, E55, G57), how they operate in innovation and adoption sphere (e.g. F56, H53), as well as where leadership occurs at different levels of an organisation (e.g. D56, F54, H55) and how it can influence what occurs in that organisation and between organisations (e.g. B56, D54, E58, F53) [Note: In fact many of the referred to statements cover lots of aspects of leadership in the same cell/quote].

Leadership appears to be very important, but the interviewees appeared to be describing traditional leadership as opposed to 'modern' which focuses more on followers and distributed leadership theory. Additionally, it appears that leadership was discussed in many different ways by the interviewees, i.e., very diverse response, but what is clear that leadership is a highly important factor when it comes to the adoption of innovation.

Leadership also appears strongly linked to other factors, indeed the second most frequently linked pair of factors was between leadership and "People Who Get Shit Done" (16 links). It also had strong links to Alignment (Actors/Objectives), Clear Vision/Culture, Personality, "Getting the Right People" and Empowerment and Networks and Collaboration (see Section 4.5 and 5.5 for further detail) (all P or PO factors interestingly).

4.3.2. Experience with Innovation (PT)

This factor was encoded for by statements from interviewees that were concerned with an individual's experience, expertise, knowledge, skills, and awareness of innovation and the innovation process in general. It is distinct from "Experience with Technology" as that code refers to an individual's experience with a **specific** innovation or technology and how that influences that specific innovation or technology's adoption, while this code, "Experience with innovation" refers to an individual's experience in working in innovation in general (i.e. the process and all that entails – working on multiple innovations and the experience that builds). A total of 38 statements by interviewees were recorded under this code, making it the joint 5th most frequently recorded code (with Alignment of Actors/Objectives).

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B112-B117; C112-C113; D112-D116; E112-E123; F112-F113; G112-G122. The following statement(s) give examples of this code:

"innovation management is a big thing. It's one of the biggest causes of failure and in innovation processes generally and I would say innovation management schools or skills or even knowledge of what innovation management is it's significantly lacking in the NHS and if you don't have those basic capabilities, how do you expect/effectively manage a highly complex process. Skills some training towards that'd be a good thing."

Quote B114

*"The NHS should be the most phenomenal adopter of innovation and technology, because it's a readymade opportunity, however, when you when you start looking at it more closely, you realise it is massively fragmented. You realise that the purchasing decisions within each hospital, which is what it constitutes, inside the NHS, is driven with different challenges in each hospital. **You realise that, in many cases the hierarchy of hospitals is run by administrators who have got no idea about innovation & technology. Budget holders don't understand it. Doctors become the proselytisers of technology, but they're distracted by other***

things, and even then they probably don't hold the budget for it."

Quote E120

(Continuing discussion about barriers) "And the other thing is, as well as turnover of staff it's people who have never been there and done it with the experience of running or trying to do a project like that being put in positions and try and work with people who haven't done it before, I'm pulling my hair out thinking this is not that complicated. So put it like this, there's a point where I was like bloody Nora, if I was incentivised to pay for getting these projects through the university systems that would be the great way of earning money because you've been there, done it you kind of know the lay of the land and the mechanisms. That appears to be missing is the experience in hands on doing it. very siloed approach, my job was to pick up from A to B, regardless of what happens, you know [at other levels]." Quote G118

As can be seen by both the content and number of statements recorded under this code, an individual's experience with innovation seems to be significantly influential in the adoption and innovation process. It was consistently mentioned many times by Interviewees (except by Interviewee H) and the consensus from their statements is that the more experience, skills, knowledge, or awareness of the innovation process an individual has, the more adoption will be enabled, and vice versa. This of course, applies (only) to individuals who actually have an influence over or are involved with the innovation and adoption process.

Of the Interviewees, two had many more statements under this code than the others: Interviewee E and Interviewee G (12 and 11 respectively). Interviewee E's statements were largely to do with the finance & funding side of the innovation and adoption process, and the how the level of experience with it affects adoption. This is likely owing to their experience with that part of the process. Interviewee G's statements were a bit broader in their scope and discussed numerous instances where experience with innovation is important as a barrier or enabler to adoption (see statements).

“Experience with innovation” and “Experience with technology”, were both very similar factors, with the former being broader and more general in its scope and the latter being specific to the single innovation that is trying to get adopted. Clearly, with 38 statements recorded under it (vs 8 for Experience with Technology), ‘Experience with Innovation’ is the more important/influential code in innovation adoption. This could be because it is significantly more important for the adoption and spread/scaling part of the process, as better experience with innovation in general and/or with many different (types of) innovations may be more beneficial here than experience (technical or otherwise) with the specific innovation you are trying to get adopted at that time.

This factor was also relatively strongly linked to many other factors including (from most strong links down) ‘Alignment’ (11), ‘Networks and Collaboration’ (11), ‘Identification and Communication of Need’ (10), ‘Leadership’ (9), ‘Understanding of Environment’ (9), “Getting the Right People” (9), ‘Trust, Reliability, Relationships’ (8), ‘Finance and Funding’ (8) and more. This suggests that an individual who is experienced in innovation has an influence on these other factors, and vice versa.

4.3.3. Policy/Regulatory Effects (E)

This factor was encoded for by statements from interviewees that were concerned with the role of policy and regulations on the innovation process and the adoption of innovations. A total of 32 statements by interviewees were recorded under this code.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B248-B249; C248-C252; D248-D255; E248-E256; F248-F249; G248-G252; H248. The following statement(s) give examples of this code:

(Asked about effects of regulation) Regulatory change, first of all, you have got to have an environment where you can apply - you have a lever for regulatory change - the government's in charge of regulatory change. And in the pension sphere, for example, you use it to say that people can only take their personal pensions when they're 55, so that's a regulatory thing. You could change that to say 60, so in an instant you can just introduce a law which applies to regulatory and your regulatory authority then applies

it and oversees it and makes it happen. So make sure that the industry can do it, and my world of finance is one which is very, very heavily regulated.

So is the medical world, and that's **part of the problem in many cases there's the regulatory burden upon adoptees of technology is that you need massively high levels of assurance that the technology is not going to do any harm. That's fine.** So Med-tech, you have things like, can't remember what it is now, you have in Europe, you have categories that medical devices have to fulfil, America has the same. So those are regulatory burdens. So **there may be situations where you can reduce a regulatory burden, if you think it's being inappropriately challenging for a technology to come to market.** And that's one of the situations when I referred earlier to, where things like white light. White light is finding a much more commercially successful route in things like the beauty and fashion, rather than the medical because **the regulatory burden placed on the medical environment is perhaps too great.**" Quote E254

(Continuing discussion ways around difficult systems) "The other thing which we saw in terms of the workaround and it does come back to this vex thing of procurement. Where you've got, Something might be better than what's already there but it's almost "how do you buy it?". And particularly, if the best or better ideas are going to come out with your organisation and potentially from the private sector, how do you engage with it or buy it, because that is immediately a procurement dimension, well, you can, not to say obfuscate it, you can look at it instead: well actually it is a partnering. So you have there, and it used to be the **public procurement regulations 2006, section 5, paragraph K, which said you didn't have to go through procurement in the same way for an R&D collaboration**, so if you draw something back to being, **this is now collaborative you can co-invest in something.** But it only takes you so far and I've seen a few places where you know **that has been used, not as a foil, but it's been used to sort of get momentum into an opportunity but**

it only gets momentum into it, it never gets over the line. But that's been one of the ones which there's a workaround." Quote D255

(Continuing to talk about regulation) "One of the things as an innovation business you need to look at is what regulatory challenges lie ahead and it's far too difficult to try and become a challenger to regulatory environment, to try and get the regulatory levers changed. But that's what I'm trying to do, I'm trying to use regulatory levers to support venture, by educating people who are in control of those levers to say actually if you apply this to the institutional pension world, we can free up capital to come into venture. If you do that it's like opening the lock gates or the damn gates and water will flow where it's needed. And actually then, if you take a view on venture, if you invest now, within eight to 10 years you'll see a return on that capital, certainly at the scale we're talking about, and the whole thing becomes a self-fulfilling prophecy. That's really what you're aiming to achieve. So regulation is a good thing, but you need to make sure it's not over tight and it needs to be checked for its fitness for purpose on a regular basis and I don't see that happening that often."

Quote E256

*(After asked about how industry differs in their approach to innovation adoption) "Industry have a different dilemma, so what I saw in industry is that they...so I had a lot of phone calls with people who...so one of my roles is to triage these other people who needed to receive support a bit like Agor IP might do. I think that feels close to what they might do, and so I used to have these conversations where they were like and I still have them where they like we build Apps, "so why the hell haven't we got an App for – I don't know - picking up a prescription from pharmacy?", "that exists already thanks very much" and then, "why don't you have an APP for doing the Self-management for diabetes and reporting it all back?" and it was just like...and I **had this lengthy conversation with someone who just didn't understand the context, he was working in.** And what people...so if*

I put the outsider view on, what they sometimes think is healthcare professionals and governance and regulation getting in the way - it's actually things that are protecting us. So you end down a conversation, which is really frustrating for them. You know, which is like "yes, but!", but you don't do that so much with health & care. So that's the difference, I would say, their [people within health system] in-depth understanding of what's happening is just beyond anything that I think a start-up or an external can have but, equally, it is also the reason why they might not push the boundaries as much. So, I do...I'm not saying that this is all the same, but I do think...I would wonder if what they come up with are incremental changes and something that's a little bit more safeguarded and boundaried [than what] an innovator might do. But equally with that I think what they come up with can move faster whereas an innovator might still need that five -10 years." Quote F248

The policies and regulations that healthcare is subject to play a large role in innovation and influence innovation adoption strongly. There were diverse views on regulation in healthcare and examples of where it affects innovation and adoption. Per the statements there was no strong consensus whether policy or regulation was inherently beneficial or detrimental to innovation adoption in Wales and the UK, rather it appeared to be contingent on the specific circumstances. The interview statements above give some examples where it can be influential.

The effect of policy and regulation on adoption was affected by numerous things per the statements, for example: how the regulation(s) were employed; people's understanding of them (linked to 'Understanding of Environment' and 'Experience with Innovation'); people's ability to work with or around them; how supportive or burdensome they are toward innovation both in general or in specific circumstances. The majority of interviewee statements covered at least one or usually more of the aforementioned points.

This factor was relatively strongly linked to others (see Section 4.5 and Appendix K) including 'Finance and Funding' (11 links), 'Understanding of Environment' (9 links), 'Networks and Collaboration' (8 links), 'Bureaucracy and Admin' (8 links), 'Organisational

Culture/Structure' (8 links), 'Experience with Innovation' (7 links), and 'Difficulty to Change Existing Practice/Systems' (7 links). Understanding of environment includes understanding of regulatory environment which was often the reason for the overlap between these two. Regulatory burden often was talked about causing difficulty with financing innovation and this is likely why it overlapped with 'Finance and Funding' frequently.

Interviewees talked about regulations being there for our protection and that while it may be a barrier to innovation, it is often a necessary barrier (e.g., F249). The Interviewees appear to all agree on that, but there it is also clear from most Interviewees that there could be ways to improve regulation or the approach to it to help support innovation while keeping the protections etc that regulation is there for (e.g. D255).

Some Interviewees spoke about the difficulty for industry and/or smaller businesses etc to overcome regulatory challenges and this acting as a barrier to innovation in UK healthcare (e.g. E255, F248 etc). This can be due to the burden of evidence gathering required to show the safety and efficacy of the innovation (of course a very necessary thing to show) (see Interviewee E's statements) but also for other reasons such as how does the health system then purchase and procure the innovation (and how does it justify it) (see Interviewee D's statements) or regulations around working or collaborating with the health system (e.g. C251, G250 etc).

Another interesting point mentioned a few times was how the COVID-19 influenced policy and regulations and how that affected innovation and adoption. Per the statements, the crisis of pandemic caused the reduction of extra or unnecessary steps, speeding things up from a bureaucratic or administrative standpoint (see 'bureaucracy and administration') while still observing all the important points of why the policy or regulation was there to do. It is summed up by the quote: "nothing was skipped, nothing was left out, there was nothing, whether it was ethics or anything else which was a risk to patient safety or whatever. Everything, all those regulations and everything was observed, but just quickly" (from D252). See also B249.

This code was relatively inconsistent in terms of number of statements per Interviewee: Interviewees B, F and H had 1-2 statements, Interviewees C and G had 5, and Interviewees D and E had more with 8 and 9 respectively.

4.4. Relative Importance of Factors

For the seven key participants, after direct quotes were taken from interview text and recorded under their corresponding factor(s) in the Master Data Display spreadsheet (see Appendix I), the number of quotes under each factor were counted numerically so the number of separate occurrences of each factor could be used as a measure/proxy for the relative importance of each factor for each Interviewee. This is content analysis, outlined in Section 3.5.5.

All mentions for each factor for all Interviewees were also totalled to give an idea of their overall general relative importance. The results of this are presented in Appendix J, where there are two tables showing this numeric data, the first remaining in order of discovery of factors (8.10.1.), the second sorted by total number of statements recorded under a factor in descending order (8.10.2.).

Then, to adjust for the fact that some Interviewees had more or less total statements than others (due to reasons such as the length of interviews, the level of detail given in their answers etc), a percentage value was found for each factor for each interviewee. This was done by calculating the number of statements coded to the factor as a percentage of the total number of statements recorded for each Interviewee. A mean percentage was then found across all interviewees was for each factor, and the table was sorted from highest to lowest mean percentage. This table can be seen in Appendix J (8.10.3.).

Finally, a comparison of these two methods for indicating the relative importance of factors was done, and this can be seen in Appendix J (8.10.4.). Most factors sit in the same or similar position in the ranking of overall importance between the two methods.

It should be noted that some factors have the same total number of statements, or the same mean percentage of total statements and therefore an exact rank of 1 to 44 cannot be achieved here. However, this is not a significant issue as the intent is not to provide a definitive rank, but to provide a useful approximation that gives an idea of the general importance of each factor when it comes to how often they are an influence in adoption.

Below is an excerpt from Table 8.10.3, “Percentage of Interviewees Total Number of Statements...”, to show how the relative importance data is presented:

Table 6. The most frequently mentioned factors calculated by mean percentage of total number of interviewee statements. Excerpt from “Percentage of interviewees’ total number of statements...” (Appendix J)

			Participants						
POET	Theme/Factor	Mean	B	C	D	E	F	G	H
O	Organisational culture / structure	22.8	18.5	8.2	27.5	20.0	33.3	21.1	30.8
P O T	Demonstration of Value	19.7	5.6	14.3	5.0	14.3	29.2	15.8	53.8
P O	Leadership	18.8	7.4	18.4	25.0	20.0	16.7	21.1	23.1
P O	Networks and Collaboration	18.6	9.3	14.3	12.5	2.9	20.8	39.5	30.8
P	Trust, Reliance, Relationships	18.4	7.4	8.2	15.0	11.4	37.5	34.2	15.4
P O	Empowerment	17.4	1.9	2.0	12.5	5.7	37.5	15.8	46.2
O E T	Finance and Funding	16.7	5.6	10.2	10.0	31.4	20.8	15.8	23.1
P O	Alignment of actors/objectives	15.8	5.6	10.2	15.0	11.4	29.2	31.6	7.7

4.5. Factor Interrelatedness

In addition to the relative importance of factors, an indicator for the how strongly the factors were related was developed.

First, simultaneous coding allowed the assignment of as many codes as was necessary to a chunk of data, and as mentioned the majority of data chunks (i.e., interviewee quotes) were included as whole as possible to retain all relevant detail, nuance, and complexity. This meant that often more than one code was assigned to a single datum, which was by design in part to allow for this analysis.

Then, each occurrence of a pair of codes overlapping was counted across every piece of data, for every pair of codes, for all seven key participants. This number for each pair of codes provides the level of interrelationship between them. This is a measure of the relatedness of factors.

Furthermore, this analysis allowed for the determination that the factors were distinct, for if there was total or very high overlap between two factors, factors may have had to be combined.

The results are presented in the matrix below and tables in Appendix K.

4.5.1. Factor interrelatedness matrix

	PO44	P43	O42	O41	PO40	PO39	O38	PO37	O36	P35	T34	E33	POE32	E31	P30	OET29	PO28	E27	PE26	O25	O24	PO23	O22	PO21	P20	O19	T18	OET17	O16	P15	PT14	PT13	PO12	PO11	P10	PO9	PO8	P7	PO6	PO5	PO4	PO3	P2	P1	
P1	3	1		2	5	6	3	2	7	5	1		4	3	1		3		3	3	3	5	3	5	3	7	1	6	2	8	1	3	2	4	5	3	8	5	7	5	7	3	3		
P2	4	3		1	4		1	2	2	1	1	3	6	5	2	1		1	11	5	9	1	5	1	6	10		3	4	2		3	1		4	1	1	1	5	6	1	1			
PO3	1	1	5	7	7	2	1	1	8	5	3		5	1	1	2	2	2		3	4	1	8	4	2	9		3	2	5	2	2	3	10	3	2	7	2	12	5	10				
PO4	5	3	2	6	7	3	4	1	10	6		1	3	4	2	2	3	5	4	2	3		2	5	8	13	4	6	9	7	2	11	8	7	14	2	7	2	14	15					
PO5	8	4	4	3	5	2	3		13	3	2	2	2	8	4	4		6	9	3	5		4	2	9	6	2	10	8	3		11	8	9	17	5	6	4	10						
PO6	5	4	2	7	6	5	3	1	11	16	1	3	7	2		1	5	3	6	3	4	2	3	5	4	7	3		6	12	2	9	7	7	13	6	11	6							
P7	1	4	3	1	2	1	1	1	6	7		1	1		1	2	2	4	2		1	3	1	2	2	2		2	1	5	1	3	1	4	7	4	6								
PO8	3	2	5	2	5	5	1	3	4	7	3	3	3	2	1	3	6		2	3	3	5	4	9		11	1	5	5	10	1	5	3	7	12	4									
PO9	1	1			3	1	1	1	5	6		2	2	2	1	3	1	2	5			1		2	1	4	1	1		4	1	7	3	1	4										
P10	6	2	4	2	9	2	5	3	8	10		2	2	3	1	1	3	5	12	2	2	4	3	7	4	11	1	6	8	9	2	8	7	5											
POT11	4	2	6	5	5	2	2	1	5	2	7	1	3	4	2	4	4	3	4	1	5	3	7	4	8	7	1	9	2	3	3	6	12												
PO12	2		3	2	3	2	2	1	6	3	3	1	3	4	1	1	5	6	4	3	9		4	4	10	5	2	4	4	2	2	10													
PT13	3	1	1	2	2	2	2	1	9	5	1	1	2	7	1	2	6	5	7	2	2		1	5	9	4	3	8	7	4	2														
PT14	1		1		1		2	1	1	1							3					1	1			1			1																
P15	2	1	1	2	7	3	3		9	8		1	3	2		1	4	2	1	2	1	3	2	6	3	6		3	2																
O16	3	2	1	3	4	1	3	2	3	3		2	5	8			2	3	4	7	8	1	3	3	5	14	1	7																	
OET17	4	1	2	1	2	3		1	4	2	4	3	2	11	1	4	3	3	2	8	6	5	8	3	5	7																			
T18				1		1							1	3		1		3			1				2																				
O19	3	2	2	3	9	3	4	4	4	3	3	5	8	8	1	4	5	3	6	16	15	4	10	9	6																				
P20	3			3	4		2		5	1	2	1	4	9	2	1		7	6	4	9	1	3	3																					
PO21	1		1		4	5	4	2	3	5	1	3	3	5	2	1	3	2	2	3	5	1	6																						
O22	3		3	1	4	1	2	1	4	2	3	2	9	5	2	2	3	3	2	6	6	2																							
PO23	1				2	3	1	3	2	1			2	2		1	3	1	2	1	1																								
O24	2	1	1	2	2		1		2	1	4	2	6	7		2		2	5	14																									
O25		1	1	2	1				2		4	1	5	6		2	1	2	1																										
PE26	4	2	1		4	1	1	3	3	3		3	4	2	3	1	1	1																											
E27		2	4	2		1	2		4	1	1		2	4			1																												
PO28	1		4		2	2	4	2	2	3				3	1	1																													
OET29	1	1	1	1	1				3		2	1	1	6	1																														
P30	2	1	1		2			1	2	2																																			
E31	3			1	2	2	1		3	2	3	3	2																																
POE32	3	1		2	3		1	1	3	2		1																																	
E33	1	1		1	4		1	1	2	2																																			
T34			1	1	1																																								
P35	5		2	1	3	3		1	11																																				
O36	5	1	3	3	4	3	4																																						
PO37	1		2		1	1	1																																						
O38			2	2	2	2																																							
PO39					1																																								
PO40	5	1	2	4																																									
O41	2	2	2																																										
O42	2																																												
P43	1																																												
PO44																																													

Figure 13. Factor Interrelatedness Matrix: The frequency each factor is mentioned in the same data chunk as each other factor. Source: The Researcher

Figure 13. Factor Interrelatedness Matrix: The frequency each factor is mentioned in the same data chunk as each other factor. Source: The Researcher

The key for the shorthand codes that the factors have been converted to fit on the page above can be seen in the list of factors in Section 4.1.1 (or the table in Appendix F). These shorthand codes converted the text codes to a number based on their order of discovery, preceded by their POET context coding.

As can be seen by the above matrix, there are many links between the different factors. The majority of factors were linked to each other at least once, but there was also a significant number of factors which never overlapped (see blank spaces/squares). Many pairs of factors were linked more than once, with some being linked together more than 10 times, up to the highest linkage of 17 between “Networks and Collaboration” and “Trust, Reliance and Relationships”. See the display 8.11.2 in Appendix K for the pairs of factors which were most strongly linked, from 8 links and above.

While many factors had cases of low or no linkages with other factors, the majority of them had at least one pairing (and usually many more) which had more than 4 linked quotes. The least linked factors can be seen in the matrix as the ones with the highest about of blank spaces, and the highest amount of the lowest frequency of linkages. The four factors with the least links to all other factors (none with more than 4 links, and the majority less than four or no links) are PT14: “Experience with Technology”, T18: “IP”, P30: “Co-production”, and PO37: “Reputational”. It should be noted that these were also the four weakest factors in terms of number of statements recorded under them, with PT14 and P30 having 8, PO37 having 7, and T18 having 6. This likely contributes to why these have low links with other factors.

This is a point which affects all factors of course, the more statements recorded under the factor, the more likely it is to have more links generally speaking. The latter was born in mind when viewing these links between factors. This is not a definitive rule though as the most linked pair of factors, while very strong factors, were not the two most recorded factors: “Networks and Collaboration” and “Trust, Reliability, Relationships” had 42 records apiece, and were linked 17 times.

The number of pairs of factors that were linked at each level of interrelationships can be seen in Appendix K Table 8.11.1. I.e., there were 167 factor pairs linked two

times, 135 linked three times and so on. Interestingly there was more pairs of one or two links (186 and 167 respectively) than zero links (159). Other than this, the number of pairs linked a certain number of times generally decreased as the number of links increased. The total number of links of all 44 factors to the other 43 was 946.

The matrix of interrelationships (Figure 13) and the supporting tables in Appendix K show that the majority of factors to a greater or lesser extent have a degree of interrelationship, which highlights the complexity of all of the influences on the adoption of innovations. This suggests that for any innovation, things are rarely simple when it comes to its adoption, and a myriad of factors which interlinks and may be of different importance depending on the circumstance should be considered.

4.5.2. Most Strongly Interrelated Factor Pairs

Table (8.11.2) in Appendix K shows the most strongly interrelated pairs of factors. The table is cut off at 8 links as the number of factor pairs that were linked 7 times or lower is too large to present in a table here (e.g., 35 pairs for 7 links to 188 pairs for 1 link). An excerpt of the table is presented below:

Table 7. The pairs of factors most frequently linked to each other. Excerpt from “Factor Interrelatedness – Most Strongly Related Factor Pairs” (Appendix K)

Factor 1	Context code 1	Factor 2	Context code 2	# of times linked
Networks & Collaboration	PO	Trust, Reliability, Relationships	P	17
Leadership	PO	"People who get shit done"	P	16
Organisational culture/structure	O	Systems and Processes of Organisations	O	16
Alignment (Actors/Objectives)	PO	Networks and Collaboration	PO	15
Organisational culture/structure	O	Difficulty to change existing practice	O	15

As an example of what is meant by linked factors: if “Trust, Reliability and Relationships” was mentioned and talked about in the context of innovation adoption by an interviewee, it was often immediately preceded, followed, or interlinked with a discussion of “Networks and Collaboration” and their influence. In fact, this occurred 17 times across the key interview participants as seen in the table: they were the most frequently linked factors. For an example quote (D37/90 in Master Data Display):

“What we saw working in Swansea Bay and Hywel Dda we said well let's do the same with Betsi Cadwaladr. One of the innovations we had was to then have a secondment where somebody from within the existing team would then have responsibility for identifying opportunities so then like recognising IP and working as part of a network, rather than on their own. but we did that with Betsi, we've now got the discussion because the funding had been extended, both in terms of time and also geography, so that is now happening with Cardiff and Vale and I think, and I think Aneurin Bevan as well, so seeing that that spread but what made it happen was that alignment of values in terms of we were... sometimes you get a 'not invented here', there's a resistance, so we'll invent our own thing. But actually because we went in, and we were, let's say, offering something and in a way which wasn't treading on the sovereignty of the organisation or the health board, we were saying no this is your resource it's local, but you've got this sort of centralised resource here to support you you've got this network here to draw upon and there was a trust, and yeah was the, that was the invaluable ingredient, has allowed it to be adopted sort of well pan-Wales now. That would be a success.”

The reason this analysis was performed was to assess the interrelationships between factors, but also it was useful to assess whether factors overlapped enough that they could or should be grouped together. At this stage, no further reduction in codes by grouping was required as they were found to be distinctive enough. As noted in Methodology (Chapter 3), some grouping was performed during initial coding and analysis into the Master Data Display while data collection was ongoing. For example, Alignment of Actors/Objectives was originally two codes ‘Alignment of Actors’ and ‘Alignment of Objectives’, but they were so overlapped and similar they were combined.

It is also important and interesting to note how frequently there is context overlap between these most strongly linked factors. What is meant by this is that for the majority of factor pairs that are most strongly related (Table 8.11.2 in Appendix K), they share at least one context code between them, i.e., P and PO share P, POT and OET share O and T etc. In fact, of the first 26 pairs in the table (i.e., the most strongly related: 17 through 11 links), only one pair does not share a context overlap: “trust, reliability and relationships” [P] and “Organisational Culture/Structure” [O] (highlighted). This is explored further in the Discussion Section 5.5.

Note that even though this is a pairwise comparison of the links between factors, some interviewee statements mentioned multiple factors at once. For example, this quote from Interviewee F contains 8 codes: ‘View of Other Sector’, ‘Networks and Collaboration’, ‘Champions’, ‘Trust, Reliability, Relationships’, ‘Relationship Between Sectors’, ‘Local vs Regional vs National’, ‘Getting the Right People’, and ‘Buy-in of a Few Adopters’:

(Asked about collaborative approaches) a health and care professional to help develop something, unless they're there at the start, and what I've seen on that scenario...so innovate UK did funding where you can say I'm going to work with this GP practice and help do my innovation and that's one book and then you get into the scenarios where everything relies on that one GP practice and the innovator thinks they're generalisable, but they're not. You end up in that world and... What do I think actually works, I think that you have to find the right person and that person has to find the other people, and I think it's a network effect that you're trying to create. I don't think you're trying to convince 20 people, I think you're trying to convince three or four people who have really good networks and good ways in which they will use their network, so at some point then, you trust them. You trust that person to say it will work, I will help you. And I partly say that with that exemplar and adoption/spread model, that is the exemplar is your path, even when it's an app and the industry's involved it is the exemplars coming forward and saying “you want to use it this way or I have used it this way”. Okay, so I think that having

someone on the inside, that has bought into the process of what you're trying to achieve, even after you've developed it [that is fine]. If you're if you're in industry you've got to [be careful].

As a further measure of a factor's propensity to be interrelated, Table 8.11.3, "frequency that factors appear in Table 8.11.2", in Appendix K shows how many times each factor in the 'most strongly related factor pairs' in Table 8.11.2 in Appendix K appears in Table 8.11.2, i.e., it is a measure of which factors are the most strongly linked to others the most times. This shows that certain factors such as Networks and Collaboration, Organisational Culture/Structure, and Trust, Reliability, Relationships are significantly interconnected with many other factors to a relatively high degree. While other factors such as 'Political', 'Motivation' and 'Communication (General)' have less interrelationships with other factors to a high degree. This is discussed in Section 5.5. An excerpt of this table is provided below:

Table 8. Factors that are most frequently linked to other factors. Excerpt from "Frequency factors appear in display 8.11.2" (Appendix K).

Factor	Number of times appears in 8.11.2
Networks & Collaboration	13
Organisational culture/structure	13
Trust, Reliability, Relationships	12
Alignment (Actors/Objectives)	10
Leadership	9
"Getting the right people"	8
Experience of innovation	8

4.6. Enablers and Barriers

An initial intention of data collection and analysis was to identify specific and discrete barriers and enablers to the adoption of innovation, and to analyse and present these in separate data displays as negative or positive influences on innovation. When conducting interviews and beginning to discover factors, it was difficult to always identify and assign them as either a definitive binary positive or

negative influence on innovation, and in fact most of the time, interviewees would discuss points or give examples where a factor could be both a positive and negative influence on adoption. This often depended on the context and the circumstances, and how these things changed over the course of an innovation. This is explored in detail for each factor in Appendix H.

Therefore, increasing the number of factors by having a solely positive or negative iteration of the factor (e.g., lack of trust or presence of trust) would not have illustrated the non-binary nature of the factors in that they were sometimes both enabler and barrier – sometimes discussed even in the same example. For example, see this quote from Interviewee D which concerned who and how people show leadership and work effectively:

“The ones we’ve been engaging with, I would say they are quite a heterogenous in terms of the... Some of them are assistant director level, some of them are more junior but in a very sort of passionate, ambitious and can influence within their organisation. It is more the effectiveness often rather than where they are in the stratum. You know we’ve got people we engage with (I won’t name any names) locally within health board - very senior and they’re just chair moisteners - they are part of the problem, not the solution, whereas you can have people who are further down, who can essentially navigate around them.”

A further example of the spectrum nature of codes and thus factors was apparent from the first interviewee. It seemed clear that a lack of knowledge, awareness and skills around the innovation process seemed to be an important inhibitor of innovation adoption in many cases in Wales, and therefore this seemed like a clear barrier to innovation and was recorded as such. However, as the same interview and others were continued to be analysed it was noticed that there was a clear enabler of innovation adoption which was the reverse, i.e., a presence of knowledge, awareness skills and experience of the innovation process (see ‘Experience of Innovation’ in Appendix H). Therefore, it seemed artificial to separate barriers and enablers and instead simply use “factors that influence

innovation adoption”, and coding was continued in this way during data collection and analysis.

While the above examples may seem overly simple or obvious, it appeared to work for all factors to a greater or lesser degree, even those which the researcher thought would always act as a barrier. However, the key thing seemed to be the conditions and circumstances of the case of innovation adoption, where in one case the factor could act as a barrier, but in another it could be an enabler. Therefore, it seems identifying which is which or what a person or people had in their own innovation case(s) would be very beneficial when aiming to support or enhance adoption, this is explored further in the Discussion Chapter (Section 5.6).

Some examples of factors included “Bureaucracy and Admin”, “Policy and Regulatory Effects” or “Finance and Funding” which were previously thought to always act as a barrier and be a hurdle to jump over each time someone wants to participate in and support innovation adoption. However, during the course of the interviews, it was found that each of these factors could also act as an enabler depending on the specific situation. For example, regulatory change or beneficial regulations can be a driver of innovation and adoption in a certain direction, acting as an enabler for certain innovations and perhaps a barrier for ‘less desirable’ innovations. The problem then is having the right regulations in the right place – something the relevant governing bodies decide on, and they may be influenced by a number of things. See this example from Interviewee E:

(Continuing to talk about regulation) One of the things as an innovation business you need to look at is what regulatory challenges lie ahead and it's far too difficult to try and become a challenger to regulatory environment, to try and get the regulatory levers changed. But that's what I'm trying to do, I'm trying to use regulatory levers to support venture, by educating people who are in control of those levers to say actually if you apply this to the institutional pension world, we can free up capital to come into venture. If you do that it's like opening the lock gates or the dam gates and water will flow where it's needed. And actually then, if you take a view on venture, if you invest now, within eight to 10 years you'll see a return on that capital, certainly at the scale we're talking about, and the whole thing becomes a self-fulfilling

prophecy. That's really what you're aiming to achieve. So is regulation is a good thing, but you need to make sure it's not over tight and it needs to be checked for its fitness for purpose on a regular basis and I don't see that happening that often.

Therefore, with these points in mind data collection and analysis continued with a single Master spreadsheet (display) in which was recorded all discovered factors, and when interview data chunks (quotes) were added to the spreadsheet, the cell was green or red highlighted based on whether the specific point or example the interviewee was giving was highlighting the factor as positive or negative influence, i.e., a barrier or enabler in that case. If the quote was neither wholly positive or negative, i.e., described both barriers and enablers or was neutral, the cell was left clear. This was the first stage of magnitude coding. The results of this ‘enabler/barrier’ recording are presented in Appendix L, and an excerpt of this data is provided here:

Table 9. Excerpt of “Barriers and Enablers – Number of Statements Recorded for Each Factor, with Barrier and Enabler Codes”.

POET	Theme/Factor	Total	Interviewees						
			B	C	D	E	F	G	H
P	Motivation (why innovate?)	28 (8+/2-)	3 (2+/1-)	5 (0+/1-)	7 (2+/0-)	3	4 (1+/0-)	3 (3+/0-)	3
P	View of other sector	23 (0+/7-)	1 (0+/1-)	6 (0+/2-)	7 (0+/1-)	4 (0+/2-)	2 (0+/1-)	3	0
P O	Clear Vision / Culture	24 (5+/8-)	3 (1+/0-)	3 (0+/1-)	3 (0+/1-)	2 (0+/2-)	4 (0+/3-)	3 (3+/0-)	6 (1+/1-)
P O	Alignment of actors/objectives	38 (11+/12-)	3 (2+/1-)	5	6 (2+/2-)	4 (0+/2-)	7 (2+/4-)	12 (5+/2-)	1 (0+/1-)
P O	Networks and Collaboration	42 (18+/7-)	5 (4+/1-)	7 (2+/0-)	5 (3+/0-)	1	5 (3+/2-)	15 (5+/2-)	4 (1+/2-)
P O	Leadership	45 (13+/12-)	4 (3+/1-)	9 (1+/2-)	10 (3+/1-)	7 (1+/5-)	4 (1+/1-)	8 (3+/1-)	3 (1+/1-)

4.6.1. Relative importance of factors with enabler and barrier codes

For this display, presented in Appendix L, each quote for each factor for each participant was assigned as either an enabler or barrier in the quote’s specific

context, using +/- respectively or if the quote was neither a barrier nor enabler or both i.e., mixed, it was left blank.

The number of 'barrier quotes' and 'enabler quotes' are tallied and represented in the table above in the format of X (Y+/Z-), where X = the number of statements recorded under the code, Y+ = the number of enabler statements, and Z- = the number of barrier quotes.

The number of mixed quotes can be easily calculated for a given interviewee by adding enablers (+) and barriers (-) and subtracting that from the total number of occurrences of the code. E.g., for Interviewee C on Leadership they had 1 enabler and 2 barrier codes and 9 total codes. Therefore, they had 6 mixed statements ($9 - (1+2) = 6$).

As can be seen in the display in Appendix L, the majority of codes had quotes which discussed it as a barrier, enabler, or both. No codes/factors had only enabler or barrier quotes, but some had mainly enabler or mainly barrier quotes.

In each quote, whether the statements were an enabler, barrier, or mixed often depended on the exact conditions, circumstances and setting which the quote was discussing. This suggests significant complexity when it comes to codes acting as a barrier or an enabler in a given innovation adoption situation, and that factors should be viewed more as influences which could be positive or negative on adoption depending on the circumstances, rather than the dichotomy of barriers/enablers. This is explored further in Discussion Section 5.6.

4.7. Summary of Results

A number of conclusions have been made from the findings of the interviews. These are summarised below:

1. There are 44 factors discovered that influence the process of the adoption of innovation in health and life sciences in Wales.
2. Although the respondent group was diverse, there was a high level of agreement on the factors.
3. 'People' was identified as a context distinct from T, O and E.

4. Factors discovered did fit with TOE plus socio-technical theory which supported creation of POET.
5. The contexts in POET often showed relationships with each other. The four contexts are interrelated at the factor level, and none can be considered individually.
6. The relationship between the contexts was not equal, with more being P, O or P+O.
7. Some P factors discovered were not those relating to other technology adoption models/ behavioural models.
8. The inductive process had identified new, more complex relationships between factors.
9. Although few factors were coded under the T & E context, and even fewer were coded to show relationships to both, some of the small number of T and E factors did appear high in the magnitude and importance list.
10. The interrelatedness between factors identified some key factors which were strongly linked to others.
11. It is clear that some factors never overlap.
12. Although there is a high number of factors identified, often with high relatedness between them such as Networks and Trust, attempts to rationalise this number failed to identify the nuances of innovation adoption in practice. For instance: "Trust and Relationships" was significantly interrelated to "People Get Sh*t Done" and "Personality", but "Networks and Collaboration" was not significantly interrelated to these factors.
13. Enablers and Barriers – Factors were often described as both enablers and barriers which suggests a temporal (time dependent) element detected by this investigation which is absent from traditional linear models.
14. Increasing the number of factors by having a solely positive or negative iteration of the factor (e.g., lack of trust or presence of trust) would not have illustrated the non-binary nature of the factors in that they were sometimes both. And potentially even in the sample example.

In conclusion, the challenge established by Greenhalgh et al., (2004) was to close the gap in the extant academic and professional bodies of knowledge to add greater insight into the dynamics of modern healthcare innovation systems. The field research offers many new insights into this phenomenon using a socio-technical systems and TOE approach. The findings show a dispersal of weighting of TOE elements and therefore new insights into the innovation processes at play in the Welsh NHS. Having found contradictions to what was predicted by the traditional literature review, the next chapter will discuss these findings and refine them further as a means of answering the guiding research questions of this study and to mark a contribution to the extant and theoretical bodies of knowledge from which this study began.

5. Discussion

The study of innovation is, by nature, dynamic and the science and technology that leads to innovations, which are often innovations themselves, is not well established. New technologies and innovations are being produced from a number of innovators from large businesses to lone clinicians and entrepreneurs. These ideas and manifestations, in the form of technology, face a long and arduous journey to adoption and this process is far from predictable, logical or, in many stages, entirely successful – no matter how compelling and effective the technology might appear. There are a number of decision points even in a linear process of innovation at which seemingly beneficial innovations can fail. These decisions are taken by people. These people and their employing organisations (as well as external organisations) who hold the responsibility and capability to put innovation into practice are often limited in number and often have to make decisions based on less-than-ideal levels of evidence.

The TOE framework proposes that when all three vital elements of technology, organisation and environment are in place and effective then an optimised innovation process will result. However, the previous chapter of findings shows that current practice is well short of this ideal state, and more specifically there is a lack of focus on a very important element of innovation adoption: people. Therefore, this thesis presents the newly developed POET framework, which includes the fourth context of 'People' to be considered in innovation adoption, and aims to set out the factors that come under the four contexts of POET that can influence innovation adoption and should be considered if innovation is ever to be successfully adopted and the inertia overcome.

This Discussion Chapter explores the following points:

- Conceptualising innovation adoption and the POET framework
- The contexts of innovation adoption in the POET framework
- The factors that influence the adoption of innovations in healthcare
- The relative importance of factors
- The interrelatedness of factors
- The barriers and enablers to innovation adoption

- The views of the interviewees
- The study methodology
- The implications of this study for innovation adoption theories, the case of VAD adoption, and for innovation adoption in healthcare in Wales.

As with the Results Chapter, it should also be noted here that significant analysis is present in the Appendices, which will be referred to in the text of this Discussion Chapter as necessary.

5.1. Conceptualising Innovation Adoption in Healthcare – the Creation of the POET Framework

The review of extant literature and the empirical research conducted in this study has clearly shown that neither individual-level technology adoption models (such as TAM) nor extant organisation-level models (such as the TOE framework) adequately capture all contexts and factors which influence innovation adoption in healthcare. Therefore, the creation and development of the POET framework was necessitated.

As previously described, the POET framework was developed due to the fact that the three contexts of TOE, technology, organisation, environment did not adequately cover all distinct contextual influences on innovation adoption in healthcare in Wales.

This section will discuss the conceptualisation of innovation adoption, talk about the strengths and weaknesses of other models, frameworks, and theories, and explain why and how the POET framework was developed. Then, Section 5.2 will discuss the POET framework in detail.

5.1.1. Why use a model or framework for technology adoption?

As discussed, the adoption and spread of innovations into use by people and organisations is influenced by many factors. Due to the complexity inherent in a system that is influenced by so many factors in different ways, and the fact that the field has been actively researched for at least three decades, research has generated a variety of theories and models to explain and understand patterns of adoption, and how and why it occurs.

The issue of complexity in studying healthcare has been noted (Plsek and Greenhalgh 2001), as well as specifically in innovation adoption. To try and identify,

understand, and communicate this complexity in innovation adoption is a difficult challenge which if it were to be written out textually in as comprehensive way as possible would stretch to thousands of pages or hundreds of thousands of words. Hence why presenting this complexity into models and frameworks is a good and often used option. This research is no different and addresses the challenge of complexity by developing a broad framework to more adequately cover all important contexts of innovation, suggest important factors to consider, and to allow for flexibility and adaptability in its use.

5.1.1.1. Models

A conceptual models' primary purpose is to convey the fundamental principles and basic functionality of the system or concepts which it represents. When properly implemented, a conceptual model should satisfy four fundamental objectives:

1. Enhance a person's understanding of the representative system
2. Facilitate efficient conveyance of system details between stakeholders
3. Provide a point of reference for system designers to extract system specifications
4. Document the system for future reference and provide a means for collaboration

This is what models of technology adoption, and most studies of innovation adoption are trying to do: present the complex system of adoption of innovation in a representative and clear way (see Literature Review Sections 2.1-2.4).

5.1.1.2. The Scope and Purpose of Other Existing Technology Adoption Models and Research Are Not Suitable for This Study

Generally, there have been two sides of the spectrum to this kind of modelling in research. There are the technology adoption models, such as the TRA, SCT, TAM and its successors, and the TPB, which are simpler and focus on a few factors that influence an individual's decision to adopt an innovation. I would place these factors in the technological context of the TOE framework as would others (e.g., Gangwar et al 2015) and the POET framework outlined in this research, and the unit of their analysis is only suitable at the individual level (Alomary and Woollard, 2015; Taherdoost, 2018). This is not adequate to study the adoption and spread of innovations within healthcare which as this and other research has shown is

dependent on myriad influences in various contexts, at various levels, and in different spatial and temporal scopes. Therefore, this suggests these models do not meet objective 2 of models stated above (see Section 5.1.1.1.) as they do not convey *enough* information on innovation adoption.

The other side of the spectrum is to try and model the complexity in its entirety or at least attempt a more global explanatory model, such as Greenhalgh and colleagues (2004) model, which is a comprehensive attempt to consolidate all factors and influences on innovation adoption in health systems into one model that covers all bases. The model does this well, and they also note the nuances that may alter which components of the model are more or less important dependent on the specific circumstances of different cases of innovation adoption. The issue with this model and others which are extensive and comprehensive is clarity, ease of understanding and explaining, and the fact that aforementioned changes in case, circumstance or context may render parts of it ineffectual, which is always a risk when trying to create a model on a page which represents a real-life system that is highly dynamic and complex.

Another note on the Greenhalgh model is that there is some overcomplication, over fragmentation of factors which does not serve to enhance understanding, suggesting that this model does not successfully meet objective 1 of models above (Section 5.1.1.1.). An example of a theory that has been very influential and fits more in the middle of the aforementioned complexity spectrum, is Rogers' diffusion of innovations theory (1995). While this theory posits relatively few factors that affect adoption, and these would likely be placed in the technological and organisational contexts of the TOE framework, it is possible to use this theory to analyse individual and organisation level adoption, rather than just individual, as in other models (Rogers, 1995; Rogers, 2003; Oliveira and Martins, 2011).

5.1.1.3. Frameworks

A conceptual framework is an analytical tool with several variations and contexts. It is often applied where an overall picture of a system or concepts is required or used to make conceptual distinctions and organise ideas. Strong conceptual frameworks capture something real and do it in a way that is easy to remember and apply.

Conceptual frameworks are particularly useful as organising devices in empirical research. They can be an abstract representation, connected to the research project's goal, that direct the collection and analysis of data.

Explanation is the most common type of research purpose employed in empirical research. The formal hypothesis of a scientific investigation is the framework associated with explanation. Explanatory research usually focuses on "why" or "what caused" a phenomenon to occur. Formal hypotheses posit possible explanations (answers to the why question) that are tested by collecting data and assessing the evidence.

In the case of technology adoption, a framework could be used to explain the system, concepts, or factors which influence adoption. To do it most effectively, it should capture everything associated with adoption of innovation, and do it in a way that is easy to remember and apply.

Models and frameworks are very similar in the fact that they aim to conceptualise a real world phenomenon or process and so on. The difference is models are used to represent or explain the operation and mechanism of something which exactly or closely as possible replaces that something, whereas a framework is a way of representing all aspects and empirical relations between every aspect of inquiry when considering a scientific theory or research (i.e., it is aiming for a holistic view of something, while not seeking to prescriptively show its exact mechanisms or operations).

5.1.1.4. The TOE Framework Is Closer but Still Inadequate

The TOE framework (DePietro et al., 1990; in Tornatzky and Fleischer 1990) almost meets the necessary criteria, and this is why it was initially selected as the framework to be used for this study. It is a theoretical framework that lays out three contexts that affect technology adoption in organisations: the technological context, the organisational context, and the environmental context. It is clear, simple, and easy to understand but still has good explanatory power. Like Rogers diffusion of innovations, it can be applied at the organisation level and allows focus

on the higher-level attributes (the three contexts) rather than the behaviour of individuals in response to technology (the other tech adoption models).

However, as found in this research and considered in other research on innovation adoption in healthcare (e.g., Greenhalgh et al 2004; Petkova 2010; Fitzgerald et al 2002; see Section 2.1), individuals and the interaction between them are exceedingly important and influential in healthcare and innovation and technology adoption in healthcare. Since this was clearly and strongly shown early in this research, and the various factors under the three contexts of the TOE framework and in TOE research did and do not sufficiently cover these individual and social factors, this led to the development of the POET framework to include 'People' as a fourth context.

5.1.2. Using Socio-technical Systems Theory to bolster the POET framework

This led to a return to the literature in which other models and theories were considered to help search for a theoretical underpinning for the addition of the People context to the existing TOE framework that had a clearer emphasis on individuals and social influences on adoption of innovation. Technology adoption models which focus on an individual or individuals as the *unit of analysis*, such as TRA, TPB and TAM were ruled out as this study requires a higher level of analysis, more or the level of organisational units or multi-organisation or even at system level (e.g., NHS etc). Eventually the search led to the Socio-technical systems (STS) theory, which although was developed and used mainly in work design or organisational change, had seen some use in the healthcare, innovation, and innovation adoption literature (see Section 2.3).

As can be seen in the literature review Section 2.3, a socio-technical system essentially works at the level of an organisation, as with TOE, and can be used at even higher levels, up to society as a whole. This made it suitable in terms of the level of the unit of analysis as in this study the goal is to understand what influences adoption into the healthcare service in Wales (and the UK), which happens from the

level of organisational units (e.g., a single clinic or practice) all the way up to the level of the entire health system.

More importantly the STS theory recognises the importance of considering people when it comes to organisational change (which innovation adoption could be considered a type of), and also how people and organisation i.e., the 'social subsystem' interacts with the 'technical subsystem'. Specifically, the social system is comprised of people and their attributes and the relationships between them, and also structures and systems of the organisation which are more social (to do with people) than technical. The technical subsystem is comprised of the processes, tasks, and technology implemented by and within the organisation or the socio-technical system. Also acknowledged is that the environment or an 'external subsystem' influences the socio-technical system.

5.1.3. Similarities between TOE framework and STS theory and the development of POET framework

It was relatively straightforward to draw parallels between STS theory and the TOE framework (see also Section 2.4). Within the technical subsystem of the STS, there is 'technology' (meaning both material technologies and non-material such as procedures, processes, or knowledge) which draws an easy parallel to the Technological context of the TOE framework. Then there is the acknowledgement of the external subsystem in STS, which is an easy parallel to the Environmental context of TOE. For the Organisational context of TOE, you would draw from both the social and technical subsystems of STS theory: in the social there is 'structures' and 'systems' within the organisation which would pull out into the Organisational context of TOE, and in the technical there is 'processes and tasks', which would also pull into the Organisational context of TOE.

This leaves 'people', their attributes, and the relationships among people – which gave the fourth 'People' context, and in turn completed the POET framework for evaluating the influences on innovation adoption in healthcare.

Furthermore, research papers which do not use a technology adoption model or TOE framework per se, could have their components grouped under one of the four

POET contexts. For example, Greenhalgh et al 2004 included 'the innovation' (i.e., T context), 'adoption by individuals' (P context), 'assimilation by the system' (O context), 'diffusion and dissemination' (P and O contexts), 'system antecedents for innovation' (O context), 'system readiness for innovation' (O context). This means that this framework can potentially encompass other innovation adoption research findings, even if they didn't use a similar framework.

Therefore, in summary, clear benefits of the POET framework include that it adequately covers all the important higher-level aspects and contexts of influence on healthcare innovation adoption and should be generalisable to more settings and sectors (requires further research), and it covers it in a clear and simple way which is easy to communicate to and be understood and used by stakeholders in healthcare innovation and adoption.

The POET framework could be used both as a tool for research, as with TOE, but also as a framework for analysing the specific innovation, place, setting that one may be working with, to enhance understanding of the circumstances and the factors and contexts which are most important to consider and understand the how best to enhance or enable the adoption of a specific innovation, and remove or reduce potential barriers as well. This will be discussed more in Section 5.2 and the Conclusions Chapter.

5.1.4. Why not simply use Sociotechnical systems theory to investigate healthcare innovation adoption?

Innovation adoption could be considered through the lens of a change to a socio-technical system (i.e., an organisation, health system etc) and has been used in this regard previously in literature (see Section 2.3). However, this was considered unsuitable for this study for a few reasons including the fact that it wasn't developed for use in this field and would require greater adaptation and development. Furthermore, it doesn't view the situation through the lens of "what influences innovation adoption", rather it views it through the lens of "organisational change or work design should consider social and technical aspects". The main reason was because STS splits organisational characteristics

between the two subsystems (structures in social and processes in technical) which people and technological considerations are in turn blended with (people in the social subsystem and technology in the technical), you lose some of the clarity that a context focused approach which TOE and POET allow. What is meant by this is that by giving the clear distinction between the four contexts of POET (while still acknowledging their interrelatedness and interdependency) it is easier to investigate and discuss the contextual influences separately. The importance of this will become apparent throughout the rest of this Discussion Chapter, where the significance of the People context is particularly highlighted, in addition to the O, E and T contexts.

5.2. The POET Framework and Its Four Contexts

Now that the POET framework has been posited as a way to assess and understand the influences on innovation adoption in healthcare, a deeper discussion into the contexts, their importance, how they relate, and how they overlap will be explored in this section.

5.2.1. The Importance of Contexts and Their Overlap

The data seen in Section 4.2 in the Results gives an idea of the strength of each context as well as how much they overlap based on the second cycle coding of the 44 factors.

As can be seen by this data which is presented visually by the area-proportional Venn diagram in Section 4.2.3, the 'People' context appears most important, followed closely by 'Organisation', which also have a high amount of overlap at the factor level. The 'Environment' and 'Technology' contexts are relatively less important and less overlapped.

This suggests that the influences on innovation are more often to do with people and organisations, than environment or characteristics of innovations. This is interesting as a large amount of technology adoption research focuses on individual's views of technology and how that affects their intention to adopt (see Section 2.2), yet technology appears less important by the findings of this study.

It is also interesting that the TOE framework has no official weighting of the three contexts, therefore they were assumed to be of roughly equal importance.

However, these findings show that different contexts appear to have different general relative importance - which is a novel finding.

Furthermore, the fact that contexts seem to overlap at the factor level is also not present in TOE-based research (see Appendix B and Oliveira and Martins, 2011) and does not appear in other healthcare innovation research either (see Greenhalgh et al., 2004; Petkova et al., 2010).

5.2.1.1. Importance of People in Innovation Adoption

The fact this data shows how important people are as an influence in innovation adoption will be explored throughout this Discussion Chapter. It is interesting that people were only considered as a smaller sub-factor of organisation in the original TOE (DePietro et al., 1990), whereas this research shows People-related factors are likely the most numerous and strongest influences in their own context. This could be because the research was originally developed in other sectors, and that people are significantly more important in healthcare. Further to that, it could also be that people are more important in healthcare in Wales specifically. Certainly, a number of P related factors and quotes seem very related to healthcare and also to Wales. Further work can be envisaged to test this framework in other sectors and settings, to investigate the importance of these elsewhere.

The data in this study has shown that the P context, was most often the context which connected or provided relationships between and within factors – in particular, P and O were the next most numerous relationships. This suggests that people are the key ingredient in this complex domain of innovation adoption in healthcare in Wales.

Relevant people can influence innovation adoption in numerous ways. Whether it be through their interactions with others, such as their networks and collaboration, how they view other sectors, how well they align with others, how much trust they have among them and the strength of their relationships and more, or whether it is to do with their own characteristics, such as their personalities, leadership skills,

experience with innovation processes, their openness to innovation, or even their propensity to “get sh*t done”. See Appendix H and I for the evidence and detailed description of People factors and how they influence adoption.

5.2.1.2. The Importance of Key Individuals in Healthcare, Innovation, and Adoption

Further to the importance of people in general as an important context, arguably the most important in healthcare innovation and adoption, the data appears to show that some ‘key’ individuals are very influential and active, and in some instances, they are also unique and can’t be easily replaced. I.e., the distinct person (their characteristics/traits etc) as opposed to the ‘context’ of individual is what is driving the adoption. This suggests the need for a return to trait theory alongside considering the role of network hubs in considering the adoption of innovation in service-based organisations (den Hartog et al, 2020; Davies et al, 2018).

However, the research also suggests that there is ‘right place, right time’ aspect, that other people with the same opportunities and motivations could have done the same. In addition, it appears that these individuals are influential and driven/motivated, but they are part of a ‘team’ or community and a wider network, organisation and environment that actually drives the action. Nothing happens in a silo and the interaction between people is also very important. Often this appears to coalesce around these ‘key individuals’, however. See appendix H for further evidence to support this

Furthermore, many of the interview participants themselves were these kinds of people, which came through in their interviews and can be seen by their extensive and often ‘boundary spanning’ experience in healthcare and innovation (see Appendix C).

5.2.2. What do the POET Context coding interrelationships matrix findings show?

The POET context coding interrelationships matrix (Appendix G) is used to calculate how strong each context of the four POET contexts were related to each other and themselves at the factor level. This was done by pairwise comparison of the context

code(s) assigned to each of the 44 factors with the other 43. The calculations in Table 8.7.1 in Appendix G show how often any of the four contexts were coded together. For instance, the pairwise comparison of Motivation and View of other sector were both considered to be 'P' context only, generating a P result. However Clear Vision /Culture and Alignment were both PO, generating a PO result. However, Motivation (P) and Vision and Culture (PO) respectively generate a P, because there is only an overlap with P. Therefore, it is a way of numerically showing the strength of and overlap between contexts.

This data is used to present the level of interrelationship within and between the four contexts graphically via an area-proportional Venn diagram (Section 4.2.5). The implications of this data are explored below.

5.2.2.1. Implications of Dual-Context and Multi-context Combination Factors Discovered in This Study

As can be seen in Appendix F a large number of factors were coded to more than one POET context. This was done if the factor was considered to be related to, influenced by, or concerned with those two or more contexts. This seems to be an important finding, as the most frequent type of factor coding was a dual-context combination of 'People' and 'Organisation', with 14 factors. It seems that many factors, and some very important factors (see Appendix J) were related both to the role of the individual and the organisational capacity, capabilities, policies, or culture, and therefore these were coded together, such as Alignment of Actors/Objectives, Networks and Collaboration, and Leadership.

Previous literature scanned had not acknowledged or posited a dual- or multi-context capability of factors. Research on the TOE framework, other technology adoption models, and into healthcare innovation would seem to place each factor under one context. In the case of TOE research, factors are placed under technological, organisational, or environmental context either because they do indeed fit (mostly the case), or because they are made to fit (they could be arbitrarily created or altered to fit more neatly under a context, or simply placed under the context that fits best) (see Section 2.1-2.4; see Appendix B; Greenhalgh et al., 2004; Oliveira and Martins, 2011).

In the case of healthcare innovation research such as Greenhalgh's model (Greenhalgh et al 2004), factors are generally placed under one of their 'contexts' which the researchers created based on their own research. Firstly, their created contexts can easily directly correspond to, be placed under, or be split between the four POET contexts for simplicity and ease of understanding (e.g., 'the innovation' corresponds to the T context, 'system readiness for innovation' comes under the O context). Generally, the factors which come under their contexts fit well, as the contexts used are very specific and focused (especially in the Greenhalgh et al 2004 model) and so potentially do not have the issue of being 'made to fit' as much the factors in TOE research. However, this potentially leads to more contexts and also to factor splitting or duplication to fit under the increased number of contexts.

For example, Greenhalgh et al 2004 have three factors related to 'networks' which all come under a different one of their specific 'contexts': 'Network structure' under 'Diffusion and Dissemination'; 'Interorganizational networks' under 'Implementation and routinization'; and 'Informal interorganizational networks' under 'Outer Context'. While this was suitable and effective for the type of study those researchers were conducting, it is not appropriate for this research, which has the approach of pragmatism and the goal to create an approachable and accessible framework that can be applied in a practical way for stakeholders of innovation in healthcare. In addition, if you actually talk to people, they likely wouldn't differentiate networks so specifically, they will talk about how networks did or did not benefit adoption. This is indeed how the Interviewees in this study discussed it and these were people selected for their expertise in healthcare innovation (see quotes under 'Networks and Collaboration' in Appendix H). Therefore, in this study the single factor of 'Networks and Collaboration', which encompasses all points that pertain to the use and extent of networks available to individuals and organisations and how they contribute to collaboration as it relates to innovation and adoption, is placed under both the 'People' and 'Organisational' Contexts, because it is affected by and relates to both, and importantly it is how the Interviewees spoke about the factor.

This type of example can apply to various of the other factors of this study and those found in previous research (see Appendix M, Table 8.13.1). This issue of how to define factors, under what context to place them or where in a model or framework is a challenge that is owed to the complexity of the adoption of innovations and is why it is difficult it is to express in a conceptual model or framework that covers all bases. As discussed, this challenge is addressed in other research in ways such as: making factors fit under desired contexts, creating new or more specific contexts, or fragmenting or duplicating factors to have slight nuances but fit into separate specific contexts.

In this research, the novel approach of allowing factors to sit within two or more contexts, based on the assessment of what the factor is influenced by or related to, addresses this challenge in a way that has beneficial implications. These include the fact that it removes the issue of having to fit factors neatly into a single context by either placing them based on best fit, or fragmenting, changing or duplicating them so they can fit in two or more contexts separately when they are (likely) closely related at the factor level and it would be simpler if they were grouped and placed within more than one context.

In addition, this approach acknowledges the complexity of these factors which influence adoption by noting that they can affect or be affected by multiple contexts, but still in a clear and communicable way, which achieves the parsimony goal of this research. Furthermore, it acknowledges the complexity, interrelatedness and overlap between contexts, which is discussed below.

Finally, it also keeps the framework simpler with its four POET contexts rather than the requirement for more contexts (as discussed, the addition of the P context was an essential development and leaving it as the three contexts of TOE was unfeasible). The goal is to include everything influential in innovation adoption in as clear and simple way as possible.

5.2.2.2. The Overlap Between Contexts

As discussed above, it was found in this study that a single factor can sit within two or more contexts and so were coded as such. This means that at the factor level

there is an overlap between the four contexts. From the data calculated from the POET context coding matrix (Appendix G), an approximation of the size of this overlap across all factors can be expressed in a numerical way and the area-proportional Venn diagram (Section 4.2.5) in a visual way.

It should be noted that here we are discussing the *overlap* or *similarities* between contexts, which appears to be a novel finding, not their *influence* or *relatedness* on each other, which is noted by previous models usually via arrows between contexts or factors in models that represent a relationship. This will be discussed at the factor level in Section 5.5.

5.2.2.2.1. The P and O Contexts' Overlap

As can be seen from this data, the most significant overlap by a large margin is between the People and Organisation contexts, which suggest a few important things. Firstly, it suggests that factors which are related to or affected by people are relatively frequently related to or affected by the organisation as well, and vice versa, meaning it is important to consider them both simultaneously and be cognizant of their interrelatedness or interdependency when it comes to influencing factors of adoption. For example, when thinking about leadership, the person(s) that leads and their characteristics, beliefs etc are important but also how they fit within an organisation and how the organisation facilitates the expression of their leadership (see leadership quotes and analysis in Appendix H).

Secondly, it suggests that People and Organisation contexts share similarities with each other as contexts in healthcare regardless of factors of innovation adoption, which agrees with what is often discussed in literature (e.g., Plsek and Greenhalgh 2001; Fitzgerald et al 2002; Plsek 2003; Greenhalgh et al 2004; Petkova et al 2010). It may be why initially there was no P context in the TOE model, and some factors that would be assigned P in this study likely would have been placed under O in a TOE framework study (or potentially T or E) or under a different created context. For example, Moore & Benbasat (1991) had the factor of 'Result demonstrability' in the Technological context which is comparable to Demonstration of Value factor in this study, assigned to P, O and T contexts. As another example, 'championship'

(found in Grover 1993, Meyer 200, Lee & Shim 2007) which corresponds to 'Champions' was listed as a 'Support' factor.

Thirdly, as discussed, P and O are shown to be the most important contexts in healthcare innovation, and as they are most frequently coded and related and overlapped it would follow that they are the most important in relation to each other, so this taken with the previous two points would suggest that this is the most important thing to consider in terms of the contexts that matter in healthcare, healthcare innovation, healthcare adoption.

Previous literature acknowledges the role of individuals and organisations, and the models and frameworks have also acknowledged that different contexts influence each other (Petkova et al 2010; Fitzgerald et al 2002; Greenhalgh et al 2004; Rogers 1995; Oliveira and Martins, 2011; also see Appendix B) but the interdependency and overlap has not been represented or approximated in terms of strength of the overlap in a quantified way (in the searched literature), and so this is a novel finding.

A final note on the P and O overlap should be that there was not too large an overlap, i.e., there was enough 'non-overlap' to show that these two contexts are indeed distinct and warrant existing as their own context. While there was a significant number of factors assigned both P and O, there was also a significant number of factors that were assigned to the P or O context, but not both. As can be seen in Table 8.7.1 in Appendix G, the internal relatedness of P was greater than O (254 vs 226), and the overlap was around half as strong as the individual contexts (120). This supports the fact that while closely linked and overlapped in many ways, the P and O contexts should remain as distinct contexts for analysis.

From the point of view of STS theory, this appears to show that the social subsystem is more important than the technical in healthcare innovation adoption, at least in Wales, and likely the wider UK also.

5.2.2.2.2. The E and T Contexts and Their Overlaps (or Lack Thereof)

The data from Appendix G, Table 8.7.1 and as seen in the Venn diagram in Section 4.2.5 shows that the Environmental and Technological contexts were very weakly overlapped with each other and with the People and Organisation contexts. This is likely in part due to the relatively weaker interrelatedness of these contexts (E=17, T=15) compared to P and O (254, 226) found in this research. It may also suggest that these contexts are more distinct from each other and from the P and O contexts, than P and O contexts are with each other, at least in innovation adoption in the setting and sector of healthcare.

As mentioned, previous literature does not specifically discuss the overlap or importance of difference contexts and this work likely needs further testing in both healthcare and in other contexts.

5.2.3. Implications of the Strength and Overlap Between Contexts

As discussed, using the calculations, and creating area-proportional Venn diagrams allows us to see the 'strength' of the contexts based on number of factors assigned to them, and this gives an idea of the importance of the contexts in healthcare innovation adoption. The data shows P is the most important followed closely by O, and that E and T have less numerous coding and therefore this suggests they are generally relatively less frequently important in this setting.

The fact that P was the most important was an unexpected finding as P was not initially considered a context before re-evaluation and development of the TOE framework aided by other healthcare innovation literature and the Socio-technical systems theory. Though given the fact that the importance of people is strongly noted in literature and given by Socio-technical systems theory, it is not surprising that the new context of 'People' is the strongest in this study, which investigated healthcare innovation.

The fact that Environment and Technology were both least frequently noted contexts individually and when overlapped with others was an unexpected finding because prior research into the TOE framework suggested that the environment

and technology contexts were equally as important as organisational context (see Section 2.2; Appendix A and Appendix B).

The Organisation context was strong, which was an expected finding of this study, since healthcare is very dependent on organisations and other research has noted this (Petkova et al 2010; Fitzgerald et al 2002; Greenhalgh et al 2004; Rogers 1995; Oliveira and Martins, 2011; also see Appendix B).

In this study, there was a considerable number of factors found in this study which are complex and related to two or more of the contexts. No single context was found to be 'standalone', i.e., all of the contexts had at least one factor that was also assigned to another context. Therefore, there is a conceptual understanding that these four contexts are interrelated at the factor level, and none can be considered individually, which is shown by the overlap in the Venn diagrams in Section 4.2.3 and 4.2.5.

This is also significant as it confirms that none of the contexts exist in isolation and share some similarities (some more than others i.e., the case of P and O). This is to be expected to an extent because the world is inherently complex and doesn't neatly fit into the categories or labels, we assign it. But categories and labels have their use, and this work shows that the four-context framework of POET succeeds in retaining simplicity, while also capturing the relevant contexts and their importance, as well as highlighting that P and O share the most similarities.

Given the high number of factors found (44), and the significance of these in the health and life science industry in Wales, it is possible that the context plays a part in which factors are prevalent for the actors involved. In much innovation adoption research, there are often only a couple of factors that are being searched for, via quantitative reductionist approaches (as noted in Greenhalgh et al., 2004). This research, via a holistic inductive process, has identified new and more complex relationships between factors, as well as new factors that are important in the People context.

5.2.4. Interviewee insights into the contexts and the factors within them

Environment and Technology are considered by adoption stakeholders as being fixed because they are (usually) outside of their control or influence. Therefore, the challenge is how to adopt a given technology in a specific environmental context. The concentration on P and O are a recognition that interviewees identified a pragmatic approach.

Interviewees identified that those capable of changing regulation/policy (i.e., environmental factors) or the inventors and creators of technology were important influencers, but the interviewees' own perspective was to concentrate on the factors that they felt they were able to control or influence (see Appendix H).

5.2.5. Importance of Understanding Relationships Between Contexts

The high level of interrelatedness identified in the factors (Factor interrelatedness 4.5.1, Figure 13), and the extent to which it was considered that factors could not be considered in individual contexts, suggested that, while the individual skills, knowledge, behaviours, and motivations of 'people' were making a contribution to innovation, understanding the relationship between people and organisation, people and environment, etc was also necessary.

5.2.6. Area-proportional Venn Diagram as a visual representation of the conceptual POET framework

The area-proportional Venn diagram seen in Section 4.2.3 (Figure 11) can be used to present the POET framework visually as a new conceptual framework for the adoption of innovation, given in Figure 14 below. Since this study was specific to healthcare in Wales, this framework is specific to this setting and sector. Further studies are required to assess its generalisability in different settings and sectors. It is predicted that it should have good generalisability in other healthcare settings at both the factor and context level.

It can be imagined that different sectors may show different levels of interrelatedness with different contexts being more important. For instance, the

literature that supports the TAM model suggests that the interrelatedness between technology and organisation for firms primarily engaged in the information

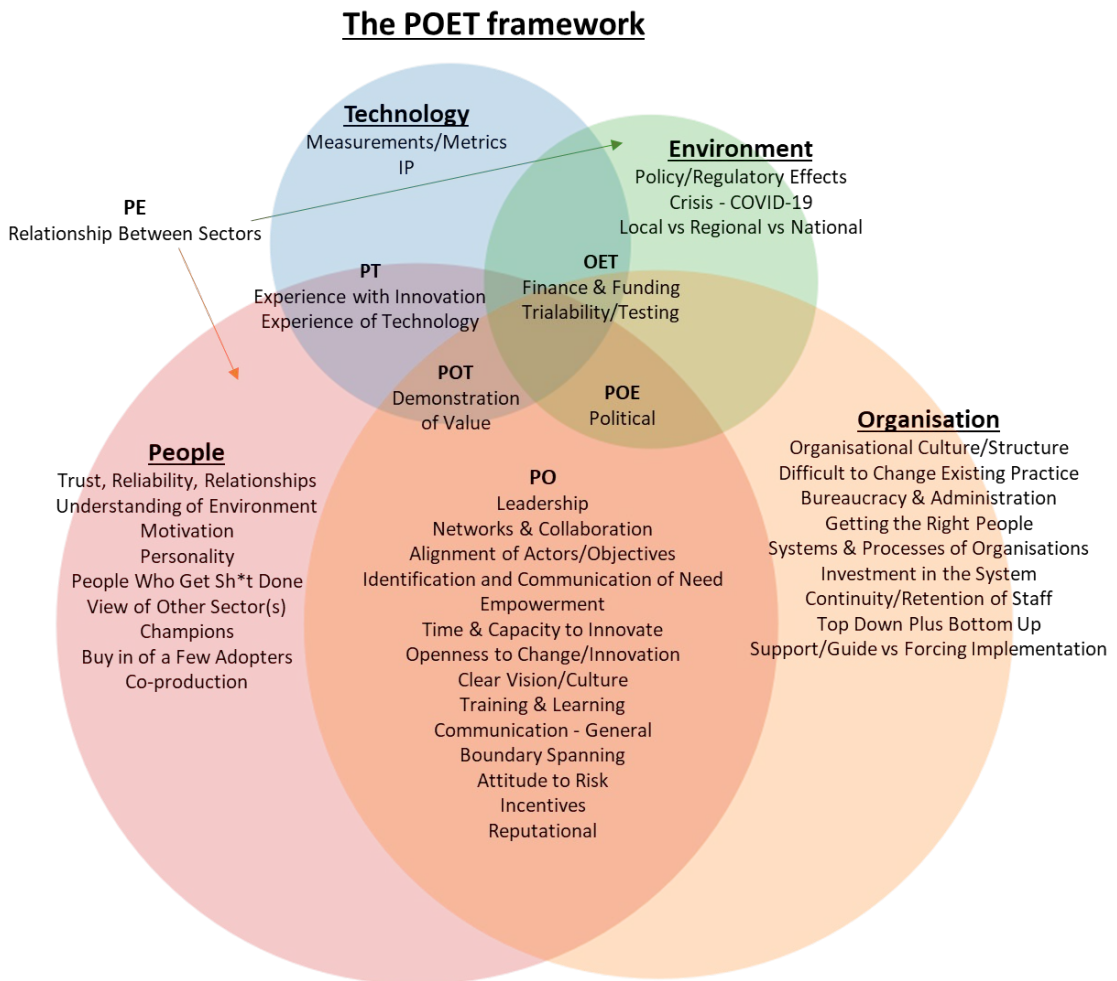


Figure 14. The POET framework for investigating the influences on the adoption of innovations in healthcare in Wales.

technology sector (Oliveira and Martins, 2011; Appendix B) would be both the greater proportion but also that Technology would overlap strongly with the other contexts, leading to a more balanced Venn. The 'People' context might be a much smaller proportion because the people involved in the firm and sector are focused on the technology as the primary product and as their personal productive output (see Section 2.2).

Having identified this process, therefore the conclusion drawn is that successful adoption of innovation requires organisations to identify the 'people' and

specifically the ways in which their organisation empowers or enables the people (both context and factors) in order to see innovation successfully adopted.

5.3. The Influences on Adoption of Health Innovation in Wales – the 44 Factors

5.3.1. Comparison of factors discovered in this study to the literature

The Literature Review Chapter 2 presented many factors which were predominantly associated with failed new innovation adoption. Literature often presented innovation as a largely linear and logical incremental approach which was context-free. In effect an innovation in a manufactured product for use in automotive vehicle assembly was considered similar to that of the healthcare setting. Those researchers working in the focal field of healthcare disagreed and revealed a “fragile system” of multiple actors each with a degree of power to slow, halt or refuse to adopt the new innovation. Hence the need for theory building research to explore the dynamics of attempting to innovate in this societally important sector. Despite the use of case studies and quantitative methods to identify significant factors for healthcare innovation success or failure, few studies proposed a holistic model which could explain the practices in the context of healthcare.

This study has identified numerous factors that influence innovation adoption in health and life sciences in Wales. There was a lot of diversity in different peoples’ points of view regarding these factors, and a lot of nuances based on specific conditions and circumstances, but on the whole Interviewees in this study had a lot of agreement and similarity in what were the important factors in innovation adoption in this sector. A total of 44 factors were discovered and considered valid for inclusion in the analysis, as described in the Results Section 4.1.

Numerous factors were considered to be the same as, or similar to what was found in the literature (see Appendix M). Most studies did not have all of the 44 factors, or close to that, but did have a few matching or similar factors. This indicates most of the research misses/excludes a significant amount of factors, either by design or oversight, and does not present a holistic view as this study aimed to. Further possible reasons for this are explored below.

Previous literature on technology adoption models and frameworks generally concentrates on fewer factors and/or a narrower unit of analysis (i.e., the individual level adoption of technology), and was often created as a result of quantitative studies (Alomary & Woollard, 2015; Taherdoost, 2018; Oliveira and Martins, 2011; also see Appendix B). The findings of this study generally do not disagree with findings of quantitative technology adoption studies, rather they tend to go beyond them as this study is aiming for a more holistic view. For example, the TAM model (Davis, 1989) identifies three major areas as factors for adoption of innovation, as shown in Section 2.2. These concentrate heavily on the technology and the individual's intent to adopt. However, a number of factors identified in this study had not been identified in the TAM model, and other individually focused technology adoption models (e.g., TPB, TRA), such as 'Organisational Culture/Structure'. Therefore, this suggests that these previous technology adoption models were not-comprehensive enough, or underdeveloped and had too narrow scope for use in this study, where the goal was identifying all influences of technology adoption in healthcare in the setting of Wales.

The researcher found that the TOE framework came closest to capturing the dynamism and the wider array of the factors that influence adoption, as it includes the organisational and environmental contexts, which are not developed in the other technology adoption models such as TAM (which is arguably concerned more narrowly with the technological context). For example, most TOE studies had a variation of this study's 'Organisational culture/structure' factor (see Appendix M). However, previous research using this framework did not include or cover all factors that were discovered in this study. Generally, each TOE study had a selection of factors placed under one of the three TOE contexts, and then these factors would be tested (often via questionnaire) with participants to elucidate their importance. The selection of factors for these studies were not always clear. Often, they would be based on prior research, occasionally they would be added under the author's prerogative, and sometimes it was less clear why. Most research (see Appendix M; Oliveira and Martins, 2011) did not stick to exactly to DePietro and colleagues' original TOE framework factors, as outlined in Tornatzky and

Fleischer (1990), likely because of the high degree of freedom afforded to vary factors and measures under the framework (Zhu and Kraemer 2005). Which is indeed this study's use of the TOE: to use its contexts as the framework and place discovered factors under each context, except of course it has undergone further development as well in this study (addition of P, presence of multi-context factors).

Other healthcare innovation adoption literature which doesn't use the recognised technology adoption models and frameworks (such as TAM or TOE) but builds their own models/frameworks or develops them from previous literature does appear to cover more factors, and more relevant factors and there is a significant amount of overlap with this study (see Appendix M). Greenhalgh and colleagues (2004) significant and comprehensive systematic review on technology adoption and spread in service organisations has probably the most amount of similar or same factors as discovered in this study. In that study they develop a model derived from the synthesis of their theoretical and empirical findings, which is intended to show the different aspects of the complex innovation adoption situation and their many interactions, not a prescriptive formula for innovation adoption. Their factors are nested under the various 'components' of their model (that this study would consider comparable to or groupable under the four POET contexts) and it is a considerable list (which even they consider to not be exhaustive). Even so, there wasn't total overlap between their study's factors and this study's, even though there was the most similarity.

The exact similarities and more importantly the differences between the literature on innovation adoption and this study will be explored and discussed in the below section

5.3.2. The similarities and differences of the factors to the literature, and why this might be the case.

As can be seen in Appendix M (Table 8.13.1) there are a significant number of similarities between factors in the literature and discovered in this study. Of the 44 factors, 28 had at least partial, similar, or exact correspondence to factors in the literature found via the search.

Some of the factors in this study had multiple similar factors in literature (see ‘Organisational Culture/Structure’, or ‘Leadership’) and some had only one or two similar factors in literature. It was rare for a factor in this study to exactly correspond to what it was in literature, one of the only examples is ‘champions’ which has a direct correlate to Greenhalgh et al (2004). Instead, the majority of factors in literature encapsulated part of (or was in part related to) the factors discovered in this study as can be seen in Appendix M (Table 8.13.1). The reasons for this could be that the factors in this research were emergent and discovered through the inductive research process and were often named according to how the Interviewees spoke about them, without aiming to fit or map to a pre-existing factor in the literature. It could also be because of the broader scope of innovation adoption looked at in this study, and the allowance of factors to tend more broadly, sit within multiple contexts, and the decision to not fragment them as much as possible.

The fact that the majority of factors did have similarities to or correspondents in existing healthcare innovation literature adds to the validity of this methodology for researching this topic and can justify further research perhaps expanding this methodology or adjusting it to test it and investigate the factors in different settings or sectors.

Sixteen of the 44 factors in this study had no direct or suitable indirect counterpart in the searched literature. Roughly in order of importance (in order of total number of statements by Interviewees by percentage of total Interviewee statements – see Table 8.10.3 in Appendix J), these factors are as follows:

Table 10. Factors that were not present in searched innovation adoption literature.

POET code	Factor
P	Trust, Reliability, Relationships
P O	Alignment of actors/objectives
P T	Experience of/with innovation
P	Understanding of environment
P E	Relationship between sectors

POET code	Factor
P	Personality
P	"People who get shit done"
O	Investment in the system
P	View of other sector
E	"Crisis" (COVID-19)
P O E	Political
P O	Incentives
O	Top-down plus bottom-up
P	Buy-in of a few adopters
P O	Reputational
T	Intellectual Property (IP)

As can be seen, the majority of these factors have a P coding, and this may be part of the reason why they did not exist in previous literature using technology adoption models or the TOE framework, but other P coded factors did have similarities to other literature factors so this cannot fully explain this.

Another reason, or part of the explanation for these factors not appearing in literature may be because these factors are novel in their discovery in this setting and/or field, or at least nuanced enough that they don't match well enough to existing literature. As mentioned, as this research was exploratory there was always the possibility that new factors would be discovered and different things that influence innovation adoption emerge or are considered more important by stakeholders/Interviewees. Take the factor 'Crisis (COVID-19)' as an example - if this study had taken place before the COVID-19 pandemic it is unlikely there would be factor discovered that covered an acute crisis situation such as this. However, in light of the numerous times different Interviewees discussed how the pandemic directly and indirectly influenced innovation and adoption in a number of different ways, the factor needed to be created and included.

The most significant three factors that did not have a compatible counterpart in literature were among the most important factors in this study. 'Trust, Reliability, Relationships', 'Alignment of actors/objectives' and 'Experience of/with innovation'

were in the top 5 in terms of total number of statements across all interviewees (Table 8.10.2 in Appendix J) and in the top 10 in terms of mean percentage of total statements (Table 8.10.3 in Appendix J).

5.3.2.1. Trust, Reliability and Relationships

The trust and relationships between individual stakeholders in the innovation adoption process was consistently mentioned by Interviewees and a large emphasis was placed on the importance of this in terms of its influence on successful or unsuccessful adoption. (See Appendix H, 8.8.1.1.4.), so it is surprising not to see it represented in the other literature searched. Factors related to communication or networks were present (see Appendix M, Table 8.13.1), and indeed this study shows that Trust and Relationships is strongly linked to other factors including Networks and Collaboration, but nothing specifically covering trust and relationships is present in searched literature, suggesting this is a novel finding that warrants further research.

5.3.2.2. Alignment of Actors/Objectives

In the literature, there was the presence of factors which covered an individual or organisation's goals, motivation, values etc, but there was not discussion on the 'alignment' of people or organisation (actors) on these factors (objectives) (Appendix M, Table 8.13.1). Alignment of actors and objectives in terms of these relevant factors was very important to the majority of interviewees in this study. 'Aligning' or 'alignment' of stakeholders was a keyword used consistently and is suggested by this study to be an important factor to consider in innovation adoption in this setting. This is a novel finding to research further: that 'alignment' is a key factor which joins up or is related to the goals, values, motivation etc of multiple individuals and organisations aligning or not aligning, and the effect that has on adoption.

5.3.2.3. Experience with Innovation

There were various factors in literature to do with awareness, knowledge, skills, expertise with the *specific innovation* being positioned for adoption, as well as the required training or learning for that innovation. These were coded as the factors

'Experience with Technology' and 'Training and Learning' in this study. However, there was little to no discussion about the influence of experience with the innovation (and therefore adoption) process itself. This study found this to be a very important factor in innovation adoption and so again is a novel finding for further research. It may be that experience with the innovation process is a key factor for the success of individuals (and potentially organisations) that participate in or drive adoption of innovation, such as change agents or opinion leaders (as laid out in Rogers Diffusion of Innovations theory, 1995). A key finding of this research then, is that having participated in innovation before and built experience around the process seems to be very important, separate from a specific expertise in the exact innovation trying to be adopted, and also separate from any other reason that they are influential and are able to cause change.

5.3.3. The high number of factors identified suggested that there are potentially high numbers of unknown unknowns.

The high number of factors means that there are a lot of considerations that must be taken into account when adopting or promoting the adoption of new innovations. There is likely a lack of understanding of the high number of factors that influence the innovation process and how they might affect a given situation. Without prior experience of success or dedicated training or support from those that are experienced, it is less likely that adoption will be successful. This is supported by interviewee statements under the factor 'Experience with innovation', by the amount of factors, their relative importance (Section 5.4, and Appendix J) and their interrelationships (Section 5.5, and Appendix K)

5.3.4. Factors from Literature Not Identified in This Study

As can be seen in Appendix M, Table 8.13.2, some factors were present in other studies that were not discovered in this one. This could be due to a few reasons. Firstly, it could be that those factors play some role, but are not important enough in innovation adoption in healthcare setting or in the setting of Wales for the Interviewees to mention, or perhaps to be consciously aware of. It is also possible

that more Interviews with more people would eventually discover those factors, but this is less likely as after the first half of interviews few new codes were discovered and after around interview 10, no new codes were.

Conversely, it could be that these factors are simply not relevant in healthcare innovation adoption in the setting of Wales (and the wider UK) at this point in time. However, it is probably more likely that they do have some influence, just not large enough to be the critical factors or factors of greater influence in this setting.

A further point to note is that some of the factors in Appendix M, Table 8.13.2 were similar to some of the factors in this study but were deemed not similar enough and did not meet the level of similarity or relatedness deemed necessary to be considered a counterpart factor. An example of this is “recency of staff’s medical education” which might be considered similar enough to training and learning on the surface, but the former is trying to measure how the recency of all staff’s medical training in a hospital, clinic etc. influences that organisation’s ‘innovativeness’, and the latter is concerned with how training & learning surrounding an innovation affects that innovation’s adoption. Another example would be “Organisational perceptions of environmental uncertainty” which could be considered similar to this study’s “Understanding of environment”, but the former is to do with perception of environmental uncertainty, and the latter is concerned with an individual’s actual understanding of the environment they are operating within and how that pertains to adoption of innovation – mildly similar but nuanced enough to be considered different.

Another important point highlighted by Appendix M, Table 8.13.2 is that some factors not found in this study were considered significantly important in other technology adoption studies and are often found in the models themselves. This includes factors such as “Relative Advantage”, “Perceived ease of use” and “Perceived usefulness” amongst others, which are often found in TAM, TOE, and other technology adoption model research (see Oliveira and Martins, 2011; Appendix B and Appendix M, Table 8.13.2). These would be placed in technological context as they are to do with characteristics and views on the technology itself,

and their lack of presence in this study suggests again that technological context is less influential in healthcare adoption than other contexts, or in other settings.

5.4. Relative Importance of Individual Factors

As described in Section 4.4, and illustrated in the tables in Appendix J, detailed manual qualitative analysis of the data tables of the key participants shows that certain factors were mentioned with more frequency by interviewees, and certain less so, which suggested that certain factors played a more significant role than others in healthcare innovation adoption. Using the content analysis, each datum (i.e., interview quote) recorded under one of the 44 factors was counted and the sum total data chunks for each factor, for each Interviewee were found, and this data was used to create the tables in Appendix J. These tables quantitatively show which factors appear with more frequency in discussion and therefore indicate which factors are more frequently important, with the added benefit of presenting the extensive qualitative data in terms of direct interview quotes in a clear and presentable way, which highlights the findings of this study well.

It should be noted that while these tables are informative and can give a good overview, approximation or guidance of the relative importance or influence of factors, they are not intended as definitive or prescriptive quantitative measures of importance. That was not the goal of this methodology, which was to discover and explore factors inductively and assess them from there in terms of their POET context(s), their approximate and relative importance, and their relatedness.

Potential further work would be to test these factors for importance and influence and would possibly be better suited to an alternate methodology, such as the methodologies' employed by other empirical technology adoption studies, including further interviews or surveys with a larger sample that have questions related to the factors discovered here (see Section 2.1-2.4 in literature review). Another approach would be to expand the methodology from this study to include more participants and complete the detailed coding and analysis for more participants. This added volume of research was out of scope for this study as it

would add too much bulk to the data, but with more time and resources (potentially qualitative coding research software, and more researchers) it could be conducted.

The significance behind these findings shows which factors may be more or less important and influential in healthcare innovation adoption. It is difficult to say how this compares to literature, because as discussed earlier in this Chapter, there is not total similarity between this study's factors and those in literature. In addition, most literature uses different methodology than this study to determine importance, generally using Likert agree to disagree scales to quantify (see Section 2.1-2.2, Appendix B) whereas this represents a different method, likely novel in this field. Other literature describes and discusses the importance of specific factors in the text but does not attempt to determine the most and least important. Based on the findings of this study I think this method warrants further exploration in this field.

The rationale for attempting this approximation of relative importance is, as explained above, so that stakeholders in innovation can gain an awareness and understanding of the factors, and generally what will be more important and less important to consider, which this work does achieve. Any presentation of this work would explain that this is not a definitive and prescriptive list – which is likely not even possible to create due to the complexity and circumstance-dependent nature of innovation and adoption, which will of course be different across different cases, places, settings, and sectors. Rather, these importance rankings are more like guidelines, than actual rules.

This work on factors, would also be taken together with the interrelatedness work below, and the POET framework, to provide an overall picture to stakeholders of innovation adoption.

It should be noted that while there was a general consistency between the interviewees in terms of number of statements for each factor, some factors were skewed higher or lower in terms of relative importance because one or more interviewee(s) had it coded more or less frequently.

This is a reason why the rank importance of factors should not be viewed as prescriptive or definitive but as a general guide.

5.4.1. Comparison of the 'Number of statements' data with the 'Percentage of Total Statements' data

As mentioned in the Results Section 4.4, in addition to the number of statements recorded under each factor being totalled to give a way to rank importance of the factors, a second method was added to rank importance. This was done by finding what the percentage each factor's number of statements made by an interviewee was of the total number of statements made by that interviewee. Then the mean was taken of this across all interviewees to find the mean percentage, and therefore the normalised, relative importance. As can be seen in the comparison Table 8.10.4 in Appendix J, most factors remain in a similar position and either do not change in rank importance or change relatively little (3 ranks or less). This shows that either method could be suitable and with increasing data it is likely you would see reducing difference between ranks using either method.

Some factors were more different with either method (4 or more ranks), this might be due to skew by interviewees with more or less total statements, for example Interviewee H had much fewer statements relative to the other Interviewees and therefore had larger potential to skew the percentages (see Appendix J, Table 8.10.3). It may also be because many of the factors are very close or the same in terms of number of statements which would mean some difference as soon as you add in the percentage calculations. It is likely given more data from more Interviewees this issue would reduce, but that is beyond the scope of this study. In any case, as discussed, it was not expected or a goal of this study to provide a definitive quantitative rank of the most to least important factors in healthcare innovation adoption, rather the aim was to discover all the relevant influences, and then these tables are to give a guidance on or overview of what are the more to less influential factors.

5.4.2. The Ten Most Frequently Mentioned Factors

As can be seen in Table 8.10.4 in Appendix J, using both methods to rank relative importance allows the following most influential ten factors to be identified:

1. **Organisational Culture and Structure** [O19] (1st & 1st)
2. **Leadership** [PO6] (2nd & 3rd)
3. **Networks and Collaboration** [PO5] (3rd and 4th)
4. **Trust, Reliability, Relationships** [P10] (4th and 5th)
5. **Demonstration of Value** [POT11] (7th and 2nd)
6. **Alignment of Actors/Objectives** [PO4] (5th and 8th)
7. **Experience with innovation** [PT13] (6th and 9th)
8. **Finance and Funding** [OET17] (8th and 7th)
9. **Empowerment** [PO8] (13th and 6th)
10. **Difficulty to change existing practice/systems** [O24] (9th and 11th)

These ten factors seem to be relatively stable between the two measures of number of statements and percentage of total statements. All had 30 or greater statements recorded under the code, and greater than 13.5 % mean percentage of total interviewee statements.

This suggests that any of these ten factors will be influential in a given innovation adoption case or situation with relatively high frequency.

5.4.3. The Ten Least Frequently Mentioned Factors

The approximate ten relatively least important factors were as follows (from least to most important):

1. **Intellectual property** [T18] (44th and 44th)
2. **Reputational** [PO37] (43rd and 42nd)
3. **Buy-in of a few adopters** [P43] (40th and 43rd)
4. **Co-production** [P30] (42nd and 41st)
5. **Experience with technology** [PT14] (41st and 40th)
6. **Top-down plus bottom-up** [O41] (38th and 37th)
7. **Continuity/Retention of Staff** [O38] (37th and 38th)
8. **Trialability/Testing** [OET29] (35th and 39th)
9. **Support & guidance vs forcing implementation** [O42] (39th and 30th)
10. **Political** [POE32] (33rd and 36th)

These ten 'least important' factors seem less stable than the ten 'most important' factors above but are a reasonable cut off. All have fewer than 17 total statements or less than 8.2 % mean percentage of total interviewee statements.

This suggests that any of these ten factors will less frequently be influential in a given innovation adoption case.

5.4.4. The Median Factors (Middle 24)

The rest of the factors were found, with varying stability, to be of medium relative importance in terms of these measures in this study. Almost all of these 24 factors all have fewer than 33 total statements and more than 16 and have less than 14.2 % mean percentage of total statements and more than 7 %.

Since they are quite close in terms of relative importance, factors within this middle 24 are likely to be influential in a given innovation adoption situation/case with moderate frequency.

Further study may be required to elucidate further the relative importance of factors in terms of how influential they are likely to be as well as how frequently influential they are on a case-by-case basis. However, as shown by the detailed analysis of Appendix H, the majority of these factors have the potential to be highly influential in a given situation, with some more or less than others. The circumstance and setting, with all of its complexity and nuance again is shown to be important to consider.

5.4.5. This data shows the general relative importance in innovation adoption, not the specific importance of each factor in every case

It should be noted that the data in Appendix J gives an idea of the general importance of each code and therefore each factor when it comes to considering innovation adoption in healthcare overall.

In a case-by-case basis, in specific situations, the importance of each code/factor will likely be different each time. Some factors found to be most relatively important in this study may not be the most influential in a certain innovation adoption case, and the reverse is also true, relatively less important factors in this study may be highly influential in another case. For example, it is possible that in a certain innovation adoption situation, Finance and Funding, a generally highly important factor, would be less influential if funding was readily or more easily

available (as in some of the examples related to COVID-19 where funding became more accessible in that situation). In the same case or in another, it could also be possible that Intellectual Property, which was generally the least important factor by magnitude of mentions, plays a highly significant role if there was a dispute or difficulty working out that element of the innovation process.

Therefore, these tables are informative in that they suggest at which factors are more or less *likely* to be influential in a given case, but not which ones actually are important in every case. Instead, this data can be viewed as a guide of the important factors to consider in healthcare innovation adoption, and could be used like a checklist, to consider each factor and its relevance and influence on a specific case.

A further note on the importance of factors: what is likely is that numerous factors are important and influential in each case, and frequently it may not come down to one or two critical factors, but an array of influential factors with a higher degree of complexity. This notion is supported by the Interrelationship data in Section 4.5 and Appendix K, which is explored below in Section 5.5.

5.4.6. Representation of contexts in terms of magnitude of mentions of factors

As can be seen in the relative importance tables, both magnitude and percentage, there appears to be a spread of the contexts in terms of representation in the highest to lowest relative importance of factors. It appears that P and O contexts are represented frequently in the highest relatively important factors, the factors of medium importance, and of lowest importance. This may be due to the fact that there were many more factors assigned within P and O than within E and T. Therefore, it is probably more informative to look at the E and T assigned factors to determine the relative importance of those contexts at the level of their factors.

In order of highest rank to lowest rank by magnitude (and percentage), the Environmental context's factors were: Finance and Funding [OET] (6th and 7th), Policy and Regulatory effects [E] (12th and 16th), Relationship between sectors [PE] (18th and 23rd), Crisis (COVID-19) [E] (26th, 31st), Local vs Regional vs National [E]

(27th and 27th), Political [POE] (33rd and 36th), and Trialability and Testing [OET] (36th and 39th). This shows that the relative importance of E context assigned factors is also spread from high to low, as with the P and O factors.

In order of highest rank to lowest rank by magnitude (and percentage), the Technological context's factors were: Demonstration of Value [POT] (7th and 2nd), Experience with innovation [PT] (6th and 9th), Finance and Funding [OET] (6th and 7th), Measurements/Metrics [T] (36th and 26th), Trialability and Testing [OET] (35th and 39th), Experience with Technology [PT] (41st and 40th), and Intellectual Property [T] (44th and 44th). This shows that the relative importance of T context assigned factors is also spread from high to low, as with the other three contexts. It does seem that T factors are slightly more polarised than E, with more representation in the ten most and least frequently mentioned factors and less in the middle (three in top 10, three in the bottom 10).

This suggests that the context(s) that a factor is assigned to does not affect how important that factor will generally be at the factor level. However due to the greater number of P and O assigned factors compared to E and T, the former contexts will likely be more important in most cases due to that fact. It also suggests that there is more complexity to these contexts, as more factors make them up and they will have more internal influences.

Furthermore, it should be noted that the most important E and T assigned factors were all in combination with either P or O (or both), i.e., were multi-context factors, which further hints at the importance of the P and O contexts as moderators, modulators, or influencers on the other contexts.

5.5. Interrelationships Between Factors

Determining and Assessing interrelationships between codes is commonplace in qualitative research and can be achieved through numerous methods. This study applied “simultaneous coding”, as laid out by Miles & Huberman & Saldaña (2018) and Saldaña (2021), where two or more codes are applied to the same passage or sequential passages of text due to the content of the Interviewees responses where the codes would often be overlapped or intertwined within the same passage or

even the same sentence. This method lends itself well to exploration of interrelationship between codes, as measuring the frequency that codes are coupled with each other can reveal emergent patterns for further exploration and testing (Saldaña 2021). This method was effectively used in this study to investigate the interrelationship between the 44 codes in a pairwise way.

As can be seen in Section 4.5 and Appendix K, certain factors had strong interrelatedness, and others had very weak or no interrelatedness. This suggests that some of the factors that influence the adoption of innovation in healthcare are interrelated either causally or through correlation, while others are more standalone as influences. In addition, more factor pairings have some interrelationship than have none (see Appendix K, Table 8.11.1), which again suggests at the complexity of innovation adoption in healthcare. These interrelationships warrant further testing and exploration.

This investigation of interrelationships between codes/factors is lacking in technology adoption research, in healthcare or otherwise (which often but not always uses quantitative methodology). Therefore, this study not only shows that the qualitative coding of interviews can be an effective way to approach technology adoption research to discover factors, but also to identify and investigate the relationships between them, which is a novel contribution to this field.

This method of investigating interrelationships between pairs of factors can suggest at the strength of relationships but may not directly be able to determine the nature of the relationships: i.e., whether it is correlation or causation.

Unanticipated patterns of interrelationship (i.e., correlation), influences and affects (i.e., causation), cultural themes, and longitudinal trends may emerge from the systematic investigation of data or even hunch-driven queries according to selected characteristic combinations of interest (Bazeley, 2003; Saldaña, 2013), which was beyond the scope of this research. However, in the below sections, interpretations of the relationships will be given for some of the stronger interrelationship pairs with reasoning based on the researcher's interpretation of the interview data.

The paradigm and scope of this study would not allow for further analysis in this regard. However, potential further work increasing the sample size and performing

this analysis on further participants could add additional strength and validity to the interrelationship findings. It is also possible that interrelationship with triplet codes and higher could be investigated - where more than two factors are present in the same passage of text, which did occur in this study. As discussed previously, it is likely that qualitative coding or other software could be required to enhance the feasibility of expanding to this level of analysis, as undertaking it manually would be a significant undertaking in terms of resource and time.

5.5.1. Factors That Are Most Interrelated

As can be seen in the matrix in Section 4.5.1 (Figure 13) in the Results Chapter, certain codes/factors showed strong interrelationship because they occurred together in the same interview statement(s) numerous times.

The high number of factors with a strong interrelationship further adds to the assertion that technology adoption in healthcare is very complex with multiple influences that are interlinked in multiple ways. The literature does acknowledge this complexity and the link between factors (see Section 2.1), but this methodology allows the interrelationships to be quantified and presented in an accessible way.

Some factors were not only linked numerous times to another factor, but were linked numerous times to numerous factors, i.e., they appeared frequently in Table 8.11.2 in Appendix K. These factors can be seen in Table 8.11.3 in Appendix K. This shows that some factors are strongly interrelated with many others, which suggests that these factors are influential or affect many of the other factors in innovation adoption. The strongest of these factors are Networks and Collaboration, Organisational culture/structure, Trust, Reliability, Relationships, Alignment (actors/objectives), and Leadership.

This method provides the strength of interrelationships between factor pairs, but not the nature (correlation vs causation), which requires further interpretation of the data (and potentially further additional research and data). Doing this interpretation for all factor relationships was beyond the scope of the study,

however, some of the relationships were interpreted in the detailed factor descriptions and analysis in Appendix H.

Some relationships were easier to interpret in terms of whether they influence and affect one another rather than are simply correlated than others. With stronger factor interrelationships, it is generally easier to see the nature of the relationship as there are more examples to work with and interpret. Generally, for the stronger interrelationship pairs it seems that the factor pairs were more likely causally linked (i.e., influenced or affected each other).

5.5.2. The interrelationship of factors, the strength of the POET contexts, and their intra- and inter-context relationships.

In addition to showing the interrelationship between pairs of codes at the factor level, the interrelationship between the codes/factors data presented in Section 4.5 and Appendix K can also tell us about the relationships within and between contexts, in addition to what was discussed in Section 5.2.

To start, it is interesting to note that of the top 26 strongest pairs of relationships (which are factor pairs with 11 or above links), all but one share at least one context code between them. I.e., Networks and Collaboration (PO) and Trust, Reliability, Relationships (P) share a P context coding, while Organisational culture/structure (O) and Difficulty to change existing practice (O) share an O context code. Since this occurs for the majority of the strongest interrelationship pairs, and for a significant amount of the remainder of pairs (see Section 4.5 and Appendix K, Table 8.11.2), this suggests that there are strong relationships between factors within a single context. Put another way, the four POET contexts have strong 'intra-context' relationships, which was the same finding of the POET context interrelationships matrix (see Appendix G and Section 4.2.5), which adds further credibility to each four remaining as separate contexts.

Another thing that can be seen in Appendix K, Table 8.11.2 is that, as with other areas of analysis, the strongest context is again People, followed by the Organisational context. I.e., in terms of the most interrelated pairs of factors these two contexts are most represented, followed by E and T which have much lower

representation. For example, of the top 26 factor interrelationship pairs (which are pairs that had 11 or more links), 14 shared a P code, 13 share an O code, and 5 shared both a P and O code, compared with one pair that had an E overlap.

Furthermore, the 'overlap' of contexts in the strongest factor interrelationship pairs also shows that factors within P and O overlap, or 'interrelate' the most with each other and others (again P is strongest, followed by O). For example, of the top 26 factor interrelationship pairs (which are pairs that had 11 or more links), 16 of the pairs had one factor with a P and one with an O, which suggests at a strong 'inter-context' relationship as well as 'intra-context' relationship between these two contexts, which again mirrors the findings of the POET context coding interrelationships data (Appendix G and Section 4.2.5).

A much smaller overlap can be seen between the E and T contexts and with the others. It appears that the P context again is the strongest link between factors and contexts.

This similarity of these findings with the POET context strength and overlap findings explored in Section 5.5 and presented in Appendix G and Section 4.2.5 increases confidence in both sets of findings.

These findings are potentially modulated by the fact that P and O contexts were stronger in terms of number of factors within them, and the fact that their factors were generally stronger in the relative importance findings (see Section 4.4 and Appendix J), which could be part of the reason why pairs in those contexts show stronger interrelationships. However, there are instances of strong interrelationship between factors in the E context, such as Finance and Funding (OET) and Policy/Regulatory effects (E) with 11 links, and also in the T context, such as Demonstration of Value (POT) and Finance and Funding (OET) with 9 links. This suggests that the interrelationship pairs with POET context overlap do not depend significantly on the strength of the context itself.

This method again presents a novel way to not only assess interrelationship at the factor level, as discussed above, but also at the context level, to investigate inter

and intra-context relationships. There is no literature which has used this approach in technology adoption.

5.5.3. Factors That Are Least Interrelated or Never Overlap

As can be seen in the matrix in Section 4.5.1 (Figure 13), it is clear that some factor pairs never overlap, i.e., show no interrelationship, or overlap so little that their interrelationship is too weak to consider those factors to have a strong effect on each other, or have strong relatedness.

There were generally two kinds of weak links when it came to factor pairs. The first type, which constitutes the majority of factor pairs, had many weaker links (1-2), then a slightly smaller amount of zero links, then fewer links the stronger the links were. One example of this would be 'Networks and Collaboration' which had 17 links with 'Trust, Reliability, Relationships' (the strongest of all factor pairs), but zero links with 'Experience of technology', 'Attitude to Risk', 'Training & learning' and 'Reputational'. Further examples (and a good overall picture of the links) can be viewed in the matrix in Section 4.5.1 (Figure 13). This type of factor links is expected, as given a large number of codes, you would expect some to relate and some to not relate.

The second type was dependent on certain factors themselves. There were a few factors that had significantly weak relationships with all other factors, and the largest number of pairings with zero interrelationships. As can be seen in the matrix in Section 4.5.1 (Figure 13), the four factors with the least links to all other factors (no pairs with more than 4 links, and the majority of pairs having less than 2 links or having zero links) are PT14: "Experience with Technology", T18: "IP", P30: "Co-production", and PO37: "Reputational". It should be noted that these were also the four weakest factors in terms of number of statements recorded under them (magnitude coding), with PT14 and P30 having 8, PO37 having 7, and T18 having 6. This likely contributes to why these have low links with other factors, but cannot completely explain it, as they had significantly more pairs with zero links than other factors as well. Therefore, it is likely that some factors have much less effect on others or less dependency or interrelatedness.

5.5.4. Additional rationale for and benefit to this analysis: determining factor validity and distinctiveness

As mentioned previously, another reason for and benefit of this analysis is that it helped to determine whether some of the factors with high interrelationship could be combined. However, it became clear that even though some factors were strongly interrelated – for instance ‘Networks and Collaboration’ and ‘Trust, Reliability, Relationships’ – they were still significantly different as to require their own factor, as can be seen by the fact that both codes had 42 statements recorded under them, and 17 of those statements overlapped while 25 did not. Examples of a quote from these two factors which did not overlap include: *“In those situations and in any situation where I’ve worked over the last 20 years, part of its relying on the relationships with all of that is about.”* [Quote C86] and *“if you can leverage your network or others close network and successfully, much the possibility [is] much greater”* [Quote B41].

No factors were determined to be so similar to others at this stage as to be combined or one grouped under another.

As a note, during initial coding of interviews when factors were being discovered, some were combined as it was clear that they overlapped enough to be practically identical. For example, “Alignment of Actors/Objectives” was initially two codes “Alignment of Actors” and “Alignment of Objectives”.

5.5.5. Factors that interrelate with more than one other factor (i.e., triplets and higher) within the same statement

The ‘inter-factor’ relationship matrix and tables (in Section 4.5.1, Figure 13; and Appendix K respectively) identify how frequently statements made by interviewees hit a pair of factors together. In addition to this some interviewee statements mentioned more than two factors at once, but it was beyond the scope of this research to account for all multi-factor interrelationships. However, here is one example which illustrates the point, where one part of an answer to a question posed to Interviewee G had eleven codes within it (which have been added into the

quote's text in the relevant place— although it should be noted that some codes apply to the piece as a whole rather than a specific part of the text):

Asked about characteristics of 'right people': "I'd say these are people who are experienced, open minded to innovation and trialling [EXPERIENCE WITH INNOVATION] [PERSONALITY] [OPENNESS TO CHANGE/INNOVATION] [GETTING THE RIGHT PEOPLE], but also have a network, both within and outside their own organisation to pull levers, where necessary, or call for help and support where necessary, because what happens to a lot of projects and that's why imagine lots of projects sink, is that people are not keen on sharing collaborative efforts they want to silo it and eventually usually kills it, because innovation is a team sport; adoption of innovation, more than a team sport right it takes many teams to be working together and from experience, a lot of things are slowed down or killed right when they got really nice vision of being embedded in health and care in Wales, but because they were not able to share or work with the right people [NETWORKS AND COLLABORATION] [EMPOWERMENT]

So, who is the right people? The right people, from this project in particular, it was a clinical academic who held the position at the university and also a position within the health board so they were able to see through both lenses, if you like, or wearing both hats [BOUNDARY SPANNING], how this project might align to both academic research to satisfy the machine for the University, as well as meet the compliance ethics and regs required to navigate the evaluations that you need within a health board [ALIGNMENT OF ACTORS/OBJECTIVES] [CLEAR VISION/CULTURE]. So, somebody with that type of clinical experience. And that's [Redacted Name], who does many things. [GETTING THE RIGHT PEOPLE]

The next challenge was to identify the right funding to get the money, and it was very opportune that Welsh government policy at that point during the pandemic was posting a lot of money adverts/applications for COVID, for solutions to COVID effectively [POLIC/REGULATORY EFFECTS]. So, we found a nice project that developed/evaluating a diagnostic tool/artificial technology tool for COVID 19 using patient's ultrasounds. Which is great, so we brought the project, there was four of us a part of that group: the university, Respiratory Innovation Wales (set up bit like an arm's length consultancy from academia and the health board), [Redacted company] (the originator of the technology), and the health board, so it was it was a nice, well-rounded multidisciplinary team [TRIALABILITY/TESTING] [BOUNDARY SPANNING]."

The multi-factor interrelationships present in this study further shows the complexity in innovation adoption, and how closely linked different factors are when it comes to influencing the adoption of innovations in healthcare. This suggests that a holistic approach which accounts for as much nuance and detail as necessary in a given case of innovation adoption would be beneficial, as suggested by Greenhalgh and colleagues in their 2004 paper on diffusion of innovations in service organisations.

5.6. Enablers and Barriers

When entering this research, the presumption was that factors would be identified clearly as a barrier or an enabler to innovation and would be recorded as such. As can be seen in the findings from the interviews, this was not found to be the case, and it was quickly seen that interviewees spoke about factors in a variety of ways: at times positively influencing innovation adoption, at times negatively, and at times mixed. It seems to highly dependent on the specific conditions, the circumstance, and the setting as to whether a factor will be an enabler or a barrier (see Appendix H for detailed analysis factor by factor).

Therefore, capturing factors as broadly as possible without losing discrete meaning was the best approach. As an example, the factor “Leadership” was recorded in lieu of “Poor Leadership”, “Lack of Leadership”, “Good Leadership”, “Visionary Leadership” and any other more fragmented ‘sub-factors’ that could come under the purview of leadership.

5.6.1. Majority of factors could be an enabler or a barrier depending on circumstance

As shown in Appendix L in almost every instance, and explored in Appendix H, each factor was talked about positively, negatively, or mixed – i.e., the factor could be both a barrier and an enabler. This generally confirms most literature which recognises that many factors can either facilitate or inhibit the adoption of innovation depending on the circumstances (see Section 2.1-2.2; Appendix B; Greenhalgh et al 2004).

However, this research does indicate that some factors may act as a barrier more often than an enabler, and vice versa for other factors, while some just appear to be 'influential' factors without a clear trend to positive or negative (see Section 5.6.2 below).

In some cases, it could have been possible to increase the numbers of factors by having an enabler and barrier for each factor, however this would not have recognised the inherent flexibility in each factor in that, for different individuals in different environments, the same underlying factor could be either, or both, a barrier and an enabler.

5.6.2. Magnitude coding of statements to show as enabler, barrier or mixed

In order to denote enablers or barriers when recording codes, the statements were highlighted green for 'enablers', red for 'barriers' or left clear if mixed. This was then converted into numeric data displayed in Appendix L, where a '+' is used to denote enabler, '-' to denote barrier, and statements which were not clearly either were not highlighted or coded. This is the coding method of magnitude coding.

For example, you can see in the data in Appendix L that Leadership was mentioned 9 times by one respondent (Interviewee C), but only once was it clearly an enabler, twice clearly a barrier and otherwise it was an influential factor but not clearly or wholly positive or negative within those statements.

This method was useful to get an indication of the frequency with which a given factor acts as a barrier or an enabler. Again, it is not meant to precisely determine whether factors are barriers or enablers. It gives a view of the *propensity* of factors to be enablers or barriers. This is visualised in Appendix L with a total propensity for each factor shown via a proportional scale from green (more enabler) to red (more barrier), based on the total number of enabler statements vs total number of barrier statements. Again, this is not a prescriptive rule, but acts as a guide of how much the factor is currently acting as a barrier or enabler across the interviewees' experiences and examples, and thus in healthcare in Wales. Ultimately this again

shows how circumstances, context and setting have to be considered in cases of innovation adoption.

Therefore, since whether a factor is a barrier or enabler is likely to be mainly circumstantial, carrying out further work to determine in more granular detail what usually acts a barrier or enabler may be unnecessary – instead simply recognising that it could be either and investigating to determine what is needed for a factor to become an enabler on a case-by-case basis of innovation adoption would be a realistic, although potentially unpopular, approach.

5.6.3. Implications of the Spectrum Nature of Factors' Influence

When attempting to improve the adoption and dissemination of innovation, it is therefore important for organisations and policy makers to recognise the situation, circumstance, and setting that they are in – understanding whether each of these factors is an enabler or barrier in a given situation and whether they can be mitigated as a barrier, enhanced as an enabler, or changed altogether from barrier to enabler (or the reverse if care is not taken).

Being aware of the fact that factors may sit along a spectrum from barrier to enabler is important so that elements that may have been 'assumed' as a positive or negative are investigated in order to identify whether this is the case.

Some examples of factors which were previously assumed to always act as a barrier by the researcher included: Bureaucracy, regulation, and finance- which were found in some situations to be an enabler or to influence an innovation's adoption more positively.

An example Interviewee quote that highlights this ability for bureaucracy to be positive is quote B137:

[discussing a 3rd sector organisation] “what they've done is, as with many private sector companies do they've taken their research innovation improvement department outside the organisation and spun it out into a different companies different models so they're not bogged down in the bureaucracy and the higher management and their demands they look at it from an external-internal perspective and they allowed them to build their own network interactive those different people without being associated with the major body of the organisation”

This quote shows that there are ways of organising that can reduce the negative impact that bureaucracy can have and turn it into a positive. Interviewee B had other examples under this code which highlighted how bureaucracy can be an issue by not being fit for purpose, slowing things down unnecessarily, or being overburdensome, but quote B137 shows how this doesn't have to be the case.

Similarly, regulation or finance and funding were assumed to always be a 'hoop to jump through', or a hurdle to overcome, but there were a few quotes from respondents that showed how this wasn't always the case (see analysis in Appendix H).

This is not to say that these factors can always be an enabler or more frequently and enabler or barrier but does go to show it isn't as simple as a factor always being a barrier or always being an enabler, for example it isn't that regulation is always a barrier, as sometimes 'regulation is one of the biggest drivers of adoption going' (Quote E253). Again, the theme that emerges is always that healthcare innovation and adoption is always more complex than it is simple.

5.7. Further Interesting Factors and Findings

Before the study, there was little prediction as to which codes would be discovered and become factors and to what extent they would be important, related or whether they would act as barriers. However, after the Interviews were complete and the data analysed, some factors became interesting in terms of where they ranked in terms of relative importance, their interrelationships with other factors,

whether they acted as barrier or enabler (or both), the relative importance and so on. Key among these is discussed below:

5.7.1. Experience of technology (and experience of innovation) – a technology versus people perspective

The influence of an individual's experience, expertise, knowledge, skills, and awareness of the specific innovation they work with, on that innovation's adoption was shown to be low importance in this study when the expectation from literature is that this would be more important (see Section 2.1-2.2). For instance, a heart surgeon might be a world expert in a specific technology and its use in the body (such as VADs), but this alone may not be enough to influence the adoption strongly enough for success. This is likely to be the case for a lot of sectors outside of information technology and perhaps other technology focused sectors.

"Experience with Innovation", which was discovered as a code before "Experience with Technology" and was shown by this study to be far more important, is concerned with how an individual's experience, expertise, knowledge, skills, and awareness of innovation and the innovation process *in general* influences an innovation adoption. This suggests that people with a lot of relevant experience with multiple innovations, in different circumstances, settings etc. in healthcare are usually more beneficial to the adoption and spread of an innovation, as they have seen more examples and have more experience to draw upon. This suggests a different skill set is needed when positioning innovations for adoption, rather than being an expert in the innovation's use, or the evidence behind it etc. Judging by the interrelationship of "Experience with Innovation" with other P and O context focused factors (see Section 4.5 and 5.5), this skillset likely includes ability to interact and deal with other people and organisations, communicating well, forming relationships, collaborating, aligning people's goals and so on. I.e., relevant interpersonal skills more important than technical skills in healthcare innovation adoption.

Some of the other more technical or technology focused factors assigned to the T context also share this point of being relatively less influential compared to more

people or organisation focused factors, such as “Intellectual Property”, “Measurement and Metrics” and “Triability and Testing”. These more technical aspects of an innovation (either its direct characteristics or other technical aspects related to it), while possibly more influential in some cases, generally seem to play second fiddle to the factors that are concerned with dealing with other people, being able to facilitate others, engender trust, alignment, or a person’s general characteristics such as charisma. I.e., personality plus experience matters, and the one may shape the other, and key individuals who have these attributes are potentially more likely or able to influence the adoption of innovation in a beneficial way.

Seeing this through the lens of STS theory would suggest that the social subsystem is much more important or a stronger influence than the technical subsystem. See Section 5.10 for further detail.

5.7.2. Finance and Funding

Finance was mentioned many times and was counted among most important factors, which was expected, but it was not considered to be a decisive factor in innovation adoption in many cases, which was not expected, as it is often cited as a limitation in healthcare innovation (Rogers, 1995; Denis et al., 2002; Fitzgerald et al., 2002; Hughes et al., 2002; Greenhalgh et al 2004; Consoli et al., 2007; Petkova et al 2010; Aylward et al., 2013; Kelly and Young, 2017 and others, see Section 2.1-2.2). In fact, part of the reason it was as high as it was because it was a ‘Circumstantial factor’, as Interviewee E with a background in venture funding understandably spoke a lot about Finance and Funding, skewing the factor higher in terms of its relative importance (though it was fairly consistently mentioned between other Interviewees as well, just not as frequently).

It could also be considered unexpected that *any* other factors were more important than it in terms of number of mentions as money is often thought of as the bottom line, whereas this study seems to show it isn’t always or at least doesn’t have to be, and other factors may play a larger sway in innovation adoption.

Additionally, it was not always considered a barrier, which was unexpected, with some interview statements being recorded positively - usually owing to that fact that in those examples achieving funding for an innovation was easier for whatever reason, such as environmental causes like COVID-19 increasing accessibility for funding, or because key individuals are present who are more experienced in securing funding (see Interviewee F's statements for insight into this).

Of course, innovation will always need to be funded somehow – everything does, but very often it is not the most important factor to consider in innovation adoption and may just be a simpler hurdle to jump over at times than a mountain to climb. As Interviewee F says:

“People do a lot with very small amounts of money so actually the culture and the support is so invaluable, that sometimes it's not the money, often it's not the money that we've seen play out - if someone's telling you they can't make a business case because it's the money, it's not always true” [Quote F147].

5.8. The Interviewees

The Interviewees in this study represented a mix of backgrounds and expertise relevant to healthcare innovation and its adoption. Healthcare professionals were represented, as were innovators, personnel from industry, from third sector or from advisory organisations, as well as academics – and often this diversity was present within the same person - as some (but not all) interviewees had also multidisciplinary backgrounds and roles (see Appendix C). All interviewees were highly educated with a large amount of awareness, knowledge, skills, and experience when it comes to healthcare, innovation, and the adoption of those innovations within it – but they often had different relevant experience to offer in different areas, which added to the diversity and nuance of views and experiences that were able to be shared in this research.

Since the respondents are highly educated, experienced people used to dealing with complex situations, it is unsurprising that the answers provided were often

suggesting complex relationships between factors, complicated processes, and multiple, conditional responses to the same situation. This is authentic to the situation as these are all active innovators in the field of health and life sciences in Wales. The key findings from this research are novel in comparison to the literature on technology adoption models which rarely explores this complexity (Greenhalgh et al., 2004). This may be because the quantitative research predominantly used is not:

- Context-specific: there is so much nuance one cannot just use a simple formula – the TAM model etc is not context-specific enough.
- Sometimes there were factors that were so similar to each other out of context, but in context they were very different in practice.

Overall, there was some divergence between Interviewees on what they discussed most often, and this was often due to their background and specific experience. For example, the interviewee with significant experience in the financing and funding of innovation spoke most often and most in-depth about finance and funding.

However, even given the diversity of the Interviewee group, the coding suggests that overall, the Interviewees mostly had similar views on the factors that influence innovation adoption in healthcare, and the importance of those factors (see all tables in Appendix J).

This adds weight to the significance of the findings, as the diversely and highly experienced Interviewees had similar things to say about the adoption of innovation in healthcare. As can be seen in the Results Chapter 4, there wasn't a significant amount of divergence in opinion, perhaps more of a divergence in interests, such as the example of Finance and Funding laid out in the previous paragraph.

5.8.1. Similarities and Overlap Between Interviewee's Viewpoints

It is interesting how even though they are diverse background the respondents had significant overlap in viewpoints and factors they highlight that are important in adoption. This along with the fact that the majority were also covered in literature gives the factors validity since the varied backgrounds come up with similar points.

These can be seen in the tables in Appendix J and L and are also explored for each code in depth in Appendix H.

5.8.2. Differences Between Interviewees Viewpoints

The differences between the interviewee views are just as interesting as the similarities:

- The differences in which factors they deem most important – can be related to their background, or who they are as a person or their beliefs, or their experience in innovation.
- The differences between how they view the different factors – occurred less often as there was a lot of consensus between interviewees but there were a few significant differences.

These can be seen in the tables in Appendix J and L and are also explored for each code in depth in Appendix H.

5.9. Evaluation of Methodology in Answering the Research Questions

Most technology adoption studies use a quantitative approach: often reductionist, survey based with a majority of closed questions utilising a Likert scale and a mixture of statistical data analysis methods such as logistic regression, structural equational modelling, or confirmatory factor analysis (Oliveira and Martins, 2011; Greenhalgh et al., 2004). There are examples of more qualitative approaches in some key studies, which present single or a small number of case studies (e.g., Denis et al., 2002; Fitzgerald et al., 2002; Nahta and Esteva, 2007), are executed using more qualitative interview approaches (e.g., Greer, 1988) or utilise mixed methods approaches (Meyer & Goes, 1988), but generally have poor generalisability.

The pragmatist research paradigm which involved choosing the best methods to answer the practice-based contribution to knowledge adopted the research question “*what influences innovation adoption in healthcare?*” as well as the further questions which stem from this, has brought tried and tested qualitative methods, mixed with some quantitative methods to investigate the research questions of this study in similar ways to some previous research, but also there has

been novel approaches that have uncovered novel findings in this field, which have been discussed in the preceding sections.

Some examples of novel approaches to investigating innovation adoption include using mixed methods to get to an approximately quantification of the importance of factors by seeing how often they are brought up by interviewees and how consistently they are talked about, as well as investigating the relationships between factors and contexts, and the propensity of factors to act as barrier or enabler.

The method of semi-structured, open-ended interview was an effective way to approach this type and area of research. Using the theoretical framework of TOE, an interview framework was developed with relevant themes and questions to use in the Interviews to keep on topic and to keep the interview moving where needed, which was useful during the Interviews. However, it was found to be less required than anticipated, as the interviews and interviewees responded well to the more unstructured elements and open-ended questions. This also led to the development of POET framework due to the frequent discussions on the significance of people.

Since this method's structure resembles a more 'natural' conversational structure, the cultivation of a relationship, and the use of open questions and follow-up questions, it created an atmosphere where the respondent is more comfortable and at ease and encouraged to think aloud. Furthermore, approaching it in this way largely eliminates the issue of bringing (the majority of) preconceived ideas about the topic to the interviews which could occur with closed questions, and it makes it easy to not overly prompt or lead respondents in questioning, and to not restrict where the interview can go (within reason – necessarily the interviews stayed within the topic of technology adoption in healthcare but anything within that area could be explored). These advantages have been noted before by many researchers (Dearnley, 2005; Low, 2013; Brinkmann, 2014; McIntosh and Morse, 2015).

This method proved a highly effective way at discovering factors that influence innovation adoption in healthcare, as discussed in Section 5.3. In addition, further

evidence toward this approach's validity is the fact that there was a significant number of factors discovered in this study which corresponded to those in literature. It also appears to have been effective at discovering greater detail and nuance, as well as further factors which were not present in searched literature.

In addition, recording the interviews in full and capturing quotes as full as possible, including all the pertinent contextual, setting-specific, and nuanced information was a fitting and effective way to record and analyse the data in this study. As has been shown and discussed, healthcare and innovation adoption within it is significantly complex (Plsek and Greenhalgh, 2001; Greenhalgh et al., 2004) and very people dependent. Compare this method with an electronic, telephone or paper quantitative survey questionnaire methodology (which was initially considered – see Section 3.4), where respondents could give answers from 'strongly agree' to 'strongly disagree' and a few textboxes to fill in – a significant amount of the relevant detail and nuance would be lost via this method. Additionally, the responses may not be as valuable because the respondents are not talking with a real person.

Finally, presenting the data via the data displays, that can be seen in the Results and Analysis (Chapter 4) and the Appendices, is an effective way to present the data, as it captures necessary, relevant, and important detail while remaining easy to understand and communicate (Miles, Huberman, and Saldaña, 2018), which is an important goal of this research as it is intended to be accessible to all stakeholders in healthcare innovation adoption.

5.10. What Are the Implications of This Study for STS Theory and TOE Framework?

The findings of this study suggests that the social subsystem far outweighs the technical subsystem of the STS theory in terms of innovation and adoption in healthcare. People and relationships between them are shown again and again by the data to be among the most influential when it comes to healthcare in general, and in innovation adoption in healthcare.

This is shown by the fact that more factors are in the P context, more of them are important, more of them have a high degree of interrelationship with others, and they have a greater ability to be influential in innovation adoption. Compared with this, the technology component of the technical system seems far less important as a consideration in this setting. What this means is that in a given situation, the successful implementation of a new innovation (either material technology or non-material) will be more contingent on the influence of relevant people than the influence of that innovation's characteristics and surrounding attributes.

In a social technical system human skills match technology and everything else is there to support it, in a perfect world. What this study shows is that the technology is relatively inert, what is interesting is the people and organisation, roles, responsibilities, clarity over who does what and how, and what they are capable and enabled to do.

This study's findings have the same implications for the TOE framework, where the technological context, which was assumed to be among the most important, is shown to be less so than anticipated. The environmental context is also shown to be less of an influence, whereas the organisational context is shown to be key. Of course, the most significant finding is that the framework required developing to include the fourth context 'People', which appears to be the most important context to consider when it comes to influences on healthcare innovation and adoption. This potentially means much technology adoption research which looks at organisational level adoption and does not focus on people will be lacking, and this should be incorporated moving forward.

5.11. What Are the Implications of This Study's Findings for the Case of VAD Adoption?

The case of innovation adoption that helped to kick off this study was of ventricular assist devices' adoption and use in the UK. As explained in the literature review, VADs are an invasive technology with high skill level required to operate (cardiac surgeon with transplant experience). They also have a high cost per unit attached to them (though comparable in cost to many other healthcare interventions, either

devices or medicines, that are deployed widely in NHS) (Westaby & Deng, 2013; Miller, 2013). VADs have a large amount of evidence concerning their use, with relatively high addition to quality and length of life, and NICE issued guidance on their use in advanced heart failure (NICE, 2015). However, their use in the UK is relatively low and is not in line with other high resource healthcare systems such as the USA or Germany (NHS blood and transplant, 2015; Kirklin et al., 2015).

Before undertaking this study, after speaking with experts on VADs and after reviewing relevant literature on VADs, the possible reasons posited for their low adoption in the UK seemed to be due to a combination of the high cost of VADs and care surrounding them, or to do with very technical clinical reasons specific to VADs such as the relatively high skill level required for their implantation, or the difficulty in deciding on suitable patients, or to do with other technical clinical reasons more general to medical devices in general such as compatibility with the body and so on. With this in mind, what are the implications of the findings of this study for the case of VAD adoption and use in the UK (and in Wales where VADs are currently unused)?

For a start, the findings of this study, backed up by other healthcare innovation literature (e.g., Denis et al., 2002; Greenhalgh et al 2004; Plsek & Greenhalgh 2001; Consoli et al., 2007; Petkova et al 2010; Fitzgerald et al 2002) (also see literature review Section 2.1-2.4), suggests that the situation is likely far more complex than these relatively simple and discrete reasons.

The findings of this study also suggest that it is likely that a relatively high number of the factors discovered in this study could play an influential role in this technology's adoption and spread and that a significant number of those factors would be affected, influenced, or mediated by relevant people and organisations, and by the characteristics of and relationships between those people and organisations. Additionally, it is likely that (a relatively lower number of) environmental factors and technological factors could also play a role.

Using the POET framework laid out and tested in this study, stakeholders in the adoption of VADs could apply the framework and assess which factors may be influential in the situation specific to VADs, in the setting of the UK or Wales to

determine what is present and what is missing, what may be utilised as an enabler, what may need to be mitigated as a barrier, and also how the different factors relate to and influence one another etc.

A study could be undertaken using this framework that is more VAD specific, to determine more accurately the influences are in that technology's adoption. For now, this study's findings both generally and specifically (as one interviewee spoke about a VAD innovation as an example) can be used, supported by background literature and prior knowledge from discussing with experts, some specific points that may influence VAD adoption can be suggested.

To start with, the codes which were identified when Interviewee E discussed a specific VAD innovation included 'Boundary Spanning' (see E78 in Appendix I), 'Demonstration of Value' (E99-100), 'Identification and Communication of Need' (E106), 'Experience with Innovation' (E113), 'Finance and Funding' (E145,147-149), 'Intellectual Property' (E155), 'Understanding of Environment' (E170-171), 'Time and Capacity to Innovate' (E178), 'Attitude to Risk' (E192), 'Triability and Testing' (E240,242,243), 'Policy/Regulatory Effects' (E248,250-252), 'Measurements/Metrics' (E273), 'Getting the Right People' (E288), 'Incentives' (E301). This already gives us a large number of examples of factors that influence this specific innovation and may influence VAD adoption more generally.

Of course, further factors discovered in this study could also potentially play a part in VAD adoption. Each of the 44 discovered in this study could be discussed here at length as to how they may influence this case for this technology. However, to keep it brief, an example will be used instead using the relatively highly ranked people factors. It is relatively easy to consider how strong People-related factors such as Leadership, Networks and Collaboration, Trust and Relationships, Alignment of Actors and Objectives could influence any innovation adoption case in healthcare, with VAD adoption being no exception. Any of these factors could act as a barrier or an enabler depending on the circumstances. The direction of these factors matters, such as the opinions of leadership – do the relevant leaders view the technology favourably (which ties into 'Demonstration of Value'), had the need been communicated and so forth, is there a champion present, how is the champion

viewed by others – there are many possible questions and iterations to be asked here, and numerous potential links between different factors of influence. Simply understanding this fact is important for understanding innovation adoption cases in healthcare. In addition, being able to discover and know what one may not know is also important- and with this framework and list of potential factors to explore this becomes achievable for this case. All that is needed is to identify and speak with the relevant people that have a stake in or may influence VAD adoption, from cardiac surgeons to med-tech companies to regulators to academia and so forth.

5.12. What Are the Implications of This Study's Findings for Innovation Adoption in Wales?

All of the findings and points from this Discussion Chapter apply to the setting of innovation adoption in healthcare in Wales.

The focus of this study was the setting of Wales, and the majority of Interviewee's experience was within Welsh healthcare innovation and most of their examples looked at Wales also, with exceptions to this where Interviewees also discussed examples from the wider UK and further afield internationally as well. This means that this study's findings can directly apply to and inform policy for innovation adoption in Wales, but also have the potential for generalisability or comparison to other healthcare systems and possibly other settings entirely.

Altogether the findings suggest a few things important in healthcare innovation in Wales. Firstly, People and Organisations have a higher importance, impact, and influence, for good or ill, on adoption than the external environment and technological factors. People particularly seem to affect almost all aspects of innovation adoption, including the role of all relevant individuals, as well as key individuals ('the right people'), and the social networks that connect them to each other, and also form organisations or inter-organisational ties. The overlap and relationship between people and all the other contexts and those contexts with the others are also important to understand and acknowledge.

It is possible even that individuals can be so influential in Wales as it is a relatively small country with less people and networks might include all people who are

stakeholders and potential influences on innovation adoption (Howson and Davies, 2018).

Looking directly at the factors from the perspective of all of Wales, they should be considered in terms of their relative importance and the strength of their interrelationships, and also it should be considered how to develop them into enablers or reduce and eliminate them as barriers.

As mentioned, there is a strong overlap and relationship between the different contexts which cannot be ignored, but generally there seems to be two types of change that Wales could implement for enhancing and supporting innovation and adoption: more 'people-focused' or 'human resource' changes, and more organisational change (structural, resource allocation, and so on) – which are both relatively strongly linked to and influence each other.

For example, the 'Organisational culture/structure', or 'systems and processes' of the NHS in Wales may be difficult or even impossible to change easily, but over time an approach to nudge the culture in the direction of innovativeness and adoption may be possible, as well as re-structuring to actually allow it to happen, which ties to empowering people to innovate, giving them time and capacity and so on. It also likely requires significant investment in the system, which of course raises issues on where best to allocate the investment.

Leadership also seems to be key for Wales – recognising the leaders it has and helping to develop and encourage leaders ('Getting the Right People', 'People Who Can Get Sh*t Done') who can in turn develop and encourage innovation and adoption. Many of these things rely on trust and relationships, good networks and collaboration and aligning people to the goals, objectives, setting a clear culture and vision (which ties back into organisational wide changes) and so on – and the interrelationships between all of these things should also be acknowledged and understood. For example, you are unlikely to empower people to engage with innovation adoption if they do not have leadership support, do not have the time and capacity to innovate, or a clear reason or motivation to do so. And even if you have people motivated to do so, if they cannot easily access channels to collaborate with, communicate and form relationships with others who are necessary for the

process it is likely to go nowhere. A lot of this ties in to experience with innovation, which leads to the suggestion that innovation management services or organisations which can act in a support and advisory role could also be highly beneficial in this setting.

Following on from that, as mentioned many of the most influential factors tie directly into specific individuals with certain characteristics who can be highly influential in the innovation adoption process. Identifying these individuals where they currently exist, understanding why they are effective and how others can be cultivated like this, as well as finding ways to reduce negative influence of certain individuals also, appears to be very important. This study highlights some of the key factors which apply to, or are often associated with these key individuals, which can be seen under the codes: 'personality', 'getting the right people', 'people who get sh*t done', among others. This likely warrants further investigation into individuals versus systems when it comes to innovation adoption in healthcare in Wales, with the hypothesis that it is likely influenced by both, with the research questions of which is more influential, why, and how.

In summary, this study suggests innovation adoption in Wales is likely influenced by multiple contexts, with People and Organisation being most strong, that there are likely many factors at play, some generally more influential than others, some with stronger relationships to others, and some which are usually an enabler and some a barrier. All of this complexity should be considered when determining how to approach changing or influencing innovation adoption in the NHS in Wales. The POET framework represents a suitable and effective way in which to approach this.

5.13. Chapter Summary

This chapter has drawn together the various threads of literature and extant research studies that were found in the literature review to 'make sense' of the current relationships and design of the Welsh NHS Innovation system. Previous studies, drawn from healthcare or product innovation from a mainstream engineering and manufacturing perspective, have proved to be ineffective ways of exploring this significant and influential sector. At this point in the research process, the field research has been presented and refined to answer the guiding research

questions and make its contribution to these existing debates. The study does not find simplistic linear systems with actors that contribute to the success of the new innovation at each stage of the process. Far from it. The study shows a messy and interrelated process which is less prescriptive and more influenced by the power (or withholding of power) of actors to support or prevent an innovation from progressing.

At the heart of this mix of stakeholders is a combination of POET factors where the weighting of influence and power is not equally distributed. Instead, the social aspects of this socio-technical system have a disproportionate amount of power to support or hinder the process of an innovation from concept to practice. Such an influence is unsurprising because innovation adoption represents a series of decisions involving people (sometimes with limited evidence) and each with a predisposition to preventing innovation if it is, in any perceived way, incapable of justification and passage through to the next decision-maker. This is the first study of its kind since Greenhalgh et al., (2004) to use a methodology, drawn from the established methods of the social sciences, which has proved useful and a very effective means of exploring the current system as a dynamic whole. The next chapter will present a brief summary of the study findings again before exploring the implications of this study for the researchers and policymakers and other stakeholders focusing on innovation adoption in the healthcare setting.

6. Conclusions

This final chapter will bring together the conclusions made from this study, which had the aim of answering the research question “What influences the adoption of innovation in healthcare in Wales?”

As shown by the extensive results produced from the interviews, the use of coding for discovery of factors of influence, the newly developed POET technology adoption framework, and the presentation of data in displays including secondary analysis: the qualitative approach taken has provided a rich source of new insights into innovation adoption in healthcare in Wales.

As shown in Section 5.9, aspects of this methodological approach are novel in the field of innovation studies and the approach has proven to be both effective and valid.

As a result of taking this open-ended, semi-structured interview approach, new relevant factors that can influence innovation adoption were discovered which would not have been raised by respondents in a closed structure survey as was originally tested (see Section 3.4.4 in Methodology). In doing so, this study has provided a case for further research to test the POET framework in other settings.

6.1. Answering the Research Question

The study has provided a number of insights into the factors that can influence the adoption of innovation in healthcare in Wales. As shown in Section 4.1, there were 44 factors described that influence the adoption of innovation healthcare in Wales, which grouped under one or more of the four contexts of the POET framework.

Although the respondent group were diverse, in that they had very different experiences of having introduced innovation in healthcare in Wales, as discussed in the Section 5.8, there was a high level of agreement on the factors, which can be seen the tables in Appendix J.

Sixteen of the 44 factors were not found to have a similar enough counterpart in the searched innovation adoption literature (see Appendix M, Table 8.13.1). The remainder of factors (28) did have a suitably similar counterpart in the literature,

which provides further confidence in the methodology of this study. In addition, the value of the qualitative approach in this study is further enhanced by the fact that none of the empirical innovation adoption studies contained all of these factors together, instead they worked with a smaller set of previously identified and tested variables i.e., deductive approach (see Section 2.4), which again shows the limitation of the reductionist approach.

Contrary to the expectation at the outset of the study, the TOE framework, with its three 'contexts', was found to be inadequate to describe the totality of the factors. Due to the readily apparent importance of people, an aspect that was missing from TOE, an alternative theoretical framework was sought to explain this. Socio-technical systems theory, originally developed for use in organisational development and work design, described the importance of the relationship and interdependence between a social subsystem (including people) and a technical subsystem (including technology i.e., innovations). This led to the development of a new conceptual framework based on TOE, bolstered with STS, named POET (see Section 5.1).

Therefore, it can be concluded that the factors that influence innovation adoption need to be considered in these four contexts: People, Organisation, Environment, Technology. Including 'People' in this way provides a new insight for organisations or policymakers seeking to influence the adoption of innovation, because it emphasises the role of experienced and enthusiastic individuals, as well as the relationships and networks that they form. It can therefore be suggested that those seeking to introduce a new innovation in healthcare in Wales, will need to identify key actors and potentially gaps in expertise, in addition to organisational, environmental, and technological considerations.

6.1.1. Relationships Between Factors and Contexts

The contexts in the POET framework often showed relationships between each other. Many factors discovered had dual or multi-contexts creating linkages between contexts. Therefore, it can be seen that the four contexts are interrelated at the factor level, and none should be considered in isolation.

However, the numbers of factors assigned to each context was not equal, as shown in the area-proportional Venn diagram in Section 4.2.3 (Figure 11); in Appendix G; and explored in detail in Appendix H. Using the area-proportional Venn diagram (Section 4.2.3, Figure 11) to visually conceptualise the new POET framework, the relative importance of each context is shown, as well as their overlap. The factors can be placed in their corresponding context(s), and this could be used to investigate in cases of innovation adoption in different settings or sectors as shown in the diagram in Section 5.2.6 (Figure 14).

For instance, this study's findings suggest that in healthcare in Wales, technological factors regarding the innovation, are far less influential in the decisions to adopt that innovation, than in other sectors. As shown from Section 2.2, the majority of studies around innovation adoption have been in the field of information technology. It can be imagined that technological factors such as complexity, relative advantage, and ease of use are a greater consideration to IT professionals, for whom marginal gains in these areas would be of greater benefit. Whereas for a healthcare professional, the *perception* of the value of a healthcare innovation is the most important technological consideration. This may be because many of the technological considerations are assumed to, and usually have been, tested and supported by rigorous evidence and research before they are considered for adoption.

Interviewees confirmed that the barriers and enablers for adoption were rarely related to *characteristics* of the innovation but were very often related to individuals' willingness and enthusiasm to solve the problem that the innovation would address.

Using the method of simultaneous magnitude coding and content analysis it was possible to identify the relative importance of factors. These are not necessarily prescriptive in describing a definitive priority list for consideration when adopting an innovation but instead provide a list of likely consideration from most to least likely to have an influence. This is because the actual circumstances of an organisation seeking to adopt an innovation, and the conditions they find themselves in, are unique.

The relative importance of factors identified those that were both highly and consistently mentioned by all respondents, suggesting that these are likely to be of relevance to the majority of innovation adoptions, these include the 'top 10' as shown in Section 5.4.2:

1. **Organisational Culture and Structure** (1st & 1st)
2. **Leadership** (2nd & 3rd)
3. **Networks and Collaboration** (3rd and 4th)
4. **Trust, Reliability, Relationships** (4th and 5th)
5. **Demonstration of Value** (7th and 2nd)
6. **Alignment of Actors/Objectives** (5th and 8th)
7. **Experience with innovation** (6th and 9th)
8. **Finance and Funding** (8th and 7th)
9. **Empowerment** (13th and 6th)
10. **Difficulty to change existing practice/systems** (9th and 11th)

As shown in Section 4.5, simultaneous coding identified numerous interrelationships between factors. The matrix (Figure 13) that illustrates this demonstrates the complexity of innovation adoption because it shows that many factors often rely on other factors in order to be effective. However, the fact that some factors never interrelated to others suggests that these are all discrete factors in their own right, and that combining them would fail to demonstrate the authentic complexity of the innovation adoption process.

6.1.2. Barriers and Enablers

At the outset of this study, it was assumed that barriers and enablers, distinct from each other, would be discovered in order to provide guidance on what aspects of innovation adoption needed to be addressed in Wales. I.e., barriers would be identified that needed to be mitigated, and enablers would be identified that should be enhanced. However, when the results were analysed and the enablers and barriers were encoded (Section 4.6, Appendix L) it was found that factors can be either enablers or barriers depending on the unique circumstances. Therefore, the approach should be not to look for barriers and enablers, but to look for factors

of influence, determine the nature of their influence, either as barrier or enabler, and then to make decisions on that basis. For example, 'Organisational Culture and Structure' had mainly mixed statements (and more barrier than enabler).

Therefore, the role of those leading innovation adoption is to understand the organisational culture and structure, and to recognise that it needs to be influenced in a positive way for it to act as enabler or to be mitigated as a barrier for adoption to be effective.

All findings show how complex and nuanced every case of innovation adoption is and should be considered on case-by-case basis, aiming to understand all factors of influence together and their relationships. Using the POET framework with the factors discovered in this study makes this achievable.

6.1.3. Summary of Answers to the Research Questions

This section of the Conclusions Chapter will, for the ease of the reader, provide a high-level synopsis of the findings and contributions that answer the research questions. These are declared as:

- What are the influences on innovation adoption in healthcare in Wales?
→ The 44 factors.
- Which previously identified innovation adoption factors in literature will also be relevant in healthcare in Wales? → The ones which correspond to literature in Appendix M, Table 8.13.1.
- Are there innovation adoption factors that have not been identified or adequately explored in literature which are of influence in healthcare in Wales? → Yes, the 16 in Appendix M, Table 8.13.1 with no correspondent.
- What are the levels of importance and relevance of factors? → the relative importance findings – Section 4.4, 5.4, Appendix J.
- How do factors influence and relate to one another? → interrelationships findings – Section 4.5, 5.5, Appendix K.
- How are these potential factors affected by circumstances, setting and contexts, and what is the importance of these? → POET context findings

and discussion – 4.2, 5.1-5.2, Appendix F-G; barriers and enabler sections – 4.6, 5.6, Appendix L.

- Is using TOE framework and STS theory suitable for investigating innovation adoption in this setting and sector? → TOE unsuitable alone – P required adding. This is supported by STS, which gives the POET framework.

6.2. The Contributions of this Study

This study contributes the People-Organisation-Environment-Technology (POET) framework: a novel technology adoption framework grounded in the literature, developed, applied, tested, and refined in a novel setting and sector i.e., healthcare in Wales. This framework was developed with the intention to be used as a tool by any stakeholder in health and care innovation, from healthcare entrepreneurs to innovators within the system, who seek to understand and influence innovation adoption. Therefore, it was designed to be easy to understand, explain, apply, and use, in addition to being an academically rigorous research tool.

Findings relating to the importance of the four contexts in the POET framework shows that the hypothesised balance of power presented in the literature and implicit to many existing technology models is untrue in the case of this study. The balance in socio-technical elements is unequal as hypothesised by others and is weighted much more to the People-related elements in this healthcare setting, followed closely by organisational considerations, then by environmental and technological.

The POET framework also has the potential for generalizability and use in different settings and sectors. This ability to generalise is based on the grounds of similarly complex settings with formalised processes and multiple stakeholders. These stakeholders do not belong to one employer and do not share any real dependency relationships other than their stage and supporting role in the process of influencing new technology adoption. Such sectors might include new innovations in regulated sectors such as aviation and transportation in general for instance, or other sectors which provide professional services (e.g., law).

The field research identified numerous key factors that influence technology adoption in Wales (and in wider settings) that come under one or more of the four POET contexts, and these were further explored through cycles of coding. Some of these factors were not present in the innovation adoption literature at the outset of this study and represent contribution to knowledge in terms of novel factors that can have significant influence in innovation adoption. Additional novel findings included ranking and presentation of factors in terms of relative importance, investigating their interrelationships and assessing the propensity of factors to act as a barrier or enabler to adoption.

6.3. Recommendations and Implications

It is typical in the conclusion chapter of a thesis to declare the implications of the study on the practice of professional management and explore the implications for academics. The following are offered to these audiences:

6.3.1. Implications for Teaching

- Teaching from textbooks is a process of transferring general knowledge to students. This study finds significant weaknesses in innovation models when applied to specific settings. It would be prudent for students to learn by using case studies of success and failure in innovation adoption and for students to look at the potential factors which influenced these outcomes.
- Lecturers should use seminar classes to identify and embrace the complexity and limitations of existing general models of innovation adoption and innovation diffusion. Such teaching must explore the power relationships between systems actors and influencers as well as the timing of the innovation and its success.
- The researcher suggests the use POET framework as a tool in these instances, to conceptualise innovation adoption in complex settings and sectors.

6.3.2. Implications for Management

People are important is the resounding message from this POET socio-technical study when seeking to manage innovation in healthcare systems at every level.

Managers must therefore conduct formalised routines to understand their stakeholders, the decisions that these stakeholders take, the factors which impinge upon the person's ability to make a reasoned decision, and the success and quality inputs that must be given to them to promote innovation adoption. Only by understanding this stakeholder analysis and 'voice of the next person in the chain', will meaningful progress occur, and the probability of failure be reduced.

Managers are therefore advised to investigate and develop their own formalised and documented innovation and adoption strategies, policies, and standard operating procedures to ensure these systems are in place and robust whenever they are needed. These systems should be adaptable on a case-by-case basis and should also include technology route mapping and planning what future innovations are likely to occur and when these are estimated to be launched into the innovation process.

Other recommendations and implications include:

- Identifying and developing people, leaders, and key 'decision-making' individuals so that they have more skills and access to quality information/collaboration and feedback on their role and outcomes.
- Empowering key individuals to collaborate and make decisions (within an organisation or between organisations) as one panel.
- Utilise the advice and support from relevant bodies and best practice groups including:
 - The Bevan Commission, the Welsh University system, Accelerate programme, Agor IP and others who support and provide additional capabilities/resources to support innovation in Wales.
 - Find ways of sharing staff between organisations to develop their experience with innovation capabilities and understanding of the system and its influencers.

The implications for national systems designers and policymakers will now be addressed.

6.3.3. Implications for Policymakers

A national system of innovation is a difficult system to conceptualise, and many policy makers lack the skills to do so. It is not easy to see the unintended consequences of a policy decision without understanding the system itself and its multiple stakeholders and influencers. National governments and regulatory bodies (as well as professional bodies) need to put focus on and resource into people, understanding innovation as a national system and source of competitive advantage as well as a form of national wellbeing. Existing systems are ingrained and take a long time to change but change can be facilitated by the policymaker and engaged civil servants. Recognising national weaknesses and identifying critical success factors, barriers, and enablers should include a detailed understanding of the relationships between stakeholders. As such civil servants should be allowed to work at other stakeholders (both public and private). These individuals understand systems and have good diagnostic skills and potentially could contribute a lot of benefit to ensuring innovations are successful and go through the process right first time.

Many of the conclusions and recommendations for all stakeholders is that people are important and must be factored into the excitement that is generated by a new innovation. Individuals learn and are capable of learning so they also can problem-solve, and this is necessary if the Welsh national system is to come together into a process that delivers for all concerned – especially the clinician and their patients. Removing or clarifying the “known unknowns” of a process is a good way to rebuild a system that has simply evolved and results in more failures than successes and its ironically in need of an effective triage process to halt innovations at an early stage if they will not make it to adoption. Restoring the system to a good level of functionality so it is fit for the modern and highly innovative healthcare environment is a global challenge and it is hoped that the relatively small geography of Wales, with long-standing relationships between stakeholders could be an exemplar of success.

6.4. Future Research

6.4.1. Reflection on This Study

A researcher must reflect upon their professional research journey and to suggest areas from which they had learned and potentially what they would do differently if they were to re-do this study again from the start. These recommendations are also useful for other researchers who may be interested in furthering the work contained in this thesis. The reflections are as follows:

- The onset of the COVID-19 pandemic caused significant disruption to the work of the researcher and necessitated a complete change to the methodology which took considerable time. These contingencies cannot be planned for but being willing to adapt when problems arise is important. In adapting the study, the learning of the researcher concerning methodological choice allowed him to maintain his focus but find alternative (and likely more effective) ways of researching this vital area of management understanding.
- The planning of time and the willingness of key (and very busy) informants to help the researcher was greatly assisted by the relevance of the study to practice in general. The movement from a longitudinal case study to a whole system perspective was a worthy and fruitful change in research design which has reaped benefits and more closely aligned this study with the gap in the literature.

Apart from these points, the researcher would not change anything related to the actual study undertaken and its methods.

6.4.2. The Researcher's Future Research Agenda

Doctoral studies are constrained by time and budget. It is singular piece of research undertaken by one person. With more resources (money and time), the researcher would conduct:

- A longitudinal study to see how interviewees views changed over time as an organisation engages with the process of new technology development and adoption.
- Take specific findings using a second phase of exploratory and contextually rich research, aiming to understand the thought processes and how actors think and conceptualise their roles/decisions.
- Conduct case studies of success and failure of innovation adoption through the lens of POET framework to identify common general patterns and any outlier organisation that is highly successful in a given context which would allow the POET framework to be extended into other settings/sectors (such as wearable devices).

These new additions will form the future research agenda of this researcher and will be pursued following the publishing of this thesis.

Having reflected on where to go next with this research, the researcher will be creating a longitudinal study to see how views of interviewees change over time, how examples of innovation adoption develop, whether successful or not and why. Such longitudinal data could allow the analysis of duration; permit the measurement of differences or change in a variable from one period to another, that is, the description of patterns of change over time; and can be used to locate the causes of social phenomena and sleeper effects. Could help identify cause vs correlation of factor interrelationships

The researcher, together with his supervisors, has the opportunity to compare Wales with a similar health economy – namely New Zealand. These two countries have very similar populations, challenges, and health systems. As such this study would be able to isolate differences in design and potential national culture. Both private and public sector health innovations will be addressed in this study to determine any differences in collaboration, speed, or effectiveness between a public and private setting.

6.4.3. What Research Should Be Conducted Next?

It is typical in the Conclusions Chapter to discuss what the researcher would do if they became a member of a supervisory panel and could direct the efforts of newly recruited PhD students. Upon reflection, the researcher proposes these further doctoral studies:

1. A PhD student should take the POET framework and apply it to another form of innovation within a regulatory and multi-stakeholder setting e.g., aviation.
2. A PhD student should compare private and public settings to assess the rate of final adoption and use (last two stages of the linear model) and their success rates to see if private care (with its resources) has a higher rate of adoption.
3. A final PhD student should compare country systems such as the UK versus Japan (the latter country having extensive use of Total Quality Management and lean approaches to processes which theoretically could have influenced the national process of innovation adoption).

These studies would each add new knowledge to:

- Test POET framework
- Test factors and their importance
- Test interrelationships
- Reflect on the effectiveness of other systems and create a typology using the POET framework.

6.5. In Conclusion - Final Thoughts and Words

This thesis represents the culmination of thousands of hours of work researching, designing a study, interviewing, and collecting data, analysing the data, and writing it all up into the document present here.

The research presented in this study has contributed to the understanding of the phenomenon of innovation adoption, both generally and specifically, to the setting of healthcare in Wales.

The researcher hopes that the findings of this study: both the POET framework and the factors that comprise it, will prove useful tools for stakeholders in innovation adoption. This could be innovators; managers; policymakers; researchers; and anyone else that seeks to understand and influence innovation adoption for the good of the health system and ultimately the patients, who will benefit from the best technology being adopted into practice- be it material or processes; medicines or medical devices.

Finally, the researcher hopes others will use this work as the beginning of their journey into studies of innovation.

Harry Bell, March 2022

7. References

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8. Appendices

8.1. Appendix A – Theoretical basis for the Technology-Organisation-Environment framework

This appendix gives an overview and review of the prior research in technology adoption and innovation by organisations that led to the development of the TOE framework (Tornatzky et al., 1990).

8.1.1. Organisational context

Firms provide a source of structures and processes that may facilitate or inhibit adoption. Some are formal:

- The way organisation divides labour into distinct tasks
- The way they achieve coordination among tasks via mechanisms such as
 - Mutual adjustment
 - Direct supervision
 - Standardisation of processes, outputs, and worker skills (Mintzberg, 1979)

Some are informal:

- Represent naturally occurring behavioural patterns and roles
 - Can achieve similar coordination functions as the formal structures

It is noted that organisations don't 'just happen'. They are result of intentional and unintentional decisions and actions taken by organisational members (works for both formal and informal structures).

8.1.1.1. *Organisation Structure*

8.1.1.1.1. *Organic and Mechanistic.*

Burns and Stalker's (1961) work - Organic organisational systems more highly associated with frequent adoption of innovations than mechanistic structure.

Organic organisation characterised by:

- frequent lateral communication between individuals and subunits

- decentralisation of leadership and control
- higher degree of networking between people and units
- Aiken and Hage (1971) also found this

Some empirical evidence relates formalisation (rules and regs) inversely to innovation (Rothman, 1974) – difficult to replicate

Evidence links centralisation (concentration of decision-making activity and power) to innovation (Price, 1972) – more decentralisation = more innovation

- Centralisation often equated to number of hierarchical levels in an organisation
- Confusion whether it is a structural or process variable – has been interpreted as a process (reflecting how decision-making is used) but was measured as a structure (authority hierarchies and delegations of responsibility).

Some studies suggest organic environment not conducive to innovation at every stage:

- Suggestion that while organic structures seem to support the *adoption of innovation*, mechanistic structures are better at the *implementation stage* (Wilson, 1966; Zaltman et al., 1973).
- Rationale: adoption creative activity (thinking about new things and making creative decision), but implementation is a process of making that choice part of a bureaucratic routine.
- E.g. Zaltman et al. (1973) found **organisational complexity** (number of occupational specialties and employee professionalism), **formalisation** (emphasis on rules and procedures), and **centralisation** (centralised decision-making processes) had opposing influences on the innovation process.
 - Complexity aided adoption but didn't help implementation
 - Formalisation and centralisation were helpful for implementation but not adoption

Daft (1982) – dual-core model of organisational innovation takes Zaltman's structural argument a step further, distinguishes between two types of innovations:

- **Technical innovations** – often result from bottom-up pressures, percolated up from within the technical core, especially under conditions of:
 - high employee professionalism
 - low formalisation
 - generally organic organisational system
- **Administrative innovations** – often result from top-down pressures

Research suggests that structural characteristics such as complexity, formalisation and centralisation are related to innovation. Literature fails to provide:

1. A sense of which structural features contribute most
2. Which are most responsive to intervention

One way to gain more precision in understanding relationships between structure and innovation is to link discrete structures to functional task embedded in the overall innovation process. For example:

- Organisation be designed to be more effective in scanning environments for information on which to base decisions about technological innovation.
- Design features take two forms:
 1. Removing structural barriers that impede change
 2. Creating structures that facilitate coordination and information exchange within and between organisational subunits and levels of the organisation's hierarchy

8.1.1.1.2. Formal Boundary Spanning Structures.

In addition, the more general organic versus mechanic structural characteristics, there are many specific types of structure that can help scan the external environment for information about needs and opportunities for technological change, and to process and move this information so that it can support decisions about adoption. These can be thought of as 'linkage' or 'boundary spanning' structures.

Galbraith (1973) identified seven strategies for use of formal, internal linking structures, referred to as *lateral relations*:

1. Including direct contact between managers
2. Creating liaison roles
3. Creating ad hoc task forces
4. Using permanent teams
5. Creating integrating roles
6. Changing to managerial linking roles
7. Establishing a matrix form of management

He found when organisations take on uncertain tasks – e.g., scanning and processing complex information about new technologies, they have to choose on or more of these design strategies to cope with an increased information load.

This is important in *turbulent and dynamic environments* where tech innovation occurs at rapid rate and innovations are competing with one another for recognition and use.

Key design issues for these linking structures:

- Orientation to external task environment
- Integration with the rest of organisation
- Cost of increased information processing for decision-making.

Galbraith considers linking structures as lateral information systems helping managers to solve problems at their own level and to contact and cooperate with peers in units affected by new information.

They facilitate interunit communication and coordination that is necessary to acquire all information relevant to the use of shared resources for processes such as planning and decision-making about tech innovation.

Allen (1986) found linking structures needed to manage two types of communication:

1. Task coordination

2. Keeping abreast of technical developments in the field (to be effective this requires a functional organisation with well specified roles)

Organisations have designed linking roles to increase information links between strategic planners and researchers and between internal managers and external knowledge producers.

Tushman and Nadler (1986) identified four ways internal linking mechanisms can affect the innovation process:

1. Teams, committees, and task forces bring together individuals from diverse areas, providing different perspectives on problems and opportunities
2. Project managers work to achieve integration and coordination for new products or process development
3. Formal meetings offer opportunities for individuals from different areas to share information and ideas
4. Joint problem-solving teams maximise ownership of the innovation among parts of the organisation

Two features of lateral information systems identified by DePietro et al. (1990) that may be important for tech innovation:

- **Interchangeability** – capacity of system parts to be substituted for other parts within and outside the system, thereby augmenting the system's effectiveness in acquiring information about environmental change.
 - Present in many Japanese firms where engineers routinely move through marketing and sales depts to help them develop a strong orientation towards the external task environment (Pascale and Athos, 1981)
- **Subsystem differentiation** – degree of specialisation of subsystem parts for scanning and information processing.
 - Complexity of information about environmental change present in the external task environment must be matched by specialised structures within the organisation that have the capacity to scan and process information about it.

- Without fit between informational requirements of the org and the design features of the information system, such systems are invalid.

8.1.1.2. *Process Factors and Technological Innovation*

Processes are as important as structures in an organisation for innovation. Two processes appear to be key in establishing a positive environment for adoption decision-making:

8.1.1.2.1. *Informal Linkage and Communication.*

Rich literature on informal internal linking agents influencing innovation – such as product champions, idea generators, gatekeepers, boundary spanners (Rogers, 1995; Tornatzky et al., 1990)

- These roles are not typically prescribed by the formal organisation, but that employees acquire because of an interest in an area or activity.
- The determination that someone fulfils such a role is often made based on the amount of personal contact or communication an individual has with other employees used for acquiring or exchanging information about innovations (Allen, 1977).
- Informal internal linking agents also important as they provide the energy and labour so necessary for later adoption and implementation activities.
- Internal linking agents also can act as bridges between different phases of the decision process about technological innovation, including early pre-adoption decisions, such as whether information about a new tech enters a firm and is diffused throughout, as well as the actual decision to adopt.

Chakrabarti (1989) found these informal roles are dynamic, not static: individuals change roles depending on the situation.

- For example, information promoters been found to take on the role of power promoters to quicken decision-making about adoption and implementation.

Whether these informal roles can be designed and managed is debatable, but organisations can create conditions conducive to their initiation and continuation –

e.g., creating reward systems to support these informal role behaviours (Tushman and Nadler 1986)

8.1.1.2.2. Top Management Leadership Behaviours.

These include planning and communication about change, developing policies and goals that support innovation. Tushman and Nadler (1986) recommend 5 specific ways executives can foster innovation:

1. Develop and communicate a clear image of the organisation's strategy and core values, and role of innovation in meeting this strategy.
 - If this isn't done the focus of the organisation will be on the status quo.
2. Serve as a role model by sending consistent signals about the importance of innovation to subordinates.
 - Many times, an inconsistent signal is sent when management claims innovation is important, but then fails to provide adequate resources or sufficient personnel
3. Use formal and informal rewards that reinforce innovation
4. Build a sense of the innovative aspects of the organisation's history in order to create an organisation culture based on innovation
5. Build an executive team with technical, social, and conceptual skills to accomplish diverse tasks and work actively toward envisioning a credible and exciting vision of the future.

8.1.1.3. *Size and Slack*

Organisation size and slack are two variables that have been researched comprehensively. They are neither structure nor process, but still have much intuitive appeal in regard to innovation, and have continued to receive attention, despite little empirical support.

8.1.1.3.1. Slack Resources

Availability of slack resources often presumed to be important in understanding tech innovation:

- March and Simon (1958) suggest many complex innovations never get implemented due to lack of such resources.
- Rogers (1995) suggests slack may be a necessary but not sufficient condition for innovation. Thus, availability of slack resources doesn't always lead to technological innovation (Tornatzky et al., 1990).

Characteristics of external task environment and organisation will affect how and if slack resources are used:

- External task environment may lack info about specific tech innovations
- Key players in an industry might be observing the experience of early adopters to assess the cost and benefits of adoption:
 - Firms may want to see how things play out before committing
 - For example, behaviour of firms when personal computer first came out in 80s, waited until there was an established standard until making purchase, despite the low costs involved
- Hage (1980) found evidence that more radical innovations are associated with greater resource needs and, by implication, a need for a higher level of slack if the innovations are to be adopted.

Different types of slack may have different effects:

- Slack financial vs slack human resources.
 - Firms with bare minimum personnel may have high profits and money to spend but lack personnel to take the necessary actions.

Organisational resources are fungible – taken from one area and moved to another

- Firm decide to reorient priorities from existing activity to innovation one.
- Thus, slack can be created for some part of the organisation, even though the organisation as a whole has none.
- This is rare event but does happen – Chrysler in 1970s: bankrupt and then devoting large amounts of resource to the development of the new K-car, which saved the firm.

Slack seems to be a good condition but not a necessary *nor* sufficient for innovation to occur.

8.1.1.3.2. Organisation Size

Empirical studies on the adoption of innovations – be they new production equipment, new product materials, new medical technologies, or a host of other possibilities – almost invariably report that larger organisations are more likely adopters (Cyert and March, 1963; Aiken and Hage, 1971; Hannan and Macdowell, 1984; Kelley and Brooks, 1988).

In fact, size is typically the *most powerful* explanatory variable in these analyses, outweighing the statistical importance of any other factor.

Unfortunately, interpretations of this common finding are often muddled and contradictory:

Size (measured in terms of numbers of employees, yearly revenues, value-added, or other approaches) has been mistakenly seen as an indicator of *purely organisational traits* (e.g., bureaucracy or formalisation).

This leads to erroneous conclusions for two main reasons:

1. Size reflects not only internal organisational structures, but also technical and environmental factors.
 - For example, technical characteristics of a particular production process may dictate that firms attain a certain minimum size in order to maintain competitive costs
2. Size is not a useful measure of organisational traits
 - Rather, Size is a proxy variable for more meaningful underlying dimensions such as resources

The general point is that any aggregate index of size (number of employees, amount of budget, gross receipts, etc.) is correlated with other intraorganisational variables to some degree (frequently to high degree) - but doesn't directly reflect the degree of vertical hierarchy, the degree of internal complexity, or similar variables, or capture much about the process of internal decision-making.

- For example: two hypothetical organisations with 1000 employees (same size).
 - One arranged into subunits such as marketing, sales, production, and research, each with its own distinctive structure (like many large retailing firms).
 - One has a unitary structure.
 - Comparison between them probably break down in many crucial areas.
 - Given intricacies of adoption and implementation process, the employment of a discriminating variable as crude as size seems inappropriate.

Hull and Hage (1981) attempt to offer an alternative to the problems of size as a measure

- Argue number of repetitive events occurring within an organisation over time, which they call scale, is more important than the number of employees, dollar sale, or number of customers.
- Scale often correlates with size, but the two concepts are analytically distinct.
- Scale is indicator of the amount of work done in an organisation rather than its inputs or outputs.
- Thus, scale would seem to indicate more about the internal functioning of an organisation than size as it is usually measured.
- Question of how far this concept can be extended.
 - May prove useful in distinguishing among manufacturing settings where numbers of unit operations are clearly specifiable.
 - Be difficult to apply in less routinised settings (white collar) matter for further study.
 - As an aggregate figure, still fails to reflect the complexity of most organisations.

Regardless of measure used, there is one area of research in which size is a useful descriptor – to delimit a class of small firms.

- Below a certain size level one can probably detect a major qualitative difference in the organisation.
- The small business with less than 20 employees would be difficult to operate as a classical bureaucracy.
- Literature wasn't precise in identifying underlying structural and process components of smallness and in specifying where smallness begins – this hampers targeted intervention involving structure and process variables.

8.1.2. Technological Context

8.1.2.1. Available Technologies

- Different firms face very diff technological opportunities.
- Not all innovations are relevant in all industries or in all plants.
- Some firms operate in technologically stagnant conditions, for example:
 - Industry mature and equipment changes little from year to year
 - Most industrial innovations ill-suited to their operations or aren't cost-effective
- Others face opposite situation – deal with rapidly changing technology base, requiring constant re-evaluation of a variety of new techniques and equipment types.

The number, quality, and applicability of innovations available to a particular firm are understandably difficult to measure.

- Scherer (1982) provides an estimate of how technical opportunity varies in the aggregate, across industry groups.
 - Using 1974 data on R&D expenditure and patent activity of 443 large corps, he was able to disaggregate R&D spending by user industry.
 - Total R&D use for a given industry consists of its own process R&D, plus the value of the R&D embodied in its share of the products it buys from other industries.
 - R&D available per use as a percent of industry sales is a rough measure of number of innovations available to each industry.

- Larger pool of R&D to draw upon relative to the size of their industry makes it relatively easier to find innovations worth considering – *at least innovations brought about by formal R&D.*

Attempts to understand why some firms are frequent adopters and other are not must find a way to control for differences in available innovations. Two methods are most common:

1. Some studies restrict their analysis to firms in a single industry
 - Most likely to face similar technical opportunities, thus any diffs in their adoption behaviour must be due to diffs in organisational or firm specific market factors
2. Some studies attempt to group firms into categories that describe the richness of available technologies

In this case, the effects of these categories on adoption can be separated from the effects of other factors

However, a simple tally of the amount of R&D spending or even a count of available innovations doesn't fully describe the nature of a firm's technical opportunities.

The characteristics of available innovations also influence adoption activity.

- Important point in looking at such characteristics is how much they affect the information processing or technology scanning function of a firm prior to adoption
- The technological environment faced by a firm (and by extension all firms in the same industry) may vary widely in its effects, even holding the absolute number or volume of technologies constant.

Tushman and Nadler (1986) developed useful framework to discuss differences in innovations that have implications for adoption. They refined the product and process distinction into three additional categories:

1. **Incremental** changes that provide added features or enhancements to an existing product or process
2. **Synthetic** changes that involve the combination of existing ideas or technologies in ways that create significantly new products or processes

3. **Discontinuous** changes that involve the development of significant new products or process

“Discontinuous” innovations have also been referred to as radical.

- Many process innovations, such as programmable automation, are discontinuous (or radical) because they represent significant departures from existing equipment.
- They are complex technologies often encapsulating advanced knowledge and requiring complex maintenance tasks.
- Because many of these technologies qualify to a degree as first-of-a-kind technologies there is high perceived risk in their use.

Tushman and Nadler (1986) align these changes along a continuum, whereas one moves from incremental to discontinuous changes, uncertainty about the impact of a new technology increases.

- As uncertainty increases, the information processing requirements of the organisation also increase
 - In terms of environmental scanning (learn more about innovation and thereby reduce risk)
 - In terms of internal communication to increase the problem-solving and decision-making capacities of adopting units.

Tushman and Anderson (1986) take this notion a step further distinguishing between two types of discontinuous innovation:

1. **Competence-enhancing**

- These innovations provide the opportunity for a firm to radically improve a product or process.
- For example, jet airliner (Boeing 707), radically improved passenger service provided by airlines but did not make all the airlines' expertise obsolete.

2. **Competence-destroying**

- These shifts cause the technologies and expertise of a firm to become obsolete, resulting in major shifts in the industry.

- For example, invention of transistors (made vacuum tube technology obsolete), or the invention of integrated circuits (made wiring technologies obsolete).

Implication of this research is that technological environments containing more radical, discontinuous innovations will require different reactions by the firms in that environment. The search process will be more difficult and more expensive as will the nature of internal communications resulting from the search.

8.1.2.2. Current Equipment and Methods

The internal technological context can affect the innovation process as much as or more than the external context.

It is less clear what the impact will be, and if there is some systematic effect based on some measurable characteristic of technologies.

Technologies can be characterised according to Woodward's (1965) scale of technological complexity; small batch and unit production; large batch and mass production; or process production.

- Batch systems are less complex and more easily changed with new technology
- More complex mass production or continuous process systems are less easy

Collins, Hage, and Hull (1988) suggest that firm's current "production system sets broad limits on the extent and/or rate of subsequent technological change".

- They studied technological change in 54 New Jersey manufacturing plants, and characterised firm's production system using an index that they called "production system development"
- This index was composed of five system attributes
 1. Technical complexity
 2. Percent of mechanical material transfer devices
 3. Workflow rigidity
 4. Initial machine automaticity
 5. Percent of sales accounted for by standardised products

- They found inverse relationship between a firm's initial score on the index of production system development and change in machine automatically over the course of the study.
- This means that production systems that were less highly developed initially tended to increase their level of automation over time.
- Suggests less automated firms may attempt to leap-frog to a higher level of automation.
- This is counter to the literature on innovativeness, which implies that more innovative (that is, more automated) firms will tend to innovate more than less innovative ones.

8.1.3. External Environmental Context

Two aspects of external environment are key determinants of innovative activity:

1. The competitive characteristics of its industry
2. The existence of a relevant technology support infrastructure

Effects of market pressures on innovative activity:

- Intensity of competition in the products or services the firm provides
- The structure of customer-supplier relationships in the firm's industry
- The degree of market uncertainty faced by the firm.

Quality and availability of external resources to which firm has access – “technology support infrastructure” – encourage firms to try new techniques

- established network of information and technology sources
- local pool of skilled labour
- access to suppliers of technology-related services

Some research demonstrated more stringent governmental regulation sometimes stimulates and sometimes slows the use of new technology. Thus environmental, energy, and workplace regulation must be considered as part of the gov's de facto technology policy, as well as its more direct efforts to encourage or inhibit the spread of innovations.

Environment should not be seen only as external forces beyond the control of the firm. Some firms have the ability to shape their environments: large, dominant firms can often dictate the nature of competition, and even smaller firms might be able to influence the actions of their customers and suppliers.

8.1.3.1. Industry Characteristics and Market Structure

Much of the variation in the degree to which firms use innovations may be traced to differences in competitive and market conditions. Firms within the same industry tend to face common problems and opportunities.

To the extent they compete head-to-head, firms in the same industry also are often forced by the nature of their products to adopt similar competitive strategies.

Firms don't respond to shared influences in precisely the same way. They tend to develop strategies (consciously or not) that attempt to exploit their own particular strengths or the weaknesses of their competition.

Early work on market conditions and rate of adoption of new technologies by Mansfield (1977) showed:

- Effort mainly put into estimating S-shaped diffusion curve for each industry-innovation combination.
- But provided rough evidence that intense competition appears to stimulate the rapid spread of an innovation.
- Found rates of diffusion were faster in industries that exhibit what economists call a low degree of concentration – i.e., industries not dominated by a few large firms.

Romeo (1977) followed up on that work:

- 152 firms across 10 industries
- Estimated diffusion rates for each industry and related the rates to both the number of firms in an industry and the variance in firm size
- Found that rate of diffusion was more rapid in industries with more firms of equal size (more competitive) than in industries with few firms of unequal size (perhaps dominated by one or two producers)

Some general conclusions regarding industry characteristics and market structure outlined by Tornatzky et al. (1990) are outlined in the sections below:

8.1.3.1.1. Firm Size.

Whether measured in number of employees, output, or sales – larger firms tended to be earlier adopters and to use more types of technologies.

- Large firms probably more likely to achieve the economies of scale required to make an investment in new equipment profitable.
- In addition, large firms may be involved in a greater variety of production activities, and thus be more likely to find any given innovation applicable to their operations.

Size also likely to be a proxy for many internal organisational variables (as discussed earlier).

8.1.3.1.2. Intensity of Competition.

Market concentration – usually measured as the percentage of an industry's output contributed by its four largest firms – is often used as a proxy for the intensity of competition.

- Higher industry's concentration: more market is dominated by a few very large firms.
- Economists hypothesised that the spread of an innovation might either increase or decrease with industry concentration.
- Some research examined effect of market concentration on adoption rates (see Tornatzky et al., 1990).
 - Most reported that low industry concentration (that is, more intense competition) was associated with higher adoption rates.
 - One found the opposite – bank's use of ATMs: banks operating in more concentrated local markets were more likely adopters of ATMs.
 - Policy implications of these findings remain unclear.

Consider Levin, Levin and Meisel's (1987) finding that industry concentration was negatively associated with the use of grocery store scanners, but also that a firm's

own market share does the opposite. Thus, a policy designed to lessen market concentration will not unambiguously increase adoption likelihoods since firms in less concentrated markets tend to have, on average, lower market shares.

8.1.3.1.3. Customer-Supplier Relations.

Many products face not only competition from other members of their industry but have to deal with powerful firms who buy their products or supply their inputs.

Dominant customers sometimes dictate tech use by the firms that serve them.

- For example: car companies and their suppliers. Dependent suppliers tend to have more innovative activity when innovation objectives of their customers are clear (when they know what kinds of innovation expected of them).
- Independent suppliers not influenced by this, but only by what they perceive as short-term benefits relative to costs of investing in automotive R&D.
- Kelly & Brooks (1988) found 20 % of 1400 metalwork plants reported receiving technical or engineering assistance from their customers – assistance proved an important stimulant to technology use, increasing probability of adoption of numerical control technologies by as much as 18 %.

8.1.3.1.4. Market Uncertainty or Volatility.

Some firms face a lot of cyclic instability (e.g., those operating in construction and consumer durables):

- Fortunes rise and fall dramatically as the economy moves through growth and recession periods.

Other firms may face different types of uncertainty:

- Some participate in industries going through turbulent shake-out periods – everyone expects many firms to fail but no one can be sure which.

Effect of uncertainty on innovation unclear:

- Some may seek out innovation to shelter themselves from uncertainty
- Others may hoard available resources and avoid further risky activity given the possibility of tough times.

Mansfield (1977) and Benvignati (1982) have found that firms are most likely to invest in new technology at intermediate points in the business cycle:

- Neither at the trough of a recession or at the peaks of activity
- Mansfield suggests that firms may perceive that troughs and peaks are particularly uncertain periods and prefer to wait for more stable times to invest in new technology.

A study of 54 suppliers to food processing industry (Ettlie, 1983) shed some light on how different types of uncertainty lead firms to pursue different tech strategies:

- Firms polled regarding how much uncertainty they perceived in several aspects of the environment
- Firms that perceived high level of uncertainty in capital supply and in their customers' new product needs were more likely to pursue an aggressive technology policy.
 - Active recruiters of technical personnel and voiced a conscious commitment to being a recognised technical leader in the industry
- Firms that perceived a high degree of uncertainty regarding the actions of particular customers or competitors tended to emphasise an aggressive marketing or customer service
- These differences in strategy proved important predictors of adoption behaviour: pursuit of aggressive technology policy was correlated with the adoption of more radical innovations.

There was empirical evidence for importance of environmental factors described, but there are many others that would appear to be important which Tornatzky et al. (1990) could find no empirical evidence for, which are described in the below sections.

8.1.3.1.5. The Dimensions of Competition.

While not a determinant of overall level of innovative activity, differences in competitive importance of price, quality, and service may affect the types of innovations a firm seeks out.

- For example: firms that consciously aim to offer and emphasise superior customer service, rather than low price, may be more likely to seek out innovations that help them to address this goal.
- Thus, they may aggressively pursue direct electronic communications with their customers, while overlooking an innovation designed to cut their input costs by 10 %.
- Firms will aim to pursue technology strategies and policies that are consistent with their overall business goals.

8.1.3.1.6. Industry Life Cycle.

Firms in rapid growth industries (Tornatsky et al., 1990 cite plastic products) should (other things being equal) be more rapid at incorporating new innovations into their operations.

- Current best practice equipment can be incorporated into each new production facility, without having to retire existing equipment.
- The analysis of innovative behaviour in declining industries (e.g., leather products or primary metals) requires a careful approach.
 - For example, steel producers' innovation may involve moving into an entirely new line of business.
- Role of industry life cycle in determining R&D investments has been examined empirically but no empirical work that explicitly accounts for its effect on technology adoption or implementation.

8.1.3.2. Technology Support Infrastructure

Constraints or opportunities firms need to consider when developing technology acquisition strategy depend to an extent on the quality and availability of the external resources from which the firm can draw. In particular, bringing in new

technology depends on labour costs, skills of available labour force, and access to suppliers of technology-related services.

8.1.3.2.1. Labour Costs.

- Firms paying higher wages are almost always more likely adopters of new technology.
- Higher wages should stimulate the use of innovations designed to replace labour (e.g., Globerman, 1975).
- However, Majchrzak, Nieva and Newman (1986) reported that wage rates had no impact on adoption:
 - This study was flawed due to the lack of firm specific wage data.
 - Authors substituted industry average wage rates: generally not a good proxy due to large within-industry variation.
- Cause and effect relationship between wages and technology use remained a contentious issue.
- Firms may find they must hire more skilled and more costly labour only after they have committed to more advanced technology.

8.1.3.2.2. Skills of Available Labour Force.

- New technologies generally require changes in the skills that firms demand from their employees (Flynn, 1988; Hirschorn, 1984).
- Firms operating in a labour market with an abundance of trained, experienced employees face substantially smaller innovation-related training and requirement costs.
- Study of demographic characteristics of workers in 61 manufacturing industries confirmed the importance of an educated workforce in implementing new technology (Bartel and Lichtenberg, 1987).
 - Statistical analysis provided evidence that the relative demand for educated workers within a given industry increases with the R&D intensity of that industry and declines with the age of its capital stock.
 - For example, lumber and wood products and apparel are older and long relied on established technology and practices. In contrast, the

communications field drew heavily on the latest advances in computers and data transfer techniques.

- This suggested that the relationship between labour quality and new technology becomes especially crucial for older industries undergoing a new wave of modernisation.
 - For example: the US textiles industry, since 1980, manufacturers made major investments in new plants and equipment, much of it designed to replace low or unskilled labour.
 - Introduction of new equipment increased the need for more sophisticated machine maintenance and operating skills – skills not easily available in the traditionally low-wage, low education areas in which many textile mills were located.
 - Thus, the textile industry's modernisation effort raised a host of labour dislocation and supply problems.

8.1.3.2.3. [Access to Suppliers of Technology-Related Services.](#)

Often an efficient way for firm to accomplish an array of decision-making, adoption, and implementation tasks associated with new technology is to delegate some to outside specialists.

Firms operating in industries or geographic areas with high-quality, low-cost suppliers of technology-related training and consulting have more options, and more flexibility in carrying out their innovation strategies.

Little direct evidence exists concerning the importance of these non-labour, external resources.

Research in economic geography provides indirect evidence that access to a critical mass of available information, talent, and know-how can stimulate firms to use innovations:

- Key conclusions are that being in a city is very important.
- Despite “business climate studies” proclaiming the Dakotas to be the ideal business location, firms continue to locate in major urban centres with their

higher tax rates and supposedly antibusiness environment (Tornatzky et al., 1990).

- Urban areas provide more than a large pool of available labour, although this is clearly a major attraction. They are also the nation's primary research locations (in the US at least).
- A large study of the US machinery industry (Rees et al., 1984) examined use of programmable manufacturing technologies in 628 plants:
 - Concluded that proximity to the source of an innovation was a key determinant of the likelihood to adopt
 - Particularly apparent for smaller plants
 - Larger plants often have internal resources that could substitute for the advantages of proximity
- Unfortunately, while these studies demonstrate the advantage of urban agglomeration, they beg the question of exactly *which* urban resources prove most important to the spread of innovations.
- Research concerning the magnitude of the effects of access to various information sources and to suppliers' technology services, relative to the more frequently studied labour resources, would be especially valuable.

8.1.3.3. *Government Regulation*

Government regulatory activity may impose operational *constraints* and *costs on industry*, which often induces a search for technical alternatives to current practice.

Sometimes regulation incorporates an explicit technology requirement. For example:

- Pollution-control equipment for coal burning power plants was mandated by the Environmental Protection Agency
- The Occupational Safety and Health Administration spelled out specific requirements for the protection of workers doing lead-based welding in auto assembly plants.

However, regulations can also codify existing practice – in effect introducing substantial barriers to innovation in affected industries.

Examples of industries where regulation has discouraged the adoption of innovations include:

- **Agriculture** (Ulrich et al., 1987):
 - Canadian Government graded and licensed the varieties of wheat that will be sold on the export market.
 - Regulations benefitted Canadian farmers – Canada gained reputation as a consistently high-quality grain supplier.
 - In 1974, Canadian agronomists developed new variety of wheat that can increase yields in low-rainfall West Canada by as much as 30%.
 - Government refused to license product for export until 1985.
 - Authors estimated this delay resulted in substantial revenue loss for Canadian prairie farmers and discouraged developmental R&D on other grains.
- **Home construction** (Quigley, 1982):
 - Local zoning regulations and building codes placed restriction on materials, on performance characteristics of components and fixtures, and on general building methods.
 - New materials and approaches had to be explicitly approved by local officials before they could be incorporated into new construction.
 - Found huge variance in rates of diffusion of housing innovations across local jurisdictions and were able to tie those differences to local regulatory treatment.
- **Banking** (Haywood, 1979):
 - Survey of 1700 banks found banks located in states that restrict branch office banking were less likely to offer computer-based services to their customers.
 - Explanation (often echoed in literature on regulation) was: whether intended or not, branch banking restrictions protect the industry from competition and may thus lower incentives to innovate.

In the areas of Health, Safety and Environment – evidence suggested that regulation has stimulated innovation.

- For example: Rickson and Ramsey (1985) looked at the diffusion of pollution-control technologies in 102 industries.
 - Found the amount of contact between managers and regulators (interpreted as the stringency of enforcement) was positively associated with the likelihood of adoption.
 - Whether regulation stimulates environmental and safety innovation is not a major topic of research.
 - More important was which regulatory mechanisms were most effective at promoting the search for innovative solutions.

8.2. Appendix B – Table of Examples of Empirical Technology Adoption Studies That Utilise the TOE Framework or Related Theoretical Basis

Study	Field & Context	Model	Methodology	Variables	Instrument Items		
Meyer & Goes, 1988	Organisational assimilation of innovations in healthcare Multiple mechanical innovations diffusing into use in hospitals in large midwestern US city & its surrounding rural area.	Own model (built on work that led to TOE framework).	Field interviews, questionnaires, organisational documents, and secondary sources.	Environmental: urbanisation, affluence, federal health insurance. Organisational: hospital size, complexity, market strategy. Leadership: CEO tenure, CEO education, Recency of staff's medical education. Innovation: risk, skill, observability. Innovation-decision: compatibility, CEO advocacy	Organisational attributes: experts rated hospital market strategy on 4-point scale: (1) dominate niches in stable markets (2) serve traditional market with additional services to remain viable (3) incorporate innovative programmes but preserve base of traditional services (4) pioneers in developing innovative services and programmes. Environmental variables: <i>Did not utilise instrument items: calculated via other means</i>	Innovation attributes: 7-point scale to rate innovations: <u>Risk:</u> degree of safety and efficacy (measured by medical professionals). <u>Skill:</u> extent of specialised expertise or training needed for typical specialist to begin using treatment. <u>Observability:</u> Authors decided that visibility of innovation largely depend on its impact on patients flows, so they measured by who / what must be transported to use the innovation: (1) patient specimens, (2) equipment within a hospital, (3) patients within a hospital, (4) patients between hospitals.	Innovation-decision attributes: <u>Compatibility</u> calculated using equation including no. physicians on staff directly using innovation, no. of staff who generated regular referrals to the innovation use, no. of staff who generated infrequent referral to the innovation. <u>CEO advocacy:</u> personal position on innovation (support, oppose, neutral), amount of power used in decision-making: (high, med, low).
Gangwar, Date, Ramaswamy, 2015	Technology adoption e-commerce Determinants of cloud computing	Integrated TAM-TOE model.	Questionnaire collect data from 280 IT companies. Analysed using exploratory and	Technology: relative advantage, compatibility, complexity. Organisation: organisational competency, training	7-point Likert scale across all. Technology: <u>Relative advantage:</u> Using cloud computing we: pay only for what I use, are able to scale up our requirement when required, can	Organisational: <u>Organisational competency:</u> Company hires highly specialised or knowledgeable people for __, sufficient tech resources to implement __, allocate a	Environmental: <u>Trading partner support:</u> Our agreement with __ service providers ensures that they have high availability architecture, and tested

Study	Field & Context	Model	Methodology	Variables	Instrument Items		
	adoption in IT companies (India).		confirmatory factor analyses.	<p>and education, top management support.</p> <p>Environmental: competitive pressure, trading partner support</p> <p>Perceived usefulness</p> <p>Perceived ease of use</p>	<p>access information from any time / place, can access shared resources placed in cloud, need not maintain IT infrastructure</p> <p><u>Compatibility:</u> In case of incompatibility issue ask service provider to provide integrated services, service is compatible with existing tech architecture of company, customisation is easy, Changes introduced by ___ are consistent with existing practice, incur re-training costs if ___ is not customisable</p> <p><u>Complexity:</u> ___ is flexible to interact with, ___ exposes to vulnerability /breaking down or loss of function, using can take up too much time</p> <p>TAM: <u>Perceived ease of use:</u> Procedure of using ___ is understandable. It is easy for us to learn to use ____. It is easy to make use of ____.</p>	<p>percentage of revenue for ___</p> <p><u>Top management support:</u> Management shows culture of enterprise-wide info sharing, company top m provide strong leadership and engage in processes, top m likely to consider ___ as strategically important, top m willing to take risk in adoption of cloud computing</p> <p><u>Training and ed:</u> My level of understanding was substantially improved after going through training on ___, company provided me complete training in using ___, training gave us confidence in use of cloud computing</p>	<p>platform and applications for readiness of services</p> <p>Our org. ensures that ___ provider considerably invest in security controls and monitoring of access to the contents.</p> <p>Check whether service provider has policy for handling personal ID information.</p> <p>Ensure that cloud vendors implement strong access and identity management to ensure no unauthorised access to cloud computing.</p> <p><u>Competitive pressure:</u> We aware of ___ implementation in our competitor organisations We understand the competitive advantages offered by ___ in our industry.</p> <p>Adoption intention: Overall, I think that using ___ is advantageous. Overall, I am in favour of using the cloud computing services.</p>

Study	Field & Context	Model	Methodology	Variables	Instrument Items		
					<u>Perceived usefulness:</u> Using __ allow me to: manage business operation in an efficient way; increase business productivity; enables allow me to accomplish my organisational task more quickly; improves quality of business operation; advances my competitiveness		
Chau & Tam, 1997	Technology adoption of Open Systems in Hong Kong: IT companies, senior IS executives.	TOE framework.	Face to face interview using a questionnaire. 300 senior executives found using major IT vendor and Hong Kong section of <i>Asian Computer Directory 1992</i>	Technological Perceived barriers, perceived benefits, <i>perceived importance of compliance to standards, interoperability, and interconnectivity</i> Organisational Satisfaction with existing systems, <i>complexity of IT infrastructure, Formalisation on system development and management</i> Environmental <i>Environmental uncertainty</i>	Technological <u>Perceived barriers:</u> (1) high cost for migration, (2) existing IS personnel only familiar with proprietary systems, (3) unfeasible to dispose of existing systems. <u>Perceived benefits:</u> (1) no longer constrained by existing systems, (2) more choice for hardware and software, (3) better utilisation of IT resources, (4) promote flexibility & integration, (5) allow transparent data access. <u>Perceived importance of compliance to:</u> standards; interoperability; and	Organisational <u>Satisfaction with existing systems:</u> (1) does existing system serve needs of company, (2) satisfied with price/performance of your system. <u>Complexity of IT infrastructure</u> (measures degree of heterogeneity of IT environment): (1) number of mainframes, (2) number of distinct operating systems, (3) number of PCs, (4) number of applications, (5) number of additional applications needed over next 12 months, (6) number of apps currently used in organisation.	Organisational cont. <u>Formalisation on systems development and management:</u> counted number of formal policies or standards being used in organisation then normalising the result Environmental <u>Market uncertainty:</u> describe (1) market for their company's products, (2) the competition for their company's products, (3) the demand of their major customers, (4) the degree of loyalty of major customers, (5) frequency of price-cutting in their industry

Study	Field & Context	Model	Methodology	Variables	Instrument Items		
					interconnectivity – rate importance of those 3 items from 1 (no importance) to 7 (extremely important)		
Grover, 1993	Adoption of Customer based inter-organisational systems (CIOS) – senior IS executives.	TOE framework with added factors of ‘Policy’ and ‘Support’.	Survey via questionnaire. Respondents from sampling Corporate 1000 directory and list of subscribers to CIO magazine. >1000 mailed, 226 responses.	IOS (Technological) Compatibility, Relative advantage, Complexity Organisational Centralisation, Formalisation, Integration, Size. <i>IS related organisational factors</i> : strategic planning, implement. planning, infrastructure. Environmental <i>Industry</i> : maturity; competition intensity, info intensity, adaptable innovations. <i>Customer</i> : power, vertical coordination	All items assessed via 7-point scale: strongly disagree - strongly agree. IOS (Technological) <u>Compatibility</u> : A CIOS consistent with our beliefs and values; Attitudes toward a __ in our org. have always been favourable; A CIOS is compatible with our: telecommunication infrastructure, computerised data resources, experience with similar systems. <u>Relative advantage</u> : Lower inventory costs; Quick data capture and analysis; Export of data entry work to customers; More control and coordination of customer activities; Easier transmission of sales and service messages; Cross-selling of additional products through the	Organisational <u>Centralisation</u> : Participation of subordinates in org. decision-making is encouraged; Little action can be taken until superior approves decision; Person who wants to make own decisions will be quickly discouraged here; There is frequent participation of subordinates in decision on the adoption of new policy <u>Formalisation</u> : A person here has the freedom to organise work as desired; Most people here make own rules on the job; Employees are constantly being checked for rule violations; Comprehensive rules exist on all routine procedures and operations. <u>Integration</u> : Joint dev. of projects occurs frequently with other depts.; apps are often shared	Policy: <u>Technology policy</u> : Employees are encouraged to actively participate in trade or professional orgs; Most professionals in our company hold at least a master’s degree; Our org: has long tradition of being first to try new methods and techs, spends more than others in the industry in dev of new tech products, actively recruits best tech personnel, keeps abreast of latest tech developments; There are individuals who can be identified as technical gatekeepers in our org. <u>Customer interaction</u> : Our org: engages in extensive market & customer research, is actively involved in building and

Study	Field & Context	Model	Methodology	Variables	Instrument Items		
				Support factors Top management support, Championship Policy factors <i>Environmental Interaction:</i> technology policy; customer interaction; competitor scanning. <i>Competitive strategy:</i> generic strategy, role of IT. <i>Management risk position</i>	system; Extended market reach; Lower distribution costs; Easier market analysis; More difficult for customers to change suppliers; Improved customer service; Reduced customer costs in searching for alternative products; Easy extension of services; Elimination/reduction of paperwork. <i>Complexity:</i> We believe that a CIO is: complex to use, development is a complex process. Environmental <i>Industry Maturity:</i> Our major product/service is in which of the following phases of its lifecycle: intro, growth, maturity, decline? <i>Competition intensity:</i> There is tough: price competition in our industry, competition in our industry based on product/service quality or novelty. <i>Information intensity:</i> The product/service in our industry:	between depts.; Our org encourages exchange of ideas between depts.; Data are often shared between depts.; Projects are often initiated through joint interaction between depts. <i>Size:</i> not questionnaire items, <i>found using:</i> Revenue, Size related to industry; and Number of employees <i>Strategic planning:</i> IS management is constantly involved in Business Planning; Competitive Strategy is considered in IS planning; Top Management is actively involved in IS planning; Continuous assessment of info techs in IS planning <i>Implementation Planning:</i> There are always formal goals for IS projects; Existing formal procedures for IS project planning and selection hinder rapid dev; Rules are ignored and informal agreements are reached to handle some situations during IS	maintaining direct customer contacts, has policy of being responsive to customer needs; Customers are considered an important source of new ideas <i>Competitor scanning:</i> Our org actively keeps abreast of new/ innovative use of tech by competitors; Competitors moves are monitored closely; Info on competitors is considered important for decision-making. <i>Generic Strategy:</i> Which of following forms of competitive advantage does your firm actively pursue: differentiation or cost advantage? <i>Role of IT:</i> which describes role of IT in your org: Traditional, evolving or integral role <i>Management Risk Position:</i> The extent of <i>organisational risk</i> reflected by top management's willingness to accept changes in org structure, work force composition, skills, etc that may

Study	Field & Context	Model	Methodology	Variables	Instrument Items		
					<p>generally requires a lot of info to sell, is complicated or complex to understand or use; The ordering of products in our industry by customers in generally a complex process; Products in our industry are characterised by a long cycle time from order to delivered product.</p> <p><u>Adaptable innovations:</u> the no. of operational CIOS's existing in your industry that you are aware of is approx. ____</p> <p><u>Customer Power:</u> Customers in our industry generally purchase in large vol.; It is easy for customers to change suppliers; Products/services offered by other firms are similar to ours.</p> <p><u>Vertical coordination:</u> The firms in our industry and their customers strongly depend on each other and therefore have a natural propensity to coordinate</p>	<p>project planning; A formal cost-benefit analysis is always conducted for IS projects; IS project selection always involves many checks and approvals.</p> <p><u>Infrastructure:</u> We have broad based implementation of telecoms tech to most groups in our org; We extensively share our databases for various apps, rather than a separate database for each.</p>	<p>result from a decision is ____; <i>management risk</i>, reflected by top M's willingness to absorb techs, hard & software, with which the org is unfamiliar is ____; <i>financial risk</i>, reflected by top management's willingness to commit large investments in new applications or network designs is ____.</p> <p>Support:</p> <p><u>Championship:</u> is/was there one individual who enthusiastically championed the dev of a CIOS for your org - If yes, provide the person's: level in org, knowledge of IT, knowledge of market, dept the person is a member of.</p> <p><u>Top Management. Support:</u> Top management is interested in the implementation of a CIOS, considers a CIOS as important to the org, has effectively communicated its support for a CIOS.</p>

Study	Field & Context	Model	Methodology	Variables	Instrument Items		
Kuan & Chau, 2001.	Adoption of Electronic Data Interchange (EDI) technology into small firms in Hong Kong.	‘perception-based’ model using TOE framework.	Data from 575 small firms in Hong Kong, Survey questionnaire administered to either ‘owners’ or ‘top managers’ of the organisations. Items used Likert scale 1-7 (with differing anchors).	Technological <i>Perceived technological benefits</i> (direct and indirect) Organisational <i>Perceived organisational resources</i> : financial cost; technical competence Environmental <i>Perceived environmental pressure</i> : industry pressure; government pressure	Technological (‘strongly disagree’ to ‘strongly agree’): <u><i>Perceived direct benefit</i></u> : improve data accuracy; improve security of data; improve operation efficiency; speed up application process; reduce clerical errors. <u><i>Perceived indirect benefits</i></u> : improve org. image; improve competitive advantage; benefit other business practices; improve customer services; improve relationship with business partners	Organisational: <u><i>Perceived financial cost</i></u> (‘strongly disagree’ to ‘strongly agree’): high set-up costs; high running costs; high training costs. <u><i>Perceived technical competence</i></u> (‘very bad’ to ‘very good’): Performance in providing IT support; Experience in supporting EDI software; Expertise in supporting EDI software.	Environmental (‘no influence at all’ to ‘very strong influence’): <u><i>Perceived industry pressure</i></u> : Requested by important business partners; Requested by majority of business partners; Recommended by important business partners; Recommended by majority of business partners; Important competitors using or soon to be using __; Majority of competitors using or soon to be using __. <u><i>Perceive government pressure</i></u> : Progressive mandatory measures introduced by the gov. (e.g., cessation of diskette submission scheme); Closing of paper-receipt counters by March 2000.
Lee and Shim, 2007.	Adoption of Radio frequency identification in the healthcare industry in USA.	Developed own model based on TOE.	Survey questionnaire to 865 US hospitals (web survey). Majority of Items asked level of	‘Technology Push’ (Technological) Perceived benefits; Vendor pressure	‘Technology push’ (Technological) <u><i>Perceived benefits</i></u> : Overhead cost reduction; Reduced error rates; Improved customer service;	(Organisational) <u><i>Presence of Champions</i></u> : RFID has no strong advocates in our hospital; There are one or more people in our hospital who are	‘Need pull’ (Environmental) <u><i>Performance gap</i></u> : Our employees are well satisfied with the existing inventory tracking system; Our employees

Study	Field & Context	Model	Methodology	Variables	Instrument Items		
			disagree/agree on 7-point Likert scale. Some items in form of open-ended questions. Subjects are decision makers within the Org. (e.g., CEOs, CMOs, CIOs, CTOs).	‘Need Pull’ (Environmental) Performance gap; Market uncertainty Organisational Presence of champions Moderator variables (also Organisational) <i>Organisational readiness:</i> financial resources; Technology knowledge ‘Dependent variable’ Likelihood of adopting RFID (Radio frequency identification)	Improved hospital image. <u>Vendor Pressure:</u> Please rate the pressure that vendors place on your hospital to adopt RFID; Please rate the amount of influence vendors, which are / are not (2 items) currently providing IT applications, have in your organisation’s decision whether or not to adopt RFID	enthusiastically pushing for RFID; Nobody in our hospital has taken the lead in pushing for RFID. Moderator variables (also Organisational?) <u>Financial resources:</u> Our org. has the financial resources to adopt RFID; In context of your org.’s overall systems budget, how significant would be the cost of dev. and implementing RFID technology? <u>Technology knowledge:</u> We have very little knowledge about how RFID would be used in our hospital; we might use RFID sooner if we knew more about what it could do for our hospital; We do not have the technical knowledge and skills to start using RFID.	are well satisfied with the existing patient identification system; Our patients are well satisfied with the existing patient identification system <u>Market uncertainty:</u> The competition among hospitals is very intense; the frequency of cost-increase in the healthcare industry (what?).
Mishra, Konana & Barua, 2007.	Internet use in two stages of procurement process (‘search’ stage and ‘order initiation and	Used TOE framework and ‘Resource-based view’ work to build	Survey data from 412 US firms. Mail survey developed from lit rev and	The TOE variables are ‘antecedent’ constructs to the rest of their model	All items use 7-point Likert from “strongly disagree” to “strongly agree” unless stated otherwise Technological <u>Procurement process digitization:</u>	Organisational <u>Diversity of managerial procurement knowledge:</u> Our production goods (raw materials) have a complex electronic or	Environmental <u>Suppliers’ sales-process digitization:</u> Our suppliers have computer systems in place to quickly respond to our product

Study	Field & Context	Model	Methodology	Variables	Instrument Items		
	completion' [OIC stage) in US manufacturing firms across four industries.	own research model. Model goes a step beyond adoption research looking at actual amount of use in firms and the performance of the firm in using the technology – those variables noted here as 'other'.	interviews with relevant individuals. Most items 7-point Likert scale. Variables that go beyond adoption research use different approach (percentage scale: amount of internet use for specific tasks).	<p>Technological: Procurement process digitization.</p> <p>Organisational: Diversity of organisational (managerial) procurement knowledge; Organisational perceptions of environmental uncertainty (technological and volume)</p> <p>Environmental: Suppliers' sales-process digitization</p> <p>Other variables: Internet use in Search and OIC and firm performance; Internet use in Search and OIC</p> <p>Dependent variable Procurement process performance</p>	we share procurement-related information electronically within our firm; Our firm has automated the ordering process for production goods (raw materials); We depend heavily on paper documents during the entire procurement process; Our procurement application is highly integrated with other applications (e.g. inventory, logistics, manufacturing)	mechanical assembly of raw materials; Overall specifications for the production goods we procure are simple; A large number of our production goods are custom designed to our specifications. <u>Organisational perceptions of technological uncertainty:</u> Functionality improvements are very likely in our production goods; Major product innovations are very likely in the products we procure; Major manufacturing innovations are very likely in our production goods <u>Organisational perceptions of volume uncertainty:</u> Volume requirements for our production goods are predictable; Our volume estimates for production goods are reliable; Our firm experiences frequent over-	enquiries; Our suppliers can electronically process business documents; Our suppliers have computerised their order-management process. Other variables (measured by rating percentage use) <u>The extent of internet use in Search:</u> Product search on the internet; Identification of new suppliers on the internet <u>The extent of internet use in OIC:</u> Negotiations of terms with suppliers on the internet; Completion of procurement transactions on the internet; Payment and financial settlement on the Internet; Document exchange on the internet. <u>Metrics of procurement process performance:</u> Reduction in production goods procurement costs; Reduction in lead time; Reduction in administrative expenses;

Study	Field & Context	Model	Methodology	Variables	Instrument Items		
						stocking or under-stocking of production goods.	Reduction in the time to transmit change orders.
Ramdani, Kawalek & Lorenzo, 2009.	Adoption of enterprise systems (ES) (such as ERP, CRM, SCM and e-procurement) in SMEs (Small-medium enterprises) in Northwest England in manufacturing, retail/wholesale and service industries.	Used the TOE framework to develop their own model.	Direct interviews of random sample. 102 responses analysed. Instrument not available from paper but there is a table to show how variables were operationalised.	Technological Relative advantage; Compatibility; Complexity; Trialability; Observability Organisational Top management support; Organisational readiness; IS experience; Size Environmental Industry; Market scope; Competitive pressure; External IS support Dependent variable SME's adoption of ES (decision to adopt or reject)	Technological: <u>Relative advantage, Compatibility, Complexity, Trialability; Observability:</u> Measured via multiple items from the source "Moore and Benbasat (1991)"	Organisational: <u>Top management support:</u> Measured via multiple items from "Yap et al. (1994)". <u>Organisational readiness:</u> Measured via multiple items from "Grandon and Pearson (2004)". <u>IS experience:</u> Measured with 3 point ranking scale: 1 = Low IS users, 2 = medium IS users, 3 = High IS users. From "Southern and Tilley (2000)" <u>Size:</u> Measured via number of employees with 3-point scale: 1 = 0-9, 2 = 10-49, 3 = 50-249. From "Dept. of Trade and Industry (2004)", "European Commission (2003)".	Environmental: <u>Industry:</u> Measured with 3 points: 1 = manufacturing, 2 = retail/wholesale, 3 = Services. From "Goode and Stevens (2000)". <u>Market scope:</u> Measured on 4-point scale: 1 = Local, 2 = Regional, 3 = National, 4 = International. From "Buonanno et al. (2005)". <u>Competitive pressure:</u> Measured via multiple items from "Premkumar and Roberts (1999)" <u>External IS support:</u> Measured via multiple items from "Yap et al. (1994)".

8.3. Appendix C – Interviewee Participants’ Career History and Experience

Interview Participant	Career History and Experience
B	PhD life science and health innovation; Welsh university; work in Intellectual property sector in health and life sciences innovation; publicly funded health innovation commercialisation and support project for Wales; health policy think tank programme lead; Wales/UK; 5+ years.
C	Nursing & midwifery; Women's health; marketing and policy in health service and private sector; small, medium and large pharmaceutical companies; UK and EU roles; non-exec director for public funded body for innovation and collaboration between industry, health, social care, and academia; Independent Management consultant life sciences; 20+ years total experience.
D	PhD knowledge economy Wales; Professor in Business in Welsh university; innovation management and regional economic development; work on interaction between academia and industry; knowledge and technology transfer; innovation policy and practice; health and life sciences work; Intellectual property and commercialisation initiative; head of health innovation commercialisation and support project for Wales; work with public funded body for innovation and collaboration between industry, health, social care, and academia; Wales/UK; 20+ years total experience.
E	Background in investment 20+ years; business specialised in healthcare and life science venture investing, UK focused innovation funding; set up own business still with focus on healthcare and life sciences; PhD on investment in UK healthcare and med-tech innovation.
F	PhD health planning: health policy think tank; experience in health systems, adoption and spread of innovation, health workforce development; psychology background; UK/Wales; 20+ years total experience.
G	PhD neuroscience; Welsh university; joint industry/academia projects; experience in healthcare, innovation, industry engagement; Wales/UK; 5+ years’ experience.
H	General hospital physician; non-profit organisation transformation of health care systems worldwide by measuring and reporting patient outcomes in a standardised way; National clinical adviser for NHS Wales in area of value-based health; private organisation for promotion of adoption for value-based health; work with large pharmaceutical companies; UK/International/Wales; 10+ years’ experience.
I	25+ years in commercial corporate sector mainly automotive industry; 10+ years in Welsh university director of business development and innovation - area of health.
J	Public health consultant, national and international programmes 40+ years’ experience; Welsh government 20+ years health policy; public health policy think tank; Professor Welsh university innovation.

Interview Participant	Career History and Experience
K	PhD laser tissue-interaction, background engineering, physics, electronics; 20+ years' experience academia; recent programmes health transformation, value-based healthcare.
L	Orthopaedic surgeon, China/UK; PhD and post-doc regenerative medicine; 10+ years Welsh university - regenerative medicine; 30+ years total experience.
M	General practitioner, Wales, 20+ years; interest in lifestyle medicine.
N	General practitioner, Wales, 30+ years' experience; no specific specialist interest, GP trainer.

8.4. Appendix D – Interview Questionnaire Framework: Adoption of Innovation in Healthcare in Wales.

The following document contains notes and prompts to guide the semi-structured interviews for this research.

The data will be captured into six broad categories of factors: Individual, Peer, Professional, Institutional, Policy, and Regulatory. There may be some overlap between categories, and the categories and factors within them are not fixed or rigid: should the conversation cover ground not anticipated, that will also be incorporated into the final data capture.

Beginning the interview

Housekeeping: *First introduce the study and what it is about:*

"My name is Harry Bell; I am a Post Graduate student at Swansea University School of Management. I have asked you here today to participate in my research as you have been identified as someone who would have insight into the topic being discussed."

"This study is looking at the adoption of innovations into **healthcare in Wales**, [but the UK and international examples are welcome]. The aim is to identify and understand the potential barriers to, or facilitators of the adoption of innovations into initial and wider use."

"In this discussion I will be asking you about your thoughts and experience with innovations in your own work as well as that which you have observed or perceived about the process of innovation in general."

"The format is semi-structured around a few themes that have previously been identified, however the discussion can go in any relevant direction. We have around 60 minutes to discuss."

"The interview will be recorded so that I can transcribe and tabulate the data, but other than that it will not be used for anything, and everything will be anonymised".

"Innovation"

I am defining an "innovation", for the purpose of this study, as any technology, medicine, process, or other product that is being newly implemented into use into healthcare. The innovation can be completely novel or may have existed for some time but has not been implemented into use yet in practice (in your organisation for example)."

PRESS RECORD

Demographic information

- **What is you work/career history/background?**
 - **What is your current job title and field of work?**
 - **How long have you held this position?**
 - **How long have you been in the field?**
 - **Which region and country do you work in?**
 - *(If required)* **What was your previous job title and field of work?**

Kick off questions

Use these to get the ball rolling and identify examples that we can talk around, return to them as required.

- **Is there anything you are currently working on that you could identify as an innovation you are trying to have adopted? *If not:* Can you give me an example in the past of an innovation you tried to get adopted?**
 - **What was it for?**
 - **Was it successful in your opinion?**
 - **What is the status of the innovation now?**
 - **How do you think it benefitted/improved existing practice?**
- **Have you got any more examples of innovations that you have worked on/with?**

Allow detailed and nuanced answers that remain on topic.

Then follow-up with and ask questions about influences on successful and unsuccessful adoption:

- **Why was the innovation successful/unsuccessfully implemented?**
- **How did X affect Y?**
- **What influences adoption of innovation? (General and specific)**
- **What worked? What didn't work?**

- **What worked in past?**
- **What was most important/critical influence on adoption?**

Essentially, who, what, when, where why and how questions to follow-up.

***Note:** Always try to glean the effect any certain factor had on the innovation, whether positive or negative with relevant follow-up questions, e.g.:

- **How did that affect/influence the adoption of ____?**
- **Did that act as a barrier/facilitator to adoption in your opinion?**
- **How important an influence do you think it was/is?**

***Note:** Try not to lead them in questioning, be open. Let interviewee speak about topic as much as possible unprompted. If certain topics are missed, you can try out some more framed questions below to see if they have any views on them.

Themes that can be explored to guide discussion

Draw on these themes if interview is not covering topic holistically or with enough detail. It is not necessary to draw on all of them, or ask all questions, they serve to guide conversation as necessary.

Personal/Individual

This theme includes any question about the person being interviewed, their experiences and thoughts. Potential examples include:

- **What did you think about ____?** *(General)*
- **How long have you been trying to implement ____?** *(Length of time conducting innovations)*
- **How long have you worked in innovation?** *(Length of time conducting innovations)*
- **What do you think has worked well in the past regarding innovation?** *(Positive experience of innovation)*
- **Do you think you had to take on a significant risk in implementing ____?** *(Attitude to risk)*
- **How risky do you think it is in general to try and change existing practice?** *(Change existing practice)*
- **Do you think there would be a negative impact on your career if ____ was unsuccessful?** *(Fear of failure)*
- **How close was your working relationship with 'innovator'?** *(Access to innovator?)*
- **Was the innovator able to be present when you were trying out ____?** *(Presence of innovator at test)*
- **How much benefit did you think ____ would provide?** *(Perceived credibility of innovation)*
- **How did you perceived the evidence surrounding ____ before you implemented?** *(Perceived credibility of innovation)*
- **How much do you think it could damage your career if you tried and failed to implement innovation?** *(Risk to career of failed innovation)*

Peer/Social

This theme includes questions about the interviewee's direct network, work relationships, peers and social influences etc. Potential examples include:

- **How do people influence innovation adoption?** *(general)*
 - Peers, colleagues, network etc
- **How would you describe the team that worked with ____?** *(General)*
- **How did your colleagues react to ____ / what did your colleagues think about ____?** *(General)*
- **What was the reaction of peers to ____?**
- **Can you think of examples where colleagues have tried and failed to implement innovation?** *(Negative experience of innovation)*
- **Do you have examples of colleagues who are open to taking a risk on innovations?** *(Peer Attitude to Risk)*
- **How innovative would you say your colleagues are?** *(General)*
- **How pressured do you feel by your peers to keep the status quo?** *(Pressure to conform to group norms)*

- **How much do you think your peers could influence your career? (Related to conducting innovations they don't agree with?)** (*Perceived power of peers over personal career*)
- **Do you think competition in your peer group influences likelihood to innovate?** (*Specialism competitive attitude*)

Organisational/Institution/Professional body

This theme includes questions about the interviewee's views and opinions on how their or another organisation influences innovation adoption. Potential examples include:

- **How (well) does your (or relevant) organisation/professional body/institution support innovation?** (*general*)
- **How do you think your institution perceives innovation?** (*general*)
- **How does organisation influence innovation adoption?** (*general*)
- **How easy it to innovate in your institution (I.e., health service)?** (*Access to innovation*)
 - *Availability of innovation – Similar to above with nuance*
 - *Permission to innovate – Similar to above but regarding more explicit advice/SOP on innovating in institution*
- **Are the facilities/resources/time set aside to innovate in you institution? Were they there for ____?** (*Facility for use for innovation*)
- *Authority and hierarchy/guardianship – How they feel toward the higher-ups in their institution and what they think about innovation. How important is it?*
- *Centralisation/formalisation – How is the organisation structured, how much autonomy given to individuals?*
- *Complexity of issue – How hard is it to implement innovation into institution because of its innate complexity?*
- *Financial and realism – How much money does institution have, how much budget to spend on innovation, how high priority*
- *Ethical process – What is this like in your institution? Barrier, facilitator? What do you think about committee? Fast/slow*
- *Difficulty of re-organising clinical processes – How entrenched current way? How complex? What else would have to change?*
- **Was your organisation/professional body aware of ____?** (*Awareness of innovation*)
- **Did your organisation/professional body promote ____?** (*Promotion of innovation*)
- **Did you received the endorsement of your professional body for ____?** (*Endorsement of innovation*)
- **How does health service view/support/promote innovation?**
- **Can you access training through your professional body if you wanted to implement a new innovation?** (*Availability of training in innovation in general*)
- **Were you able to access training through your professional body if you wanted to implement ____?** (*Availability of training in specific innovation*)
- *Co-morbidities/complexities – What is the innovation treating, is it a complex condition, how does this affect implementing innovation?*
- **How many people were involved in the decision-making process around ____?** (*Multiple decision makers/influences*)
- *Non-logical decision-making - Does it appear that influences other than scientific evidence affected this innovation's adoption?*

Environmental/Policy/Regulatory

This theme includes questions about the interviewee's views and opinions on how the environment influences innovation adoption, including policy/regulatory effects. Potential examples include:

- **What is the healthcare sector/industry like in terms of innovation?**
 - **What is it like in X or Y setting/location?**
 - **How does this influence adoption?**
- **What external influences are there on (the) innovation/adoption?**
- **What is the [Gov] policy/regulations surrounding innovations like yours?**
 - **Is it fit for purpose?**

- **How does it influence innovation adoption?**
- **Ask about interactions between sectors:** e.g. health service, industry, third sector, academia.
- *Endorsement of innovation – Does policy endorse ____? Do regulations support ____? What do guidelines say?*
- *Permission of government to experiment – Does gov give opportunity/permission to innovate? Do they actively block? Turn blind eye? Take no interest?*
- *Perceived Attitude to Risk of authority – How comfortable is policy makers / gov with experimenting or taking a risk on innovation in X or Y field/area?*
- *Protection for clinician/innovator – How protected is clinician/innovator against failure in risk taking, how would Gov proceed in this case, what is policy here?*
- **Who do you trust more, peer advice or policy from Gov?** Policy vs peers/profession (trust)
- *Logical (research) vs illogical/irrational (behavioural and political) – See what seems to guide their actions more*
- *Credibility of NICE/NISCE – What do they think about these bodies?*

Technological/Innovation

This theme includes questions about the interviewee's views and opinions on specific innovations/technologies and how this influences adoption. Potential examples include:

- **How did characteristics of innovation/technology influence?**
- *Any question about characteristics of technology or anything directly related to that*

8.5. Appendix E – Table of Codes Discovered Via Interviews – First Cycle Coding

Code	Description of Code & how it became Code	Evidence (cell range in Master Data Display)
Motivation (why innovate?)	Individuals underlying reasons for engaging and persisting with the innovation adoption.	B5-B7; C5-C9; D5-D11; E5-E7; F5-F8; G5-G7; H5-H7
View of Other Sector	Effect of preconceived notions that an individual holds about a different sector or industry, as it pertains to familiarity with and opinion of that sector, on adoption.	B12; C12-C17; D12-D18; E12-E15; F12-F13; G12-G14
Clear Vision / Culture	Organisational values, culture, or vision relating to innovation and how well does that translate to individuals' behaviour / beliefs.	B19-B21; C19-C21; D19-D21; E19-E20; F19-F22; G19-G21; H19-H25
Alignment (Actors / Objectives)	The extent to which the actors involved in an innovation share an understanding and agree upon objectives.	B26-B28; C26-C30; D26-D31; E26-E29; F26-F32; G26-G37; H26
Networks & Collaboration	Pertaining to the use and extent of networks available to individuals and organisations and how they contribute to collaboration as it relates to innovation.	B38-B42; C38-C44; D38-D42; E38; F38-F42; G38-G52; H38-H41
Leadership	The role of leadership in innovation adoption.	B53-B56; C53-C61; D53-D62; E53-E59; F53-F56; G53-G60; H53-H56
Champions	The role of individuals that champion a particular innovation or innovation process in that innovation's adoption.	B63-B64; C63-C66; D63-D65; E63; F63-F68; G63; H63

Empowerment	The extent to which an organisation or individual empowers individuals to engage in innovation activities.	B69; C69; D69-D73; E69-E70; F69-F77; G69-G74; H69-H74
Boundary Spanning	Individuals or organisations with the requisite characteristics that enable them to draw together organisations and different sectors for the benefit of innovation.	B78-B79; C78; D78-D80; E78-E80; F78; G78-G85
Trust, Reliability, Relationships	The role of trust, reliability, and relationships in innovation adoption.	B86-B89; C86-C89; D86-D91; E86-E89; F86-F94; G86-G98; H86-H87
Demonstration of Value	The communication and demonstration of the evidence base or value or business case regarding an innovation to the potential adopters of it.	B99-B101; C99-C102; D99-D100; E99-E103; F99-F105; G99-G104; H99-H105
Identification & Communication of Need	The extent to which the need for an innovation has been identified and subsequently communicated in order to establish the requirement for innovation in that circumstance.	B106-B111; C106-C110; D106-D110; E106-E111; F106; G106-G111; H106-H108
Experience of Innovation	An individual's experience, expertise, knowledge, skills, and awareness of innovation and the innovation process in general.	B112-B117; C112-C113; D112-D116; E112-E123; F112-F113; G112-G122
Experience of technology	An individual's experience, expertise, knowledge, skills, and awareness of the specific technology or innovation they work with.	C124-C126; F124-F125; G124-G125; H124
Personality	An individual's relevant personal characteristics which influence the success of	B127-B128; C127-C128; D127-D131; E127-E128;

	an innovation and its adoption, for example social skills.	F127-F131; G127-G133; H127
Bureaucracy & Admin	The influence of bureaucratic, administrative, and other related systems on the innovation and adoption process.	B134-B140; C134-C135; D134-D138; E134-E139; F134-F135; G134-G143
Finance & Funding	The role of finance, funding, and other costs in the innovation and adoption process.	B144-B146; C144-C148; D144-D147; E144-E154; F144-F148; G144-G149; H144-H146
Intellectual Property (IP)	The role of intellectual property in the innovation and adoption process.	B155; D155-D157; E155; G155
Organisational Culture and Structure	The effects of the structure and culture of an organisation on the innovation adoption process.	B158-B167; C158-C161; D158-D168; E158-E164; F158-F166; G158-G166; H158-H161
Understanding of Environment	An individual's understanding of the circumstances and setting that they and their innovation are in and how that influences adoption.	B169-B170; C169-C174; D169-D174; E169-E177; F169-F170; G169-G172
Time & Capacity to Innovate	The ability of an individual or an organisation to participate in innovation and adoption based on their time, capacity, or availability due to current volume of work.	B178-B182; C178; D178-D185; E178-E180; F178-F179; G178-G183; H178-H180
Investment in the System	The is time, resource or funding invested in innovation and adoption in the health system.	B186; C186; D186-D191; E186-E187; F186-F189; G186-G189; H186-H190
Attitude to Risk	An individual's and/or organisation's attitude toward taking risks in changing existing practice (i.e., innovating) (risk appetite).	B192-B193; D192-D193; E192-E193; F192-F198; G192-G195

Difficulty to Change Existing Practice / Systems	The capability or capacity of an organisation to change their existing practice, systems, or technology use in order to adopt a new innovation, and the ease or difficult in doing so, e.g., entrenched practices.	B199-B202; C199-C203; D199-D210; E199-E203; F199-F201; G199-G200; H199-H200
Systems and Processes of Organisations	Factors related to characteristics of an organisation's systems and processes which affect adoption of innovation (e.g. procurement systems).	B211-B215; C211-C212; D211-D219; E211-E215; F211-F212; G211; H211-H212
Relationship Between Sectors	How individuals from different sectors are able to relate to and understand each other (e.g., communication) and how that influences adoption.	B220-B223; C220-C223; D220-D225; E220-E222; F220-F222; G220-G226
Local vs Regional vs National	How the spatial scope affects innovation adoption: i.e., local: narrower adoption focuses to a national: broader adoption focus.	B227-B229; C227-C229; D227-D232; E227-E228; F227-F230; G227-G229; H227-H229
Training & Learning	The role of training, learning and knowledge transfer on the innovation adoption process.	B233; C233-C234; D233; E233-E237; F233-F239; G233; H233-H234
Trialability & Testing	How easy or difficult it is to trial, test or pilot an innovation in different areas/circumstances before wider scale adoption is attempted.	B240; C240-C241; D240; E240-E243; F240-F241; G240-G244
Co-Production	The effect of co-production or user-led innovation on the adoption of innovation.	C245-C246; D245; F245; G245-G246; H245
Policy & Regulatory Effects	The role of policy and regulations on the innovation process and the adoption of innovations.	B248-B249; C248-C252; D248-D255; E248-E256;

		F248-F249; G248-G252; H248
Political	The role of political decision-making in the innovation and adoption process.	C258; D258-D266; E258-E260; F258-F259; G258-G261
Crisis (COVID-19)	The effect of an acute event or crisis on innovation and the adoption of innovation (using the example of the COVID-19 pandemic).	B267-B272; C267-C270; D267-D271; E267-E268; F267; H267
Measurements / Metrics	How obtaining and/or presenting relevant measurement or metrics surrounding an innovation influences its adoption.	B273; C273-C275; E273-E275; G273; H273-H278
"People Who Get Shit Done"	The importance of specific individuals with unique characteristics that drive the innovation adoption process. Direct quote from interviewee.	B279-B281; C279-C281; D279-D284; E279-E281; F279; G279-G285; H279-H280
"Getting the Right People"	The importance of acquiring/hiring/working with specific individuals with the relevant characteristics to drive the innovation adoption process. Direct quote from interviewees.	B286; C286-C290; D286-D289; E286-E290; F286-F288; G286-G295; H286-H287
Reputational	How does an individual's and/or organisation's perceived reputational risk in engaging with an innovation and its adoption influence their decision to do so.	B296; C296; E296; F296-F297; G296; H296
Continuity / Retention of Staff	The importance of the continuity and retention of staff in the innovation adoption process.	B298-B299; C298; D298-D300; E298; F298-F300; G298-G299; H298

Incentives	How incentives drive or hinder innovation adoption.	B301-B305; C301-C302; D301; E301-E302; F301; G301-G305; H301-H302
Openness to Change/ Innovation	How does an individual or organisation's openness to change or innovating influence adoption.	B306-B311; C306-C309; D306-D307; E306-E307; F306-F310; G306-G310; H306
Top-Down Plus Bottom-Up	The simultaneous approach of top-down (management-led) and bottom-up (grassroots, employee-led) influence that signifies an organisation has a consistent approach to innovation adoption.	B312-B313; C312; D312; E312-E313; F312-F313; G312-G313; H312-H313
Support & Guidance vs Forcing Implementation	How the type of approach to introducing an innovation affects its successful adoption, i.e., soft (support and guidance given) vs hard (mandating/forcing implementation).	B314; C314; D314; F314-F318; H314-H317
Buy-In of a Few Adopters	How the buy-in of a few individuals influences adoption, i.e., a critical mass of believers which supports adoption...	B319; C319-C302; E319-E320; F319-F320; G319
Communication (General)	How the communication between any relevant parties in the innovation adoption process affects adoption.	C322-C324; D322-D324; E322-E324; F322; G322-G330; H322

8.6. Appendix F – POET Context Coding Display - Second Cycle Coding

Factor	People (P)	Organisation (O)	Environment (E)	Technology (T)	Final shorthand code assignment
Motivation (why innovate?)	✓				P1
View of Other Sector	✓				P2
Clear Vision / Culture	✓	✓			PO3
Alignment (Actors/ Objectives)	✓	✓			PO4
Networks & Collaboration	✓	✓			PO5
Leadership	✓	✓			PO6
Champions	✓				P7
Empowerment	✓	✓			PO8
Boundary Spanning	✓	✓			PO9
Trust, Reliability, Relationships	✓				P10
Demonstration of Value	✓	✓		✓	POT11
Identification & Communication of Need	✓	✓			PO12
Experience of Innovation	✓			✓	PT13
Experience of Technology	✓			✓	PT14
Personality	✓				P15
Bureaucracy and Admin		✓			O16

Finance & Funding		✓	✓	✓	OET17
IP				✓	T18
Organisational Culture/Structure		✓			O19
Understanding of Environment	✓				P20
Time & Capacity to Innovate	✓	✓			PO21
Investment in the System		✓			O22
Attitude to Risk	✓	✓			PO23
Difficulty to Change Existing Practice / Systems		✓			O24
Systems and Processes of Organisations		✓			O25
Relationship Between Sectors	✓		✓		PE26
Local vs Regional vs National			✓		E27
Training / Learning	✓	✓			PO28
Trialability / Testing		✓	✓	✓	OET29
Co-Production	✓				P30
Policy / Regulatory Effects			✓		E31
Political	✓	✓			POE32
Crisis (COVID-19)			✓		E33
Measurements / Metrics				✓	T34
"People Who Get Shit Done"	✓				P35

"Getting the Right People"		✓			O36
Reputational	✓	✓			PO37
Continuity / Retention of Staff		✓			O38
Incentives	✓	✓			PO39
Openness to Change / Innovation	✓	✓			PO40
Top-Down Plus Bottom-Up		✓			O41
Support & Guidance vs Forcing Implementation		✓			O42
Buy-In of a Few Adopters	✓				P43
Communication (General)	✓	✓			PO44

8.7. Appendix G – POET Contexts Coding Interrelationships Matrix Display

[illegible]

8.7.1. Magnitude of Context Interrelatedness

Code(s)	P	O	E	T		P^O	P^E	P^T	O^E	O^T	E^T	P^O^E	P^O^T	O^E^T
Magnitude of Interrelatedness (within and between contexts)	254	226	17	15		120	1	3	2	2	0	0	0	1

8.8. Appendix H – Analysis of All Factors by Context

8.8.1. People Factors

This section describes all codes/factors assigned to the “People” context. In order for a code to be assigned to the People context (either solely or in combination), it was related in some part to individuals, their characteristics, and their views, as well as their direct relationships.

Of the 44 codes, **28** were coded as a People-related factor (includes P-only factors and any P combination factor e.g., PO). This means **63.6 %** of all factors contained a P coding, which is the most frequent coding of the four contexts (see table).

Note: POE and POT factors will be included in “Section 8.8.5. Factors with 3 or more Context codes”.

8.8.1.1. People-only (P) Factors

As shown in the table in Section 4.2.2., there were 9 P-only codes out of the 44 codes (20.5 %), making it the joint second most numerous coding (with O-only factors). Factors which were given P-only code were considered only related to individuals, their characteristics and views and there was not overlap with organisational, environmental or technological considerations.

P-only codes included:

- Motivation (why innovate?)
- View of other sector
- Champions
- Trust, Reliability, Relationships
- Personality
- Understanding of environment
- Co-production
- “People who get shit done”
- Buy-in of a few adopters

The following subsections give a summary of the data that supports each coding as well as the basis for these codes remaining distinct.

8.8.1.1.1. Motivation (Why Innovate?)

This factor was encoded by statements from interviewees that were concerned with individuals' underlying reasons for engaging and sticking with innovation adoption i.e., their personal motivations, and how this may influence adoption. A total of 28 statements by interviewees were recorded under this code.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B5-B7; C5-C9; D5-D11; E5-E7; F5-F8; G5-G7; H5-H7. Examples of interviewee statements which contain this code include:

*Discussing an innovation's adoption: "I don't think it would have gone anywhere. Basically, the culture of academics is they're there for papers. And really not there to create these systems. There still is a very blue sky thinking culture. **The academics and the academic pathways are driven by publications, and grants funding more publications rather than translation into practice**"*

Quote B6

*Discussion an innovation's adoption: "the person developing it wasn't a company, she wanted to see the greater good, she didn't care about Economic impact, revenue streams and so that, in a sense, made it a lot easier and she was just **she just wants to see patient outcomes be better and there was no real economic driver to it**, but then obviously the companies come in and they taking some portion of the IP of this so then that turns into that commercial focus." Quote B7*

Discussion innovation adoption & collaboration in general: "for me success only comes when you reach consensus and one of the really important things is: you have to have the senior clinical leaders on board, because if not you can sometimes get buy-in at

*a board level or a senior level where they really came to drive this forward and can be strong it occurs, but it can all unravel when you operationalise it if you haven't got the clinical team engaged as well, so has to be you know the communication and engagement is really important there's a huge amount of cynicism, as to why would the industry do it, why, why are you bringing this **what's in it for you?**" Quote C9*

*Discussing successful [body that supports innovation] innovation: "we also had the people we had the, not just evangelists, but and you'll probably paraphrase this in any transcripts, but the people who can make shit happen. And also, **people who gave a shit**. So those would be, that was what really made it happen more than any process anything else... ...the other part was having something more than an evangelist – these people could actually effect change." Quote D5*

*Continuing [Redacted] innovation discussion: "The ones we've been engaging with, I would say they are quite a heterogenous in terms of the... Some of them are assistant Director level, some of them are more junior but in a very sort of **passionate, ambitious and can influence within their organisation**. It is more the effectiveness often rather than where they are in the stratum. You know we've got people we engage with (I won't name any names) locally within health board - very senior and they're just chair moisteners - they are part of the problem, not the solution, whereas you can have people who are further down, who can essentially navigate around them." Quote D6*

As can be seen, the rich diversity of how people talked about Motivation provided different perspectives and was influenced by their circumstances. However, the common thread was that an individual needs to be personally motivated to

participate in the adoption of an innovation. In addition, differences in motivation or perceived motivation also appear to influence innovation adoption (this links to Alignment of Actors/Objectives).

Furthermore, as can be seen, the full quotes provide an example of how the multiple factors influencing innovation adoption are spoken about concurrently/simultaneously and are neither wholly positive nor negative (non-binary), i.e. GD: D6. This is true for numerous codes and is expanded upon in Section 6.7-6.9.

8.8.1.1.2. View of Other Sector

This factor was encoded for by statements from interviewees which were concerning how preconceived notions that an individual may hold about a different sector or industry affects adoption, as it pertains to familiarity with, opinion of and willingness to engage with that sector. A total of 23 statements by interviewees were recorded under this code.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B12; C12-C17; D12-D18; E12-E15; F12-F13; G12-G14. Here is an example statement which contains this code:

*Discussing the interaction between public system and private sector: "on that I think there's almost a risk, **some people think: "oh if you let them in the door it is the thin end of a wedge". I think it's better to say well let's come up with the structure or a managed way of doing this, which works, rather than having something which is you know far worse, or not necessarily worse because that's almost implying that them coming in is bad, but I just think we need to find a more sophisticated way of innovations becoming far more collaborative. Whereas, you know, one extreme to kind of you know, user-centric or user-led innovation and you could say that any sort of any treatment or patient engagement is naturally that - the patient is part of the solution or***

*not just somebody who's having stuff done at them. In the same way there to have that ecosystem, where you can say well **let's have the private sector engagement, but in a way which is managed, more maybe sort of open book, I think that's the way to get around it**" D16*

"System leaders don't if they had not encountered the industry regularly and consistently they've still got that you know kind of bias towards you know and as a result of it they'll put up a block yeah and sometimes you just can't overcome that so you have to enter you know so go somewhere else demonstrated and almost allow the advocacy from within the system. I wouldn't I just I mean maybe it's just I get a bit more I'm impatient, as I get older, but I just wouldn't I wouldn't waste my or their time because I could spend the time trying to demonstrate is easier to do that by physically going and showing it through the work we do, rather than being seen as it being rhetoric." Quote C13

Asked to follow up on why innovation lead work in Wales not linking up to industry: "yeah I mean, it's missing industry direct input I'd say, but they need to be at the table I think. the reason they're probably not at the table at the moment is because it's originally developed from how can health boards commercialise research and yeah ended outward, so we can add benefit so that might be part of the scales, how can Hywel Dda develop a nice digital pain management process which jumped over them as well, and we can scale that across the rest of the health boards, because we have found benefit and it's easy, it's digital, it's scalable.

*So that that's one way of looking at it, but **I think that industry have a lot more experience than the health board given credit for in terms of you know, being adaptable and they probably got***

a list of different ways they can engage with different organisations, whereas NHS perhaps and universities might be very, you know, narrow minded to engagement.” Quote G12

These quotes show that participants mentioned and discussed how an individual's perception of other sectors / industries external to their own, in terms of their motivations, their competencies and other characteristics, affected the adoption of innovations. There was a diversity of views highlighted such as health system people viewing private sector as only trying to make money (**“oh if you let them in the door, it is the thin end of a wedge”**) acting as a barrier, or private sector people viewing the health system as unapproachable or fragmented or difficult to engage with also acting a barrier. But there was also mention of individuals who had a more positive view of other sectors and that serving as an enabler to innovation adoption as it enhances the likelihood of working together and working well. So again it is clear that this factor is non-binary and can serve as a barrier or enabler depending on an individual or group of people's views.

This factor also served to capture the interviewees' own views on external sector to their sector. This is in addition to talking about their perception of others' views and how they influence innovation adoption.

8.8.1.1.3. Champions

This factor was encoded for by statements from interviewees that were concerned with the role of individuals that champion a particular innovation (or innovation process) in that innovation's adoption. A total of 18 statements by interviewees were recorded under this code.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B63-B64; C63-C66; D63-D65; E63; F63- F68; G63; H63. Here are example statements which contain this code:

*Discussing things which support adoption: “I think **the roles of champions within organisations is massive.** so if you've got*

someone that's in touch with grassroots but also in touch with management and so on, so forth, to drive that forward and promote the culture internally that's really good." Quote: B64

Note that this interviewee uses the word champion without prompting, this occurred for a number of participants suggesting a common vocabulary. Not every statement which coded for this factor included this, including other words such as “evangelist”, “supporter”, “proselytisers”, “advocates”

*Discussing barriers and enablers to innovation adoption: “"And the other thing I think with driving adoption and which is a barrier as well is if individuals aren't resilient because if they just walk away when they when they encounter one hostile individual or somebody that is sceptical. Then you know you just have to persevere because very often scepticism - **those individuals can become your best advocates longer term** and it's reading that knowing that really. " Quote: C64.*

*Discussing health system: “The NHS should be the most phenomenal adopter of innovation and technology, because it's a readymade opportunity, however, when you when you start looking at it more closely, you realise it is massively fragmented. You realise that the purchasing decisions within each hospital, which is what it constitutes, inside the NHS, is driven with different challenges in each hospital. You realise that, in many cases the **hierarchy of hospitals is run by administrators who have got no idea about innovation & technology. Budget holders don't understand it. Doctors become the proselytisers of technology, but they're distracted by other things, and even then, they probably don't hold the budget for it.**" Quote E63*

All respondents mentioned at least once how individuals that engage with, buy into, support and 'champion' an innovation or technology can influence the adoption of innovations by acting to persuade others or otherwise support or drive the adoption of innovations. These individuals could be within the organisation that is aiming to adopt the innovation (e.g. Doctors who want a new innovation in their practice, or people in more managerial/leadership roles who support innovation) or an external person who has an interest in the innovation (e.g. patients who have interest in healthcare that may become available to them, or individuals that may have an academic interest or professional interest such as those who work in innovation management/support).

In all but one statement, Champions were always discussed as an enabler by participants (being given a green highlight/positive mark), and in the one statement which wasn't coded as entirely an enabler the interviewee did talk about positivity of champions and the negativity of those who do nothing ("chair moisteners"). So this is the first example of a factor which appears to be solely an enabler (i.e. binary factor). However, I would note that the absence of champions could be considered a barrier but interviews may not mention that as it is like mentioning the absence of an elephant in an office: technically true but not really something you need to tell people when talking about an office.

8.8.1.1.4. Trust, Reliability and Relationships

This factor was encoded for by statements from interviewees that were concerned with the role of trust, reliability and personal relationships in innovation adoption. A total of 42 statements by interviewees were recorded under this code, making it the joint third most frequent code (with Networks and Collaboration). It was considered one code, rather than split into two or more, as relationships and trust are considered inherently connected in this circumstance of working together with the adoption of innovations, and they were always discussed together or as one by interviewees. Reliability was one of the key things that built trust and relationships/ the ability to rely on someone was beneficial to the adoption process.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B86-B89; C86-C89; D86-D91; E86-

E89; F86-F94; G86-G98; H86-H87. The following quotes highlight the importance of this code to the interviewees:

“Strong relationships and trust, relationships and trust the biggest one by far - with trust you can do anything effectively” Quote B86

*(When asked how to go about beginning adoption process initially) “In those situations and in **any situation where I've worked over the last 20 years, part of it is relying on the relationships** with all of that is about.” Quote C86*

“So great friends and colleagues across the seven health boards trying to do this, who’ve come together almost quite organically to realise that they've got these common challenges and they're working on them together so IP policy - there's been harmonisation, and this is actually in response to the problem with the example I gave you, they said well actually because the university was involved, the private sector involved, the health board was involved if there's a level playing field and clear rules of engagement and how these things work, IP could be transacted, the project could then be developed, things like state aid and pricing and all these other things could be resolved.” Quote D86

*(Talking about innovators within the health system) “I met some people who innovated whilst they were clinicians and practitioners who innovated while they were in their role, who then...I would say that they faced two things: one they themselves were - if I use the word cocky – sometimes that’s what it takes to be an innovator, [inaudible] and **they didn't have regard for what needed to be done to build relationships**, so they sometimes **didn't do it right**, they’ve also had a lot of **pushback from their colleagues or organisations**, along the lines of “who do you think*

you are, to think you can do better than us?”. So I feel like when you're inside... [mentions they are user-innovators]... They are the ones in the system, who are innovating and they face different challenges, to an external person whose formal role is to innovate, so these guys haven't got a formal role... so [talking about how common it is for other people within system to act as barrier to innovation] I'm going to stick my neck out and say it happens a lot and I think that we see it in terms of them having to be very very strong and we've seen the dips and we've seen and - it's not only to this programme - I saw it before I came here and I saw it in the warnings that get given about standing out as an innovator or coming out as the person who talks about some new stuff. So yeah, so...common as well.” Quote F88

*(Part of discussion about funding barriers) “So financial flexibility or resource flexibility is important and that comes from interdisciplinary working. **People will go out on a limb if they trust you because you've built that relationship with them.**”*

Quote DR: G96

All respondents mentioned numerous times the importance of good/positive relationships and trust and what that can allow you to do when it comes to enabling innovation adoption. The reverse, where if there is disregard for the importance of or poor relationships and trust, was also discussed as a significant barrier to adoption numerous times. This code is clearly significantly important not only by its number of mentions by interviewees but by the fact that the presence of strong relationships, reliability and trusts indicates/implies that other barriers can be overcome (e.g. quotes B86, G96). In addition, a further signifier of its importance was the fact it was linked numerous times to other codes (see Section 4.5, and Appendix K) and its strongest link was Networks and Collaboration (17 links – the most frequently linked pair of factors) (see Section 4.5, and Appendix K for details).

8.8.1.1.5. Personality

This factor was encoded for by statements from interviewees that were concerned with an individual's relevant personal characteristics which influence the success of an innovation's adoption, for example social skills. A total of 25 statements by interviewees were recorded under this code.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B127-B128; C127-C128; D127-D131; E127-E128; F127-F131; G127-G133; H127. The following statement(s) give examples of this code:

(Discussing barriers) "people, [is] probably the most significant so, a challenge, conversely, can be just if personalities don't... you know if you don't build that advocacy right from the start [then that is a barrier]" Quote C127

*(Asking about personality drive in healthcare) "How personality driven is healthcare and more health care than social care, in my view, so yes, **it's all personality driven**, especially when you start to talk about specialist teams who are hard to replace, so all my career: workforce development/ workforce planning world, there's you know, it's going to take you over seven years to replace that person as a minimum, so from that point of view where does this sit. So I think that's you know that's the scary part and also if you're in a part of the country where you can't recruit them easily where does that sit, so you get **scared of upsetting your workforce and health and care is all about workforce, less about technology**, it's 70% [inaudible]. So I think that personality plays a role, but I think this is where the good conversation about culture and supportive environments can actually make a massive difference." Quote: F130*

The following statements give some examples of personality traits that influence innovation adoption:

*(Talking about enablers) “yeah facilitators, so we've already mentioned multidisciplinary within a team and multidisciplinary within a person, so a person who is **agile, adaptable, innovative, and resourceful** that's good, and can speak and **communicate** to a range of stakeholders about who they are, senior [with] boots to the ground, as you say, so people who are you know, engaging really.” Quote G133.*

*(Talking about characteristics of people who do well within innovation) “**Perseverance** would be in there. It comes back to three attributes for anybody who's half decent, which is, I think it was Warren Buffett or Richard Branson said it or they probably both said it, which was their **work ethic, intellect and integrity** and the right combination there, but the people who are generally passionate about the health system, about doing the best for patients - with those motivations, and then the work ethic and the intellect to work it through make it happen. So you know I **wouldn't say any were specialists** or anything, they **tend to be the more generalist** because they can get the subject matter, they can also work the system or reinvent the system, or work around it at least.” Quote D131.*

*(Discussing an example of innovation adoption) “Incredibly clever woman very professional in the field but as with many of the high-end academics **not the most personable**. People that haven't really got awareness of what you have to do take a good idea to commercialise it and get it adopted” Quote B128.*

As can be seen by the statements, the interviewees talked about personalities of individuals influencing adoption a number of times. It was discussed how traits could inhibit or facilitate adoption when interacting with others involved in the process. It can also be seen that often the interviewees talk about personalities of those in different circumstances and how traits may be beneficial or detrimental in those circumstances (such as the innovator, the adopter, or a facilitator or supporter of innovation) (e.g., quote B128, D131). There was also specific mentions of how important people and personalities are in healthcare as a sector (e.g., quote F130).

Some of these references to individual characteristics such as traits and people skills were implied (not necessarily directly mentioning personality – needs a level of inference)

It is clear from the number of codes under the “People” context, and the frequency with which those codes were mentioned by interviewees, as well as the content of interviewees statements (e.g. RC: F130) that people are very important and influential in the adoption process in healthcare & life sciences. Further to this, within the “People” context there appears to be a subset type of individuals who have an even greater influence on adoption and innovation. It became apparent from the ‘Personality’ code and certain others such as “Boundary spanning”, “People who get shit done” among others, that there are certain key people with a selection(?) of characteristics which give them this enhanced ability/influence. These types of people will be discussed in the Discussion Chapter

8.8.1.1.6. Understanding of Environment

This factor was encoded for by statements from interviewees that were concerned with an individual’s understanding of the circumstances/environment that they and/or their innovation will operate within in and how that influences adoption. Also captured under this code instances where the interviewee’s own understanding of the environment was being discussed (often without explicitly saying it, instead it was implied to indicated by what they were discussing). A total of 29 statements by interviewees were recorded under this code.

It should be noted that this code is a 'P-only' code due to the fact that it only strongly relates to the individual's *understanding or perception* of the environment, and not the characteristics of the environment. Therefore it did not also receive an E coding

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B169-B170; C169-C174; D169-D174; E169-E177; F169-F170; G169-G172. The following statement(s) give examples of this code:

*"When I ran for a couple of years, a programme across 16 countries in Europe, to encourage scaling. And I used to describe it to them, I used to say to them that you know, although people will say, well, Italy is different, or you just don't understand Germany is different and we need something different. I used to say to them all look it's a bit like and you'll think this is weird but, like a sausage or it's a bit like beer, you know you all have the concept and you all like sausages and you all like beer, but the ingredients are subtly different and actually that's the **important thing that we need to understand because the pathways in different health systems are different**. You're still treating rheumatoid arthritis or cardiovascular disease or and you're also doing a fantastic job, but they will be **subtly different based on the demographics, based on the infrastructure**." Quote C169*

*(Discussing putting an innovation into a certain healthcare setting where numerous aspects of that environment affected the adoption) "So this App, it was you know was created, worked in terms of an MVP or minimum viable product and you think: well, this is great let's do more of it. Well, that is when it started hitting the barriers, so because there was **already private sector company involved the ongoing development there was an***

*intellectual property dimension to it. Then there was the (inaudible) infrastructure piece, because being digital as well you are bumping straight into systems and not just the local ones you've got but then the ones of other organisations which it now needs to talk across. There's a whole **data governance or information governance piece**, which comes with it.” Quote: D169*

*(During a discussion of the characteristics of the right people for innovation) “The challenge with it is that you often don't know what you're going to need. I think it's understanding in your leadership team that you need to be flexible, and you could find yourself, in the investment world we call it the black swan event, the black swan events is something that isn't supposed to happen. And I think people now becoming much more aware of the fact that these black swan events do happen with actually monotonous regularity, whether that's the shut down to the world due to a pandemic or whether it's the 2008 shock. These things which people say don't happen, do happen. I think the answer your question is, and I sense it pretty quickly when I meet people is if they are just too narrow minded, and they are not prepared to think broadly enough as a management team, are **not prepared to understand that they might face these challenges**. So flexibility, having that flexibility of thought process is the way to overcome.” Quote E177*

These example statements show that understanding the environment in which you are operating when it comes to innovation adoption is an important part of the process. Certain respondents including Interviewee C, Interviewee D, and Interviewee E had more instances of this code than others, but it was recorded at least twice under all interviewees except Interviewee H. Most of the statements did not directly mention the term “understanding the environment”, but often what

the interviewees were discussing was either directly or indirectly regarding this code and how it is influential in adoption. For example, quote C169, which talks about the nuances between different healthcare systems and the importance of understanding how to operate within your specific environment, or quote E177 which talks about “black swan events” as potential environmental events that cause significant changes which need to be understood and navigated.

8.8.1.1.7. Co-production

This factor was encoded for by statements from interviewees that were concerned with the effect of co-production or user-led innovation on the adoption of innovation. A total of 8 statements by interviewees were recorded under this code. and it was one of the least frequently recorded codes (joint third least frequent). This may be due to the very niche nature of the code and the fact that it may be more influential in other parts of the innovation process, rather than adoption.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: C245-C246; D245; F245; G245-G246; H245. The following statement(s) give examples of this code:

*(Asked about how an innovation in healthcare is received differently across the profession) “...And then I think there probably is a smaller group who are concerned by it, because of the patient, but don't necessarily say this, but I think probably it's there, **concerned from the patient empowerment perspective**, but also from the perspective of, if you get this type of data - some people, it's going to show, have poor outcomes and that is potentially then going to affect people's, or the perception could be that it affects people's reputation, that is the reputation of health professionals and the concern there could be if you don't know how the health system will respond. So I think, I can fully understand those concerns and I think that is where, when doing this, it is a wholesale change in culture, which is, of course, using*

the data as a means to support learning and development rather than as a stick.” Quote H245

*(Discussing the interaction between public system and private sector) “on that I think there's almost a risk, some people think: “oh if you let them in the door it is the thin end of a wedge”. I think it's better to say well let's come up with the structure or a managed way of doing this, which works, rather than having something which is you know far worse, or not necessarily worse because that's almost implying that them coming in is bad, but I just think we need to find a more sophisticated way of innovations becoming far more collaborative. Whereas, you know, one extreme to kind of you know, **user-centric or user-led innovation** and you could say that any sort of any treatment or patient engagement is naturally that - the **patient is part of the solution or not just somebody who's having stuff done at them**. In the same way there to have that ecosystem, where you can say well let's have the private sector engagement, but in a way which is managed, more maybe sort of open book, I think that's the way to get around it.” Quote D245*

“And, and then I am still a major supporter of co-production and open innovation, yes, so whatever we can do as open innovation processes, and I think ultimately will help health and care.” Quote F245

Co-production was not mentioned or talked about many times by interviewees, relatively speaking. However, the example statements above show that where co-production approaches are present – or where patient involvement, user-led innovation, or other co-development approaches are present – there is an influence on the adoption of the innovation. Another reason it may have relatively few mentions in the context of adoption of innovations as co-production may be a more

important factor at other parts of the innovation process – this may be true for certain other factors as well (e.g., IP). It is important to remember that this study focuses on adoption so factors that influence adoption are what are being investigated and the relative importance of factors (see Section 4.4, and Appendix J) reflects the relative importance for adoption and no other parts of the innovation process, where some of these less influential factors in the adoption part of the process may be more influential.

8.8.1.1.8. “People Who Get Shit Done”

This factor was encoded for by statements from interviewees that were concerned with the importance of specific individuals with unique characteristics that drive the innovation adoption process and their approach to that process. It was added as a code due to a direct quote from an interviewee (in vivo coding) which captures the type of person that was being referred to in various circumstances. A total of 25 statements by interviewees were recorded under this code.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B279-B281; C279-C281; D279-D284; E279-E281; F279; G279-G285; H279-H280. The following statement(s) give examples of this code:

*“[Redacted] don't have that they just get on and do it and they can turn things around really quickly. so, for me, and I know it's not probably in any textbooks but it's all about, take this with a pinch of salt, because you just can't do in certain aspects, such as relations and stuff but it's sort of a “do it and apologise later” sort of approach is the most of the progressive **in order to get things done**. The amount of time I've wasted, and people have been pissed off going through admin and bureaucracy of large organisations, it's a significant barrier in projects.” Quote B279*

(Discussing successful innovation) “we also had the people we had the, not just evangelists, but and you'll probably paraphrase this

*in any transcripts, but the **people who can make shit happen**. And also people who gave a shit. So those would be, that was what really made it happen more than any process anything else... ..the other part was having something more than an evangelist – **these people could actually effect change**.” Quote D279*

Discussing the kinds of people that innovate: “[me] 'do you think it is luck or do you think it is because these people [innovators/facilitators] are the way they are that you are working with them?')” Well people are the way they are. Yeah I genuinely think it’s because people...they don't need to be...yeah they're doing it for values and reasons for the benefit of not them because trust me when I do it, I don't wait up all hours writing things for other people out of the goodness of my heart for pay, yes it's good to get paid, of course, you need to be paid. But it's not it's not that that takes you from the 35 hrs on your contract up to a 90-hour week, just not because of... well it is because of goodwill I suppose, because it is paying back ain't it. You're thinking that effort that you put in here would pay back in the future either for yourself, for your organisation, for society. I think that's why And that's interesting because I never thought that, internally I've always looked at others and thought why the hell are you up at this time of the night doing this, why are you doing this on a Sunday or Saturday or whatever and I never thought about it like that which is interesting that that's, why is it an interesting question, but I think you hit on it when, it is the right type person. Usually, you can usually tell after a short while, the veneer comes down and there's people who have gone through interviews and hold very high positions claiming to be X, y & z but nobody likes them, nobody wants to work with them and it's because they'd be bad leaders, they'd been bad colleagues. The more I think about it

*is the right people, you surround yourself with the right people
with the shared objective." Quote G284*

Each interviewee had examples of actual individuals, or talked about the characteristics of the type of individual that would fit this coding and spoke strongly about their influence on adoption, as is highlighted by the above interview quotes. As mentioned under 'Personality', there seems to be a subset of individuals who work toward driving one or multiple innovations and their adoption above and beyond the norm. A recommendation would be to empower these individuals and remove barriers from their way to enhance innovation adoption.

Some examples of the characteristics can be seen in the above quotes, but some further examples include: "passionate, ambitious and can influence within their organisation", "get it done and apologise later" mindset, "seeing an opportunity and understanding it", "work ethic, intellect, and integrity in the right combination", "more generalist" than "specialist", "driven", having right "values" and "vision" among others (see quotes).

Another thing to note is that while often these individuals are in leadership positions (including very top leadership), this is not always required to be the case and this type of individual also appear have the ability to navigate around disinterested or unengaged leadership or peers (e.g., quote D280, F279).

Also recorded under this code were some instances where there was a lack of individuals like this, and/or individuals in key positions of influence lacked these characteristics. This was talked about as a barrier to adoption; therefore, this code is also two-way/non-binary.

Also it was noted that in certain instances people like this may act as be a barrier (if they lack certain other traits). For example:

*"I met some people who innovated whilst they were clinicians and
practitioners who innovated while they were in their role, who
then...I would say that they faced two things: one they themselves*

were - if I use the word cocky – sometimes that's what it takes to be an innovator, [inaudible] and **they didn't have regard for what needed to be done to build relationships**, so they sometimes **didn't do it right**, they've also had a lot of **pushback from their colleagues or organisations**, along the lines of "who do you think you are, to think you can do better than us?". So I feel like when you're inside... [mentions they are user-innovators]... They are the ones in the system, who are innovating and they face different challenges, to an external person whose formal role is to innovate, so these guys haven't got a formal role... so [talking about how common it is for other people within system to act as barrier to innovation] I'm going to stick my neck out and say it happens a lot and I think that we see it in terms of them having to be very very strong and we've seen the dips and we've seen and - it's not only to this programme - I saw it before I came here and I saw it in the warnings that get given about standing out as an innovator or coming out as the person who talks about some new stuff. So yeah, so...common as well." Quote F280

8.8.1.1.9. Buy-In of a Few Adopters

This factor was encoded for by statements from interviewees that were concerned with how the buy-in of a few individuals can influence adoption, i.e., if a 'critical mass' of believers is reached does that support adoption and how. A total of 9 statements by interviewees were recorded under this code, making it the 5th least frequently recorded code.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B319; C319-C302; E319-E320; F319-F320; G319. The following statement(s) give examples of this code:

(Asked about collaborative approaches) “a health and care professional to help develop something, unless they’re there at the start, and what I’ve seen on that scenario...so [redacted innovation body] did funding where you can say I’m going to work with this GP practice and help do my innovation and that’s one book and then you get into the scenarios where everything relies on that one GP practice and the innovator thinks they’re generalisable, but they’re not. You end up in that world and .what do I think actually works, I think that you have to find the right person and that person has to find the other people, and I think it’s a network effect that you’re trying to create. **I don’t think you’re trying to convince 20 people, I think you’re trying to convince three or four people who have really good networks and good ways in which they will use their network**, so at some point then, you trust them. You trust that person to say it will work, I will help you. And I partly say that with that exemplar and adoption spread model, that is the exemplar is your path, even when it’s an app and the industry’s involved is the exemplars coming forward and saying “you want to use it this way or I have used it this way”. Okay, so I think that having someone on the inside, that has bought into the process of what you’re trying to achieve, even after you’ve developed it [inaudible - 'that is fine'] If you’re if you’re in industry you’ve got to [inaudible - 'be careful'].

Quote F319

“I think the ultimate thing is **you can’t just change the minds of one or two**, you’ve got to start a movement effectively, it can’t just be bottom-up approaches it’s got to be top-down and bottom-up approaches, where they meet in the middle, if you if you can convince the managers to get and to sort of one point where they’re more open, but you can’t convince the people on the

grassroots – it's not going to happen, and vice versa. If you can convince them both and demonstrate the value when they meet in the middle, to work together that is that's the way, I believe, has to be. And it can't just be grassroots, However anyone says it should be bottom-up, you can't do anything [without management] effectively” Quote B319

“The only other thing is within the organisation if there's somebody that really sceptical but the majority aren't, then you kind of continue, but you just want to be mindful of that. and there is an awful lot I mean I within my own organisation, you have commercial leaders that didn't believe in it, the more you know “what we're going to do on sales in year”, and you have to just be really forensic about you kind of classic stakeholder mapping, you know where who's where's the advocacy you need you know and where are they and where do you need to take them to in order to actually support what you are doing.”

Quote C319

As can be seen by the statements, certain interviewees had an opinion on how many people you are trying to convince when positioning an innovation for adoption and also who you are trying to convince, and how that can influence adoption. Sometimes it was discussed it in a positive way where it acts as enabler if you can get buy-in from a certain amount of individuals and go from there, and sometimes it was discussed as a barrier where too few or the people required would not buy-in to the innovation for whatever reason.

Two of the interviewees did not make any statements which would fit this code, and the rest did not have more than one or two statements which fit this code, again suggesting it is a relatively less important or influential factor when it comes to the adoption of innovations. However, it could be the case that it is just not mentioned in this way much, as there are related codes to this which refer to

individual's that may help drive adoption, such as "Champions" or "People Who Get Shit Done", which seem to be relatively important, therefore the presence of more individuals like this could be inferred to be a positive thing for adoption...

8.8.1.2. People-Organisation (PO) Factors

As shown in the table in Section 4.2.2., there were 14 PO codes out of the 44 codes (31.8 %), making it the most numerous coding type. Factors which were given PO context code were considered related both to individuals, their characteristics and views in addition to organisations and their characteristics. Factors that came under this code did not overlap with environmental or technological considerations.

PO codes included:

- Clear Vision/Culture
- Alignment of Actors/Objectives
- Networks and Collaboration
- Leadership
- Empowerment
- Boundary Spanning
- Identification and Communication of Need
- Time and Capacity to Innovate
- Attitude to Risk
- Training & Learning
- Reputational
- Incentives
- Openness to Change/Innovation
- Communication (General)

The following subsections gives a summary of the data that supports each coding as well as the basis for these codes remaining distinct.

8.8.1.2.1. Clear Vision/Culture

This factor was encoded for by statements from interviewees that were concerned with individual and organisational values, culture, vision relating to innovation and how well that translates to individuals' beliefs and behaviour. A total of 24 statements by interviewees were recorded under this code.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B19-B21; C19-C21; D19-D21; E19-

E20; F19-F22; G19-G21; H19-H25. The following statement(s) give examples of this code:

*(Talking about how the current health system is with respect to professional autonomy) "I think it varies by professional group, so I think most doctors definitely feel, I think this is the case, are generally trying to create new things, a lot of the time. I think they do feel as though they have the ability to do that, and my sense is that it's sometimes less in other health professionals operating within our health system, so I think it's probably good for us to be able to encourage that so that everybody has this feeling, not just the feeling, but this actual autonomy to get on and do things. And I think **the other thing that we, we have to encourage and I think this is the culture**, I think I mean with these cultures do evolve to as, And I think it probably is in a state of evolution. What we obviously don't want is everybody doing their own little things and then you have millions of things and not very much cohesion. And I think then you do need systems – I think these systems maybe could be stronger, but where ideas, of course, are encouraged, but that we are all aware of the fact that we can't do everybody's idea and that's where leadership comes in, of course, that then **hopefully people can coalesce that around a few things that we then drive forwards**. But again, the key bit, I think that is everything, and it comes back to your point about innovation, **everything has to be focused on how is that going to contribute to the outcome**, and we have to measure that to actually see has it actually contributed in the way that we expected to the outcome."* Quote H24

(Discussing leadership) "No, no, I'm getting what you mean. My view is that you can have all the structure, I mean you can have all

the structures in the world, but if you get the wrong... So you **need to be clear on what is the culture that you want** of course, and then once that is clear then you can have all these structures, but if you have the wrong people, particularly in leadership positions, but in general, if you have the wrong people it's going to be very difficult. So I think you need to then **people need to know what the culture is**. And I think, then the **leadership need to embody the values that makeup that culture**, and they need to lead by example, and they need to be steadfast in in that. And then I think people need, then I think you, of course, and when you're building an organisation, then I think of course you can recruit people in - they **know very well what the culture is and what the values are and they need to come in and be selected according to that** and they know that. And I think, of course, you want the structures and incentives in place to... so that **people are rewarded in line with the values and the culture**. So they need to support each other. But you of course really want to get people that that truly align with this ideally, but of course it's very helpful to have the structures and incentives. But of course when you're then changing an organisational culture and particularly a massive organisation, clearly you're going to **potentially have loads of people that don't necessarily align with the evolving values and culture**. And that's where I think **people again need to know what it is and what the vision is and what's going to happen**, and then I think you definitely need the structures and incentives again to align with that, so that people can work according to it. And I think you need to get the key people within key parts of the system or organisation that truly do believe in it and I think, because if you don't have that authenticity people see through it. So I think, but you also have to recognise that not everybody's going to going to truly sign up to it. Which is where the structures

and incentives come in, just to help encourage them to do that.”

Quote H25

The above interview statements show how the vision and culture of the health system affects innovation adoption. The vision and culture’s clarity, effect on individuals, and ability to change also appear important. This factor was talked about by interviewees consistently a number of times, with participant H talking about it more frequently than the other interviewees. Participant H has a background as a clinician and working to promote adoption of a system-wide innovative approach to healthcare.

The statements tend to either discuss the importance of having the right culture in place to support adoption of innovation (i.e., as an enabler) or how the lack of a clear vision or culture acts as a barrier, making this factor also non-binary/two-way.

Occasionally the interviewee did not directly mention the words “vision” or “culture” directly, but they would talk about the concept less directly (i.e. not naming it) so as with other codes where this occurs it was assessed by me and entered under this code if the statement was related to “Culture” or “Vision” and the communication of that, for example see quotes D21 and E19.

8.8.1.2.2. Alignment of Actors/Objectives

This factor was encoded for by statements from interviewees that were concerned with the extent to which the actors involved in an innovation share an understanding and agree upon objectives, and how does this affect adoption. A total of 38 statements by interviewees were recorded under this code, making it the 5th most frequent code (joint with “Experience of innovation”). This code was originally two separate codes: “Alignment of Actors” and “Alignment of Objectives” but as there was almost total overlap and the key thread to the code was “Alignment” of individuals and organisations, it was combined.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B26-B28; C26-C30; D26-D31; E26-E29; F26-F32; G26-G37; H26. The following statement(s) give examples of this code:

*“Shared values it's almost **cultures have to align**. If the industry going in there and saying that you know, this is all about adoption of my product and it isn't thinking about the longer term strategic value thinking about the benefits to patients to the system, then it will undermine itself, and so you know it does require the same **shared ambitions** to, all equally, if all the health system wants is, can you drop the cost of something if the industry is willing, then there's a method you know but you've just got to have an **aligned agreement on what's happening**” Quote C29.*

*(Discussing health system) “The NHS should be the most phenomenal adopter of innovation and technology, because it's a readymade opportunity, however, when you when you start looking at it more closely, you realise **it is massively fragmented**. You realise that the purchasing decisions within each hospital, which is what it constitutes, inside the NHS, is driven with different challenges in each hospital. You realise that, in many cases the hierarchy of hospitals is run by administrators who have got no idea about innovation & technology. Budget holders don't understand it. Doctors become the proselytisers of technology, but they're distracted by other things, and even then they probably don't hold the budget for it.” Quote E26*

*(Asked about challenges in finding networks for innovators)
“Absolutely, and I mean, as another example of an SME that looked to engage the Health Board and ignorance sometimes for SMEs is bliss. Because they're in the “real world”, as they would define it, they would argue we know best we're more fleet of foot, we're this, that and the other; however, this morning, as an example of myself being asked to help develop a grant application to commercialise a [Redacted innovation]. They're not sure which*

*direction to take it, and so, time is important as well, you must allow time for a trust relationship to build, to meet the right people, to network, identify the right skill set required for the job. Because they've already embarked onto this without Swansea University and fair enough, it's for commercialisation of a product in the US, however, it would be a lot easier if they've come to us and we knocked on the right doors knowing our links to the health board. Yeah, would have done it a lot faster and what they don't realise is that, behind the scenes of the large organisations enablers of innovation/adoption in the NHS, people like you probably interviewed what we're doing is greasing the wheels, **having the right conversation and aligning perspectives and visions**, because everybody's got their own day job, everybody's busy, nobody's got the head room. How do I get from point A to Z understanding that **everybody needs to come together and align on vision**.*

*So that's part of the job I think, the people in the academic community is to act as like a demilitarised zone **bringing the right people together with the right skills to give the company and/or the health board what they need from innovation**.*" Quote G28.

All interviewees discussed the alignment of actors and/or objectives in ways relevant to their circumstances, whether from an innovators perspective, or industry, health system, academia, or innovation support. This can be seen in the above example statements. The common thread was that the better the alignment between individuals or organisations engaging with an innovation, the more adoption would be enabled/facilitated. In addition, where there was a lack of or a 'misalignment', then that was a barrier to adoption.

Although all participants had many statements recorded under this code (except Interviewee H with only one), Interviewee G discussed this factor many more times than others (13 total), giving a number of examples where alignment or

misalignment occurs as well as discussing the importance of the concept in general (See their statements under G26-G37).

8.8.1.2.3. Networks and Collaboration

This factor was encoded for by statements from interviewees pertaining to the use and extent of networks available to individuals and organisations and how they contribute to collaboration as it relates to innovation and adoption. A total of 42 statements by interviewees were recorded under this code, making it the joint third most frequent code (with Trust, Reliability and Relationships).

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B38-B42; C38-C44; D38-D42; E38; F38-F42; G38-G52; H38-H41. The following statement(s) give examples of this code:

(Talking about supporting innovation adoption) “if you can leverage your network or others close network and successfully, the possibility [is] much greater” Quote B41.

*(During discussion of barriers and enablers of innovation adoption): “**Managing the network understanding the network and working through it**, you know for the life science sector, in England, the Academic Health Science Networks are you know are meant to be the gateway for innovation so they're meant to be how the industry engages and then supports uptake of innovation, and you know they've been around since 2012 health act. But **in practice they are not always the catalyst very often the industry will bypass and go straight to the hospital** go straight to (at the moment) the CCG (clinical commissioning group) and have the conversation there and it very much it's a bit like we talked about earlier in terms of backing the right leaders and the right systems, you know, again with the AHSN (Academic Health Science Networks) England you look for those that already really driven and motivated and will really support it.” Quote C42.*

*(Asked if any more factors influencing adoption come to mind) “So I think...I came...I guess **connectors**, so I’m just going to use that word. So **constantly need connectors whether it's between innovators and adopters, adopters and doctors, all of those connections need to be made**, and these connectors need to be open, they shouldn't be judgemental and they're not here to decide whether you're going to pass or fail, they're not here to decide whether you need a priority or not, they're there just to connect and get you to your next destination. Your next destination decides whether you pass or fail. So connectors who are only there as a supportive coaching type approach, it will lead through a lot more things that might be valuable to health and care that might not get through the gateway at the moment if you put all these barriers in.” Quote F42.*

These statements highlight how the interviewees discussed how networks and collaboration affecting innovation adoption in a variety of circumstances. The common thread was that the presence of and ability to use a network (whether it is yours or another’s) successfully supports adoption. Successful use would include (but not be entirely limited to) collaboration, and that collaboration if positive/successful would support adoption of innovation. It seems that networks and collaboration are interlinked in the context of adoption of innovation, that networks are built by collaboration and that collaboration can come via networks. On that point, this factor was linked to “Trust, Reliability and Relationships” 17 times (more than any other factor pair – see Section 4.5, and Appendix K) and it seems that trust and relationship building also enhances networks and collaboration and vice versa.

There were examples of where a lack of a (useful) network or (positive) collaboration between individuals or organisations acted as a barrier, such as H41, G50, B39. Therefore, as with other factors “Networks and Collaboration” was considered a two-way or non-binary factor.

A note about these networks: the network has to be relevant to innovation and adoption generally and/or specific to the innovation trying to get adopted.

This factor had a significant number of statements recorded under it by each interviewee with the exception of Interviewee E who only had one statement and Interviewee G, who had 15 statements recorded under it (the most recorded under any code by any participant). Interviewee G had many examples of the influence of networks and collaboration in adoption of innovation and there was a significant/strong overlap with “Trust, Reliability and Relationships” (as previously described) as well as “Alignment of Actors/Objectives” among other factors (see Section 4.5, and Appendix K).

8.8.1.2.4. Leadership

This factor was encoded for by statements from interviewees that were concerned with the role leadership in innovation adoption, in both individuals and organisations. A total of 45 statements by interviewees were recorded under this code, making it the second most frequently recorded code. The code was originally recorded as “Focal leadership” to capture examples where leadership was powerful enough to act as a strong enabler, but was changed to “Leadership” to capture all discussions of leadership whether positive or negative in terms of adoption (i.e., so it is a two-way/non-binary factor)

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B53-B56; C53-C61; D53-D62; E53-E59; F53-F56; G53-G60; H53-H56. The following statement(s) give examples of this code:

*(Asked about key influences in adoption) “I think there's something though, and I think **it probably transcends a few of them: leadership**. And that's the part where, you know, and noting it is a big risk, you know we've seen more locally, you know how you know how leaders can encounter difficulty when trying to do something transformative, putting it mildly. You've got there*

*the whole thing about procurement, and so it chimes a little bit there, but you've got there if you're going to do something creative, disruptive, sort of that paradigm shift, sort of buzzwords, it's not going to be look like what's been done before it's not going to necessarily be done in the way it has been done before so **somebody has to be bold and break that mould**, but do it in a way which doesn't put bars on the windows and so forth."* Quote

D58

*(Discussing leadership) "When you've got all the inertia in the system, people have been doing things in the way that they have, that is a lot of change to overcome, and particularly when you've got that complex system which quite rightly is trying to focus on an almost impossible challenge, which it is running beyond capacity, it's under resourced, in itself, blah blah blah. That is quite tough as leadership, particularly when you're going to have maybe those difficult conversations with the public and that's [what's in that] leadership, you know coming from the First Minister or Prime Minister, whichever you have your landscape is, all the way to down into the organisation, but that **leadership's got to give that empowerment to everyone below them to say no, you go that, you change things**. And a bit like we saw in the COVID response, where people have been **empowered to get on with things, as long as it's done with work ethic, integrity and applying their intellect** a bit like the [redacted health policy] to have people operating at the top of their licence, and just not getting in their way, while they're doing it - that's what's was needed, so I think leadership is the biggest, because, **with leadership, you can then change the processes, you can manage expectations, you can acquire the resource, whether it's out of the exchequer or an internal budget**. That would be the sort of key one."* Quote D59

(Asked about why Wales was different in supporting a system-wide healthcare innovation) “Well, I think, it's probably to do with people actually. What I think Wales has been very fortunate about, it's been very fortunate in Wales is that a number of very **senior people with the power to, with the hard power and the soft power, the hard power to actually direct resource in the direction of this type of work and the soft power to be able to influence colleagues and to build up and excitement and support** for this, I think has been tremendous in Wales. And so there has there has really been that initial, back almost about eight years ago, there has been that initial core group of people who got it going and I think have remained with it actually all the way through. And I think the other reason was that there was, I think the strategy for doing it Wales was a really good strategy. Started off very, very small, in one little area of one health board, a small disease area. That was shown to be successful, and then it has gradually scaled since then, in parallel with, trying not, I think, to force people, but to create this movement almost and I think there has been a movement, and that has created quite a lot of excitement nationally and that has enabled some more top-down, structure and processes to be put in place where, and I think it has actually worked very nice, so the two have, both top and bottom [have come together].” Quote H53.

(Asked about how leaders can make an impact) “yeah they are definitely diamonds in the rough and every organisation. It comes back...my experiences is there are **two types of leaders: people who lead from the front and delegate, I think or there's people who just happy being managers and they're more comfortable just delegating, so they don't necessarily get the boots to the ground experience.**

So great example of these, again come back to clinical academics,

*who have done the groundwork, done the research, are in practice clinically, they know what it's like to be on the ground, as well as managing people that's why those, I'd probably refer to them as diamonds in the rough are great examples of leaders, because **they know what it's like to get stuff done and they give recognition to those they're working with and say job well done,** whereas you can imagine a very bureaucratic system you can imagine "it's just as your job, you don't need any thanks".*

Quote G57

*(Asked about finding individuals within a certain organisation who can support an innovation's adoption) "I think to be fair to them, they are all very busy doing their they do. What **[Redacted person]** was very good at was seeing an opportunity and understanding it. He was extremely aware of the real world. And he had an amazing grasp of the real world and academia and the interface between them and where the opportunities arose, and how to fix things. I'm not seeing that replicated, other than his, those of us who were massive supporters of him, people like myself and [Redacted person]. And of course, you can't do that anymore so it's challenging."* Quote E55

These statements give examples of how leadership can be influential in innovation adoption. All interviewees discussed how leadership can be a strongly influential factor, many times (45 statements under the code spread quite evenly across Interviewees) across different circumstances. The common thread is that leadership can be a strong enabler when it is good or a significant barrier when it is bad (and good or bad might be relative the specific circumstance of the innovation). Individual leaders and their traits were discussed (e.g. C54, C56, E55, G57), how they operate in innovation and adoption sphere (e.g. F56, H53), as well as where leadership occurs at different levels of an organisation (e.g. D56, F54, H55) and how

it can influence what occurs in that organisation and between organisations (e.g. B56, D54, E58, F53) [Note: In fact many of the referred to statements cover lots of aspects of leadership in the same cell/quote].

Leadership appears to be very important, but the interviewees appeared to be describing traditional leadership as opposed to 'modern' which focuses more on followers and distributed leadership theory. Additionally, it appears that leadership was discussed in many different ways by the interviewees, i.e., very diverse response, but what is clear that leadership is a highly important factor when it comes to the adoption of innovation.

Leadership also appears strongly linked to other factors, indeed the second most frequently linked pair of factors was between Leadership and "People Who Get Shit Done" (16 links). It also had strong links to Alignment (Actors/Objectives), Clear Vision/Culture, Personality, "Getting the right people" and Empowerment and Networks and Collaboration (see Section 4.5 and 5.5 for further detail) (all P or PO factors interestingly).

8.8.1.2.5. Empowerment

This factor was encoded for by statements from interviewees that were concerned with the extent to which an organisation or individual empowers individuals to engage in innovation activities and how this affects adoption. A total of 30 statements by interviewees were recorded under this code.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B69; C69; D69-D73; E69-E70; F69-F77; G69-G74; H69-H74. The following statement(s) give examples of this code:

(When discussing COVID and how that may have made some things go quicker) "I think it is simplistic to say that people weren't working fast or hard enough before and that somehow a crisis got everybody going a lot faster, because the reality was, and you know we got the report which [Redacted name], [Redacted name] and Co put together and it did notice things that some things were

*happening faster in that there were approvals, whether it's for resources or whatever, going through quicker, some of it was just down it just happening faster, some of it was through what was **empowerment of teams and individuals**, because again it's a public sector thing - people don't make decisions they send it on to somebody else and if it's been across enough desks, it's no longer your decision, it becomes collectively agreed or killed off, which is often the case. That didn't seem to happen, and it would be people, whether they're within a clinic if it, closer to home for you, a GP practice, **people would just make decisions in ways that they might not have felt as empowered to before.**" Quote D71*

*(Asked whether it is people's personalities or is it something that can be learned) "You mean measuring outcomes? (yes). Oh no, see where I think that is concerned, I think for most people there, I think they do sign up to it because I think most people have gone into healthcare wanting to do that sort of thing. So, I think that generally brings people on board. And I think, as you say, people need to understand what it is, and they need to understand how to do it, and I think people then do sign up to it. Then I think **they need to be supported to do it and because otherwise people will get frustrated if they can't because they don't have the resources and they don't have the time**, so I think people need to be supported to do it. And I think then you do need as I was saying the **structures and the incentives**, so yeah I think it does need to be part of people's job plans, it does need to be part of people's appraisal and assessment process, it might even need to be part of people's payment systems, so that people... part of their compensation packages is somehow tied to some of this. And I think there is a tricky balance, but I think you probably do want that range of things so that it becomes truly embedded in the in the system, and not just something that people are... And you*

*know you need to, it needs to be an organisational priority, because you can be very passionate about this, but that's not enough, it might be enough for a small number, but for the majority it is not because it will get taken over by other things. So **the organisational system has to make room for it, and it has to again enable people to do it.**" Quote H74.*

*I also believe programmes, like the [Redacted programme], what they've done is give and staff across the health & care workforce **ownership of projects** and they've given them **responsibility**. And they've given them **elements of freedom** and to be able to do this because they were associated with a with a higher brand. So, being able to fall back on a body like the [Redacted] and obviously they've got relationships with all the innovation leaders and executives and is really useful in in leveraging that space and breed free time for people to innovate" Quote B69*

The interview statements above show how empowerment is talked about by the interviewees. This code was mentioned a significant number of times, in a nuanced way based on the circumstances they are discussing. The common thread is that giving people the ability, support, responsibility etc to participate in innovation, i.e., empowering them, appears to always act as an enabler to adoption, and the reverse where people are or feel disempowered acts as a barrier. The various statements discuss examples of instances where people were empowered (e.g. B69, D72), or where they were not (e.g. E70, F72), as well as general discussion on what needs to be done to empower people (e.g. quote H74)

Empowerment is linked to leadership a number of times, and leaders are often the ones who are able to empower others. In addition, organisational factors play a role (e.g., Quote H74, D71) such as structure, incentives, or bureaucracy.

In this coding, there was a split between interviewees where around half only had one or two statements recorded under it (Interviewees B, C, E) and half had more,

ranging from 5 to 9 (Interviewees D, F, G, H). Even so all interviewees discussed empowerment and its importance in similar ways. Interviewee F had 9 statements recorded under this code and gives a few examples of both empowerment and disempowerment.

8.8.1.2.6. Boundary Spanning

This factor was encoded for by statements from interviewees that were concerned with individuals or organisations with the requisite characteristics that enable them to draw together organisations and different sectors for the benefit of innovation. It is similar to but distinct from collaboration as it the code is specific to cross-boundary approaches between sectors or organisations as well as individuals who have a cross-boundary or multidisciplinary background and so are able to understand multiple areas. A total of 18 statements by interviewees were recorded under this code.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B78-B79; C78; D78-D80; E78-E80; F78; G78-G85. The following statement(s) give examples of this code:

*“I think there's significant roles, in terms of, establishing culture and organisations so culture and structure come together so mixing up teams so using **multidisciplinary approaches cross organisational cross-boundary approaches**. so you bring different professionals together, who have different ideas and different ambitions so you also you're **creating sandboxes there where ideas can develop**” Quote B78*

*“...So, who is the right people? The right people, from this project in particular, it was a clinical academic who **held the position at the university and also a position within the health board** so they were able to **see through both lenses**, if you like, or **wearing both hats**, how this project might align to both academic research to*

satisfy the machine for the University, as well as meet the compliance ethics and regs required to navigate the evaluations that you need within a health board. So somebody with that type of clinical experience. And that's [Name Redacted], who does many things..." Quote G79

As can be seen by the statements, 'boundary spanning' as an aspect of an individual or group, across organisations or sectors has an influence on adoption. This was not a particularly common code and some interviewees only had it recorded once or twice (Interviewee B, C, F) and one not at all (Interviewee H). Interviewee G had 7 statements recorded under the code, more than any others and clearly thought this was important, having examples of people (e.g., G79) and organisations (e.g., G83) where this code was an influence in adoption.

Mostly in the statements, the presence of a person or an organisation which embodies boundary spanning acted as an enabler and the lack of or poor utilisation of it acted as a barrier. However, it is possible for the presence of boundary spanning to act as a barrier as well, for example quote F78, where the boundary spanning person had to navigate conflict of interest. Therefore, it seems that for this factor to be a successful enabler it has to be leveraged in the right way and requires addressing of potential inhibitors to adoption, such as conflict of interest or communication across boundaries (e.g. C78).

8.8.1.2.7. Identification and Communication of Need

This factor was encoded for by statements from interviewees that were concerned with the extent to which the need for an innovation has been identified and subsequently communicated in order to establish the requirement for innovation in that circumstance, by and to either individuals or organisations, and how this influenced adoption. This code is distinct from other communication-related codes as it only recorded statements that were to do with communicating the need for an innovation, i.e., gaps or space where it could fit, clinical or other demand for it and so on. A total of 32 statements by interviewees were recorded under this code,

making it the joint 10th most frequently recorded code (with Bureaucracy and Admin and Policy/Regulatory Effects).

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B106-B111; C106-C110; D106-D110; E106-E111; F106; G106-G111; H106-H108. The following statement(s) give examples of this code:

*“One barrier not - well pretty much - related to COVID was, there are a lot of systems within healthcare services that aren't evidence-based - don't work but kept there because there's nothing else there and so a **massive thing moving forward in terms of effectiveness of care and efficiency of work spending and costs and is to identify these and sort of - One of my biggest things is yeah they may be identified but have never been communicated to people who can solve it.** So how do you communicate sort of inefficiencies in the systems to third sector to private sector to broader public sector partners that can then work together to overcome this and without that communication which we don't have the moment things just gonna continue to drain money out systems and effective treatments for the patients.” Quote B107*

*“Work in discovery was really more about pre-launch and where actually pipeline products that are close to launch, being able to work with health systems, to be able to understand pathways more effectively and to **consider how actually you could gain better value from pathway reconfiguration,** so it could be a programme to actually get a baseline of a particular therapy area what the pathway was now, **what were some of the barriers and challenges for patients to then be able to better consider.** If you're going to then in a year or two years' time introducing*

innovation into there, where would it be, is it, **how would you articulate the value how'd it better be reconfigured**, so could it be something: services suddenly being delivered at home or in a pharmacy as opposed to in hospital for example. Delivering greater efficiencies and potentially a better experience for patients” Quote C106

(Asked to discuss example of innovations) “I can recall, yes, I can recall very, very clearly. And I think I would also just say, before giving a very specific answer to that, the thing with innovation, of course, is there has to be a question of course, what is the point of the innovation? What is it there trying to do? And I think that there is often a challenge in healthcare and I, yes, I think, particularly in healthcare, both at the research stage in a clinical trial for a medicine or therapy medical therapy, for instance, but also, then **in a standard clinical practice environment that the definition of success is often not from the eyes of the patients - the user of the system**. And, as a consequence of that, it's very difficult, I think, to assess at the moment, the value of an innovation and therefore, whether that innovation should be introduced into the NHS and certainly whether it should be scaled. And then, when, if it is introduced, and if it is scaled has it actually achieved what it's supposed to achieve in terms of contributing to the achievement of outcomes that matter to people. So I think Value is important, not the only thing, but I think it is an important framework from an innovation perspective. That leads into why I moved to focus on this, because what is very clear, I think, **in healthcare settings is that there actually is very little focus on the outcome**. Now the process of care, as in the way that healthcare is delivered and you get.. whatever the diseases that you get there is a some sort of process that that is

likely to be followed and the structures of the system that are in place to enable the delivery of those processes – so hospitals, clinics, GP surgeries, these broad types of structure are of course important, and we do measure quite a lot of those things and I think we really should do that. But the challenge has often been that you can follow all of these processes which are based on varying degrees of evidence and then you can have all these structures in place, but none of that necessarily means that you are going to get a very good outcome, that matters. And so if you have a disease, like coronary artery disease, which of course a lot of people have, and we're measuring their have you been given a stent if you've got a blocked artery, are you taking these types of medicines are you attending the coronary artery disease clinic every six months - those sorts of things we probably would be measuring, but what we don't really know is how many of those people have a good quality of life, from their perspective, how many of those people, if they are wanting to, are able to work, how many of them are able to do the hobbies and activities of daily living that matter to them - we don't know that. And that was very clear, is very clear, working in hospitals and that needs to change yeah.” Quote H106

The interviewees all discussed the importance of the identification and communication of the need for an innovation in its subsequent adoption, and the quotes above give key examples of this. The code was consistently recorded across all interviewees with the exception of Interviewee F with only one statement (also interviewee H only had two statements recorded but they were extensive and very relevant to this code, see H106).

The identification of the need, the way in which the need was communicated and to whom it was communicated were all discussed in different circumstances across interviewee statements and a few different points to consider were found.

For example, type of need played a role: i.e., was the area of need a 'vacuum' (i.e., nothing being displaced where a new innovation will fit in) or was there already an existing practice or technology that needed displacing (e.g. quotes D108, F106). This links with the factor "difficulty to change existing practice" and also describes incremental vs disruptive innovation (see Section 2.1)

Also, the ability to identify need appears to be a skill that individuals may or may not have (e.g. E109) and also something that can be a formal work process carried out by teams or organisations (e.g. C106).

There was also mention of needs of who – the health service vs the patient, which are two different things. Quote H106 discusses this thoroughly among others and it appears that the needs of the patient may not be adequately looked at in certain circumstances.

In addition to adoption, this factor appears to be important at all or more than one part of the innovation process, as identifying the need is important for the early stage of deciding what to research and develop and take forward in the innovation process. While the focus of this study is on the adoption of innovation, it is likely that multiple of the factors discovered in this study will be influential at more or all stages of the innovation process, whereas there may be some which are only, or at least significantly more influential in the adoption and spread/scale part of the process.

8.8.1.2.8. Time and Capacity to Innovate

This factor was encoded for by statements from interviewees that were concerned with the ability of an individual or an organisation to participate in innovation and adoption based on their time, capacity or availability due to current volume of work, and how much does the organisation help or hinder in this regard. A total of 28 statements by interviewees were recorded under this code.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B178-B182; C178; D178-D185; E178-E180; F178-F179; G178-G183; H178-H180. The following statement(s) give examples of this code:

“Wales staff clinicians are supposed to have something like 15% of that week dedicated to their own research and innovation improvement works and whether or not, which I highly doubt, many of them use that. I know a lot of colleagues that I’ve worked with use that just to get over additional bureaucracy and paperwork and admin. So it has not been used for the right purpose , but whether that could be applied in social care situation would be interesting, but again ultimately goes down to workforce and retention, and whether they have the time to do that and also thing something like recognition of people making people champions within organisations for this. so it's almost recognition of make them be leader on this or incentivising through to now, as you said, and additional time or maybe higher roles of additional pay and to pursue this could be could be a way to proceed and but again it's, as I said, it's so complex, trying to manage this and, and I think the key one as well is just looking at the management models, this is about both health and social care, and without management buy-in you'll never get anywhere, you'll never get that time you'll never get any resources allocated to projects” Quote B182

*(After asked whether innovation happens because of or in spite of system) “because it is so strained, there's no capacity to innovate, if you going by kind of like absorptive capacity, as a concept there is none. And that is why, quite rightly it takes a lot of planning and consideration to open a new hospital, but jeez when we started talking about relocating pathology to [Redacted hospital] back in 2014. They are now still doing an options appraisal as to where along the M4 it goes and part of that is people move around, who is in charge of capital planning has shifted on since. But it's **because that capacity isn't there to do***

anything at pace, to make a decision and just get on with something. That itself creates waste which could go into service delivery or innovation.” Quote D182

The time and capacity individuals or organisations have to participate in innovation within the health system in Wales (and the wider UK NHS) appears to be significantly limited in general, which is acting as a barrier across the board, and the interview quotes above highlight this clearly. There are also instances and examples of parts of the system where time and space are available or has been created and how this supports innovation and subsequently adoption (see positive statements under this code). All interviewees appear to agree on these points that the health and care systems and people within them currently struggle for the time and capacity to innovate and do things differently, and wherever there is the capacity, or where it is created, that is a positive thing for innovation and adoption. All interviewees had at least one statement recorded under this code, with Interviewee B, D and G having the most (5, 8 and 6 respectively).

8.8.1.2.9. Attitude to Risk

This factor was encoded for by statements from interviewees that were concerned with an individual's and/or organisation's attitude toward taking risks in changing existing practice (i.e. innovating) (risk appetite). A total of 17 statements by interviewees were recorded under this code.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B192-B193; D192-D193; E192-E193; F192-F198; G192-G195. The following statement(s) give examples of this code:

*“I guess it goes down to bit of **risk averseness**, the Culture around that within care and health, that these managers that are ageing, **older people within work force**, which probably have about five years left in them, before they retire. so **for them, bring in new***

innovation is highly risky, it's not going to give them any benefits within the next 5 years say - how do we incentivise that? What's the point in them risking their steady job and they're good performance as they're doing in the sort of same situation, by trying to implement these new things where the value for that is extremely limited. so it's almost changing the mindset but that's easier said than done" Quote B192

*(Followed up about training people for the innovation) "yeah or manage the behaviours is what I would say. Training people for the actual innovation, so this hysterectomy conversation I'm pretty sure it's not about "can I do keyhole surgery or not?", it's probably "what confidence level do I need to hit to do a keyhole surgery for that type of surgery that I would normally do as an abdominal surgery?", and at that point the workforce has a decision...and they talk about this, when your surgeon retires the new innovation technique will come in. So, at that point – and **you see this all the time – this person is making this decision: "I'm three years away from retiring, am I really going to risk my clinical career over a procedure I'm not confident about, and riskier, in my view?"** As a surgeon it's riskier, as a woman it's less risky if your surgeon knows what they're doing. So you're making a lot of...so the contextual decisions have to be looked after, so if you're a leader, you'd be going "who have I got as my surgeons?", "are they going to put some behavioural barriers in?" and if they are it's going to take me a while to work through it and I can't just make them work through it and change their mind overnight, sometimes I have very good reason, and you don't want them to learn not to do it. But once you've worked that out, you then have to think "who do I bring in?", so you have a lot of conversation decision points you have to get to do, so you do have that behavioural barrier."* Quote F194

(Discussing an SME) "It is the so what if it goes wrong in a person, it's the once you engage technology in a person, you are into this extraordinary diverse, broad challenge, because you have to make sure you can meet all of those difficulties and challenges and the reason people remain involved, of course, is the benefits if you get it right, the changing the nature of the world: you're into billions and billions and billions literally trillions potentially of benefit and for many people, this is also a really important point, understanding the risk-reward, what's the best way to describe that, different people have a different risk-reward balance is the best way to describe it, and for a business like [Redacted SME] you need somebody who's got extraordinarily big risk-reward and somebody who says well actually you know what, I think that this is worth putting several million pounds of my own money into and when you look more closely at that person or that fund, you often find actually they're putting a tiny amount of their vast fund in and not really taking that much risk at all and my point is that you can't just isolate the challenges faced by the company you got to understand the challenges faced by its funder, because no one has an unlimited source of funding. And even those that you might think "well look they're being supported by these five institutional funds that have got hundreds and hundreds of millions of pounds" well they don't is quite honestly the answer, because if you take a longitudinal view of it, they have challenges too, everyone has challenges and there's a cap on the amount of funding they can provide." Quote E192

As can be seen by the statements, attitude toward risk and the perceived risk of introducing innovations can influence whether an innovation is adopted or not, in both a smaller or a larger scale.

One common point highlighted by statements is the idea that very experienced people, likely high up and in positions of influence who are usually nearer to retirement, often have a reduced appetite for risk taking (e.g. B192, F194, G192). In these cases, it can often be the perceived risk of introducing any innovation, let alone the perceived risk of introducing specific innovation that are perceived as riskier for a certain reason (such as very invasive technology like VADs). Indeed, a lot of if not all innovations in healthcare carry an inherent or higher risk relative to other industries because anything you change is affecting people's lives and health and wellbeing.

While clearly important, it was not only health and service delivery related risks of innovation that were recorded under this code, but any kind of risk associated with introducing innovation, with the main other type mentioned being financial (e.g., E192, F197 etc), and others included legal risk and risk to reputation (G194), the risk to career (e.g., F192), or just the risk of working across sectors or organisations (e.g., D192).

Interviewee statements often highlighted organisations' role in risk and the differences between organisations or sectors (e.g., D192, E193 etc). It appears in general the public sector (in this instance health and care) is generally more risk averse while private sector (e.g., SMEs & larger companies) generally are more open to taking calculated risks.

This code was in the lower half of the 44 in terms of frequency of statements recorded under it and some of the respondents had less (Interviewees B, D, E) or no statements under it (Interviewees C and H). Interviewee F had 7 statements under this code.

The interviewee statements indicate that in general risk averseness is a barrier to innovation and adoption, however in addition taking unnecessary or uncalculated risks will also act as a barrier. Therefore, to enhance and enable adoption, risk should be calculated and mitigated (especially when it comes to health and safety) but it shouldn't come at the expense of innovation, especially when the reason is something like risk to reputation and/or career.

8.8.1.2.10. Training & Learning

This factor was encoded for by statements from interviewees that were concerned with the role of training, learning and knowledge transfer on the innovation adoption process. A total of 19 statements by interviewees were recorded under this code.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B233; C233-C234; D233; E233-E237; F233-F239; G233; H233-H234. The following statement(s) give examples of this code:

“And I think innovation management is a big thing. it's one of the biggest causes of failure and in innovation processes generally and I would say innovation management schools or skills or even knowledge of what innovation management is it's significantly lacking in the NHS and if you don't have those basic capabilities, how do you expect/effectively manage a highly complex process. Skills some training towards that'd be a good thing” Quote B233.

(Discussing how to address lack of awareness in innovation)
“that's one thing's that [Redacted name 1] and I and certainly [Redacted name 2] talked about a lot is: I wanted to be involved in writing programmes and being part of the school of management to try and raise these sorts of issues. But then you realise the academics don't understand it either with rare exception, and they're sort of saying “well we've got a finance package and we've got an economics package” and, “but where's your understanding of venture?” “Oh no we don't understand venture” and where's the understanding of these challenges in terms of how do you fund innovation and they have no idea about the world I live in. That is a big gap between this and academia and I've tried to bridge it, and I can do with people like

*[Redacted name 1] who understands it, and [Redacted name 2] saw it immediately as a fantastic opportunity to get Swansea more on the map, but unfortunately with [Redacted name 2]'s change, I think the university more effectively shot itself in the head than it could have done anything else. And we had all sorts of programmes that we could see and were working towards to try and **bring this level of understanding and knowledge to people who were ever nascent innovators who wanted to actually start an innovative, they had something, they wanted to develop it and I was would be there to help them as an asset to say "well actually, do you understand how equity works in a business? Do you understand what dilution is all about? Do you understand how to approach funders?"** Rather than in a panic on the back foot. and, of course, the other thing is that everybody believes their innovation or believes what they got is the best in the world. And we'll get back to triumph of hope, a reality. A triumph of PowerPoint - you only get one shot at hope or PowerPoint and once reality starts to intrude things come crashing down."* Quote E233

*(Discussing an example of innovator & innovation) "Speech and language therapist who came up with an idea that she felt could help preventative care for families, so that you can support children who may develop speech language problems and that the parents could step in and be supportive to step in earlier on, and do things differently, so Family intervention delivered by speech and language therapists and also can be delivered by early years practitioners. She comes to mind because **she's the innovator, but she has been brilliant at supporting adopters.** Her adopters come from different places they can be the speech and language therapy department in a hospital, but they can also be the flying*

*start team in Wales who work with multiple families or families will be referred to them, for whatever reason, and they can be local authority based, so they're a nice project that goes across social care as well. **So her approach is that she gives training to these practitioners and then they support their families in doing the intervention**, which then means that they work with their children differently earlier on.” Quote F233*

The statements above show that training, teaching, and learning about an innovation or about the innovation process in general has an influence in the adoption process. There was diversity in the responses, such as the discussing the need to training innovators as well as adopters, or other stakeholders/participants in the innovation process, as well as the general need for greater training on innovation in general in the health system. In addition, provision of training on the specific innovation that is trying to be adopted is also discussed.

Most interviewees had 1-2 statements recorded under this code, with two interviewees having more. This suggests that all interviewees view training and learning as influential in the innovation adoption process. The two outliers were Interviewee E and Interviewee F, who had 5 and 7 statements recorded under this code respectively, suggesting these two placed a greater significance on this code than others, this could be due to a number of reasons, for example Interviewee E spoke a number about wanting to pass on their innovation expertise and how to go about that and the importance of it (Quote E233) and Interviewee F spoke about successful innovations or innovators who implemented training as part of their approach to adoption and they found success in it (Quote F233)

From the interviewees' statements under this code, it appears that relevant training and learning is usually an enabler to adoption and lack of it is a barrier. However, there were more negative examples than positive suggesting that overall, in health care innovation and the health system there is a lack of training and learning in this area.

8.8.1.2.11. Reputational

This factor was encoded for by statements from interviewees that were concerned with how an individual's perceived reputational risk in engaging with an innovation's adoption influence their decision to do so. A total of 7 statements by interviewees were recorded under this code, making it the second least frequently recorded code.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B296; C296; E296; F296-F297; G296; H296. The following statement(s) give examples of this code:

*(Asked about how [a healthcare innovation] is received differently across the profession) "No, I mean I wouldn't say that actually, I think everybody who you described with this is positive because it's hard not to be I think. but I think what probably that happens is after that initial positivity there are small group that actually do go away and do it, and I think Wales has been one of those places. And then there's probably a reasonably large group where it's just a little bit difficult because it takes so much time and investment, and people don't have much time and investment. And then I think there probably is a smaller group who are concerned by it, because of the patient, but don't necessarily say this, but I think probably it's there, **concerned from the patient empowerment perspective, but also from the perspective of, if you get this type of data - some people, it's going to show, have poor outcomes and that is potentially then going to affect people's, or the perception could be that it affects people's reputation, that is the reputation of health professionals** and the concern there could be if you don't know how the health system will respond. So I think, I can fully understand those concerns and I think that is where, when doing this, it is a wholesale change in culture, which*

is, of course, using the data as a means to support learning and development rather than as a stick.” Quote H296

The majority of interviewees mentioned individuals’ reputation or perception of their reputation at least once (except Interviewee D) as an influence on innovation adoption, but it was one of the least recorded codes. The statements above highlight some of the key instances of this code.

There are references to a subset of individuals who are more likely to worry about the risk to their reputation, and this acts as a barrier to innovation and adoption. Therefore, this suggests that fear for potential reputational damage of bringing in a certain innovation is certainly not ubiquitous, but there would be some individuals who’s decision to adopt would be affected by this and depending on those individuals’ position it could have a greater or smaller influence on adoption of an innovation.

This code was considered to be absorbed by “Attitude to Risk” as the code embodies attitude to reputational risk. However, there is a case to be made for it remaining separate it is a very specific kind of risk, and also some statements discuss individuals lack of care for or who aren’t affected by this (see E296 and E297) and some statements weren’t really concerned with risk. “Reputational” and “Attitude to Risk” were linked 3 times in factor interrelatedness matrix

8.8.1.2.12. Incentives

This factor was encoded for by statements from interviewees that were concerned with how incentives may drive or hinder innovation adoption. A total of 16 statements by interviewees were recorded under this code.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B301-B305; C301-C302; D301; E301-E302; F301; G301-G305; H301-H302. The following statement(s) give examples of this code:

*“Something like recognition of people making people champions within organisations for this. so it's almost recognition of make them be leader on this or **incentivising through to now, as you said, and additional time or maybe higher roles of additional pay and to pursue this could be could be a way to proceed**”*

Quote B301

“what are the incentives are there perverse incentives that actually reward a focus elsewhere so again that can be both an enabler, but it can also be a barrier of if there are incentives wrongly. You know, and that can be both for the industry, because if the industry is incentivised on the uptake of product as opposed to on number of patients treated for something, it can be a perverse challenge.” Quote C301

“So positive is making sure that everybody gets something out of it, so we talked about collaborative projects for innovation. There needs to be you know, everybody knows what the skin in the game is, what they've got to do, to make something happen, and they all want to recognise what their incentives are and what they're outcomes are, you know what matters to them and they all need to bring that to the table in the project because...and that's partly to the point where I mentioned earlier, sometimes they'll tell a finance people till later on or the governance guys or the clinician in some occasions. It's not told about what's going to happen, they probably don't feel as incentivised to get involved if there's nothing in it for them, but surely you should be able to find a middle ground where everybody get something out of a project or whether that's thinking small, as in the NHS, you know, the NHS has less waiting times or right the way up to, you know, societal stuff where you know, where no one is going to hospital anymore,

because of digital enabled meetings or whatever it might be. You know what I mean?” Quote G305

The quotes above show how incentives can have an influence on adoption and innovation, both as an enabler or a barrier, depending on what is being incentivised or the direction of the incentivisation.

Interviewees B and G had 5 statements each recorded under this code, more than other Interviewees who had 1 -2 (Interviewee F had none), suggesting they placed a higher significance on incentivisation and incentives as a facilitator for adoption.

By the interviewee statements, it seems that overall, there is a lack of incentives for engaging in innovation and innovation of adoption in the majority of areas in the health system, and this is acting as a barrier. Where incentives are in place to support the innovation process this will generally act as an enabler. In addition, interviewee C mentions (Quote C301) that “perverse incentives” or incentives which incentivise in the ‘wrong’ direction when it comes to innovation can be an even stronger barrier. It appears that this is something that needs to change in healthcare innovation if supporting it is the goal, and at the bare minimum the removal of disincentivisation is important.

8.8.1.2.13. Openness (to Change/Innovation)

This factor was encoded for by statements from interviewees that were concerned with how an individual or organisation’s openness to change or innovating influence adoption. A total of 25 statements by interviewees were recorded under this code.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B306-B311; C306-C309; D306-D307; E306-E307; F306-F310; G306-G310; H306. The following statement(s) give examples of this code:

(Discussing what facilitates sectors working together & innovation) “That’s where I think the answer is honesty and

openness, you know we reckon, just to give an example of the work we do with [Redacted tech company]. They recognise that the world was changing it's not going to be about massive government contracts for, whether its [public body] or as they had with the [government branch] and others: "here's a 10 year-long, 5 billion pound contract" or whatever, but it was going to be longer term it was understanding how to work with organisations to innovate, understanding what are the benefits to them. So they were already, without saying it, it was more that value-based paradigm..." Quote D306

*(Continues speech & lang innovation discussion) "I've seen it before...so actually now I'm thinking about it, the similar thing applied to the other person, but she stepped out of her role - the other example I talked about - but I think it happens a lot and I think it happens to the point where they stop supporting innovation because they can't risk their day job. So [Redacted Name] somehow is holding on and she's **been receptive to different ways of doing things** so, for example, she started with us - I might get the numbers slightly wrong - but I think she started with four adoption sites, she's scaled that to seven in the time she was with us up by asking, like other people wanted to come aboard and we helped that process. And now she's going to do a presentation, where she can do a train the trainer, which means that other people can scale it but **what she's been open to is having someone else front it, not her. Whereas other people leaning into that conversation with us, so they'd be like "I've got job, I can't risk it", she's kind of gone "what does it take for me to keep pushing this regardless of my job?"** because it's not about income generation when you are an inside innovator."*

Quote F307

(Talking about how COVID created openness) “And I think also it, but it has also brokered relationships that we now need to try, because the doors are wide open as opposed to foot in door. How we now go about keeping them in that space because it's very easy to revert to type and also recognise now that's systems and people are exhausted through that year of just [managing], so then to try and start to bring in fresh thinking and innovation.”

Quote C307

‘Openness’, as a characteristic of individuals and organisations is an important influence on the adoption process. This can mean openness to working with other people or organisations, working in different ways, as well as change and innovation in general (amongst other things probably). The above interviewee statements show how this can be influential. As a rule, the Interviewee’s responses appear to agree that openness and open approaches benefit innovation and innovation adoption, acting as an enabler, and the reverse, not being open, acts as a barrier.

This code was quite strongly linked to numerous other codes (see Factor Interrelatedness Matrix in Section 4.51). It seems ‘Openness’ as a characteristic of people or organisations quite directly links or builds into other important factors, such as Trust and Relationships (between individuals and sectors), Collaboration, Alignment, Leadership, Personality, and for organisations: Culture & Structure.

A thing to note with this code is that Interviewee statements did not always include the word ‘open’ or ‘openness’ and the researcher made the judgement when recording codes that the content of the statement met criteria for this code and hence would be recorded under it.

8.8.1.2.14. Communication (General)

This factor was encoded for by statements from interviewees that were concerned with how communication between any relevant parties in the innovation adoption

process affects adoption. A total of 19 statements by interviewees were recorded under this code.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: C322-C324; D322-D324; E322-E324; F322; G322-G330; H322. The following statement(s) give examples of this code:

*“for me success only comes when you reach consensus and one of the really important things is: you have to have the senior clinical leaders on board, because if not you can sometimes get buy-in at a board level or a senior level where they really came to drive this forward and can be strong it occurs, but it can all unravel when you operationalise it if you haven't got the clinical team engaged as well, so has to be you know **the communication and engagement is really important** there's a huge amount of cynicism, as to why would the industry do it, why, why are you bringing this what's in it for you?” Quote C322*

*(Asked about how diff orgs work together for innovation) “yeah I think it's getting the key stakeholders in all organisations, doesn't matter if you are large or small, **notify at the earliest point, so processes get ticking in the background anyway, as the discussions are still forming. And everybody needs to be a part, everybody who is relevant to the process needs to be brought in when relevant.** Because what happens is a really exciting idea, it gets the point where you write the project plan, but you haven't informed, perhaps finance, you haven't informed ethics and governance, you haven't informed, perhaps the department you thinking of running the research in. So, a lot of the time I imagine happens right at the end, after the ideas have crystallised, but what that means then, is those guys haven't had input and they*

could pick holes and/or complement to what you've already done, the plan. And it just means you got to do everything all over again, which doubles the time, you know what I mean, so that type thing is keeping people informed, the right people informed at the right time.” Quote G325

As can be seen by the interviewee quotes, communication between individuals, and between and within organisations, plays a role in the adoption and innovation process, likely as both barrier and enabler. Statements show, poor communication is a hindrance to innovation adoption and good communication is an enabler.

Communication is this code refers to any instance where communication has an influence on adoption and innovation, and as can be seen by the statements, that is a broad array of circumstances and situations.

The majority of respondents spoke about Communication either directly or indirectly as part of other points to consider, or more in passing. It seems that it is often taken as given that good communication is important in general in every aspect of work and so it would obviously be important in innovation and adoption.

Interviewee G often spoke more directly about communication between people and within organisations, and the effect it has on innovation and adoption, than the other Interviewees (see G322-330) and had more statements recorded under this code than the other interviewees (9 statements as opposed to 0-3 for the remaining respondents). This code was largely created due to Interviewee G's statements which did not fit under other codes and clearly spoke about communication as a factor.

This code was linked most strongly to 'Networks and Collaboration' (8 times) but was linked a number of times to other codes also, such as 'Trust, Reliability, and Relationships' (6), 'Alignment of Actors/Objectives', 'Leadership', 'People Who Get Shit Done', 'Getting the Right People', 'Openness to Change/Innovation' (all 5 times) and many more (4 times or fewer). This is likely as communication is a very general/ubiquitous factor/thing which builds up or plays a role in many of the

factors which will affect innovation (as mentioned previously). It leads to or helps or supports other things which can influence innovation, but perhaps is too general for it to be of use when discussing what is beneficial for adoption and innovation.

8.8.1.3. *People-Environment (PE) Factors*

As shown in the table in Section 4.2.2., there was only 1 PE code out of the 44 codes (2.3%). A factor given the PE context code was considered related to or affected by both individuals, their characteristics, and views, in addition to the environment and its characteristics. The factor that came under this code did not overlap with organisational or technological considerations.

8.8.1.3.1. *Relationship Between Sectors*

This factor was encoded for by statements from interviewees that were concerned with how individuals from different sectors are able to relate to and understand each other (e.g., communicate) and how that influences adoption. It is considered both a People and Environmental factor as it is to do with individual relationships but specifically how they are affected by working or interacting with a different sector (i.e. a different environment). A total of 28 statements by interviewees were recorded under this code.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B220-B223; C220-C223; D220-D225; E220-E222; F220-F222; G220-G226. The following statement(s) give examples of this code:

*“With work-from-home you miss the casual conversations bumping into people in in things for ideas and [things] coming up, but at the same time, again, I think, and that sort of a **advantage of this COVID thing was that people are talking a lot more across boundaries.** In industry, procurements are a massive barrier, But industry were actually talking to NHS talking to care and health and social care talking a lot more, it's not great, but at least they're talking a lot more. and the role of third sector within the*

ecosystems are much more prominent and everyone's all plugged in and the challenge for us this is now to sustain any good things and not bad things.” Quote B221

“barriers are: language so actually the industry, even the way that we speak having account managers or sales representatives. The NHS does not want to be sold to. An account manager for them and account is something that sits in a bank it's not you know. So language is something that you have to be really mindful of that is really critical.” Quote C220

(After asked about how industry differs in their approach to innovation adoption) “Industry have a different dilemma, so what I saw in industry is that they...so I had a lot of phone calls with people who...so one of my roles is to triage these other people who needed to receive support a bit like Agor IP might do. I think that feels close to what they might do, and so I used to have these conversations where they were like and I still have them where they like we build Apps, “so why the hell haven’t we got an APP for – I don’t know - picking up a prescription from pharmacy?”, “that exists already thanks very much” and then, “why don’t you have an APP for doing the Self-management for diabetes and reporting it all back?” and it was just like...and I had this lengthy conversation with someone who just didn't understand the context he was working in. And what people...so if I put the outsider view on, what they sometimes think is healthcare professionals and governance and regulation getting in the way - it's actually things that are protecting us. So you end down a conversation, which is really frustrating for them. You know, which is like “yes, but!”, but you don't do that so much with health & care. So that's the difference, I would say, their in-depth understanding of what's happening is just beyond anything that I

think a start-up or an external can have but, equally, it is also the reason why they might not push the boundaries as much. So I do...I'm not saying that this is all the same, but I do think...I would wonder if what they come up with are incremental changes and something that's a little bit more safeguarded and boundaried [than what] an innovator might do. But equally with that I think what they come up with can move faster whereas an innovator might still need that 5-10 years." Quote F220

The relationship between sectors can be an important influence in adoption and innovation, as shown by the example statements above. An individual's working relationships with and understanding of a sector external to their own was consistently discussed by all interviewees (except for Interviewee H) and appears that good relationships and understanding benefits adoption (& innovation) (acts as enabler) and lack of or poor relationships or understanding hinders adoption (acts as barrier), if the innovation involves multiple sectors (i.e., public, private, third).

By the statements it seems, as a rule, the health system (i.e., public sector) has a trend towards unfavourable relationships (for whatever reason) with the private sector and this is often putting barriers in place to cross-sector working and understanding and hence adoption (C220, F220).

This code is related to view of other sector but focuses more specifically on actual relationships and understanding rather than just perception of different sectors, and also the influence of the work environment an individual is in on those relationships and understanding, hence why it is a PE factor/code.

It was not all negative interaction between sectors. There were examples of positive interaction and relationships between industry and the health system and/or other sectors (e.g. B221, B222, D225, E222, G220, G223) and this acted as a benefit or enabler to adoption.

8.8.1.4. People-Technology (PT) Factors

As shown in the table in Section 4.2.2., there were 2 PT codes out of the 44 codes (4.5 %), making it the most numerous coding type. Factors which were given PT context code were considered related to and affected by both individuals, their characteristics and views, in addition to the technology and/or innovation itself, and its characteristics. Factors that came under this code did not overlap with organisational or environmental considerations.

PT codes were:

- Experience with innovation
- Experience with technology

The following subsections gives a summary of the data that supports each coding as well as the basis for these codes remaining distinct.

8.8.1.4.1. Experience with Innovation

This factor was encoded for by statements from interviewees that were concerned with an individual's experience, expertise, knowledge, skills, and awareness of innovation and the innovation process in general. It is distinct from "Experience with Technology" as that code refers to an individual's experience with a **specific** innovation or technology and how that influences that specific innovation or technology's adoption, while this code, "Experience with innovation" refers to an individual's experience in working in innovation in general (i.e. the process and all that entails – working on multiple innovations and the experience that builds). A total of 38 statements by interviewees were recorded under this code, making it the joint 5th most frequently recorded code (with Alignment of Actors/Objectives).

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B112-B117; C112-C113; D112-D116; E112-E123; F112-F113; G112-G122. The following statement(s) give examples of this code:

"innovation management is a big thing. it's one of the biggest causes of failure and in innovation processes generally and I would

say innovation management schools or skills or even knowledge of what innovation management is it's significantly lacking in the NHS and if you don't have those basic capabilities, how do you expect/effectively manage a highly complex process. Skills some training towards that'd be a good thing.” Quote B114

*“The NHS should be the most phenomenal adopter of innovation and technology, because it's a readymade opportunity, however, when you when you start looking at it more closely, you realise it is massively fragmented. You realise that the purchasing decisions within each hospital, which is what it constitutes, inside the NHS, is driven with different challenges in each hospital. **You realise that, in many cases the hierarchy of hospitals is run by administrators who have got no idea about innovation & technology. Budget holders don't understand it.** Doctors become the proselytisers of technology, but they're distracted by other things, and even then they probably don't hold the budget for it.”*

Quote E120

(Continuing discussion about barriers) “And the other thing is, as well as turnover of staff it's people who have never been there and done it with the experience of running or trying to do a project like that being put in positions and try and work with people who haven't done it before, I'm pulling my hair out thinking this is not that complicated. So put it like this, there's a point where I was like bloody Nora, if I was incentivised to pay for getting these projects through the university systems that would be the great way of earning money because you've been there, done it you kind of know the lay of the land and the mechanisms. That appears to be missing is the experience in hands on doing it. very siloed

approach, my job was to pick up from A to B, regardless of what happens, you know [at other levels].” Quote G118

As can be seen by both the content and number of statements recorded under this code, an individual's experience with innovation seems to be significantly influential in the adoption and innovation process. It was consistently mentioned many times by Interviewees (except by Interviewee H) and the consensus from their statements is that the more experience, skills, knowledge, or awareness of the innovation process an individual has, the more adoption will be enabled, and vice versa. This of course, applies (only) to individuals who actually have an influence over or are involved with the innovation and adoption process.

Of the Interviewees, two had many more statements under this code than the others: Interviewee E and Interviewee G (12 and 11 respectively). Interviewee E's statements were largely to do with the finance & funding side of the innovation and adoption process, and the how the level of experience with it affects adoption. This is likely owing to their experience with that part of the process. Interviewee G's statements were a bit broader in their scope and discussed numerous instances where experience with innovation is important as a barrier or enabler to adoption (see statements).

“Experience with innovation” and “Experience with technology”, were both very similar factors, with the former being broader and more general in its scope and the latter being specific to the single innovation that is trying to get adopted. Clearly, with 38 statements recorded under it (vs 8 for Experience with Technology), ‘Experience with Innovation’ is the more important/influential code in innovation adoption. This could be because it is significantly more important for the adoption and spread/scaling part of the process, as better experience with innovation in general and/or with many different (types of) innovation may be more beneficial here than experience (technical or otherwise) with the specific innovation you are trying to get adopted at that time... It could also be that is the more important factor in general in innovation and that the technology matters less or not as much as you would think when it comes to innovation especially adoption.

This factor was also relatively strongly linked to many other factors including (from most strong links down) 'Alignment' (11), 'Networks and Collaboration' (11), 'Identification and Communication of Need' (10), 'Leadership' (9), 'Understanding of Environment' (9), "Getting the Right People" (9), 'Trust, Reliability, Relationships' (8), 'Finance and Funding' (8) and more. This suggests that an individual who is experienced in innovation has an influence on these other factors, and vice versa. See below for the description of 'Experience with Technology'.

8.8.1.4.2. Experience with Technology

This factor was encoded for by statements from interviewees that were concerned with an individual's experience, expertise, knowledge, skills, and awareness of the specific technology or innovation they work with. It is distinct from "Experience with Innovation" as that code refers to an individual's experience in working in innovation in general (i.e., the process and all that entails, working on multiple innovations and the experience that builds), while this code is specific to the innovation or technology an individual is working on at that time and statements must refer to a specific innovation. A total of 8 statements by interviewees were recorded under this code, making it the joint third least frequently recorded code (with Co-production).

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: C124-C126; F124-F125; G124-G125; H124. The following statement(s) give examples of this code:

"We would write a case study. And I would ensure that my team had all of the key messages around what the value was. The fact that it reduces admission rates, it reduces a particular you know it may be a diagnosis people six months earlier than the kind of standard rate for diagnosis, you know, whatever those things are that are in language and metrics that resonate with the system . That would be the really important thing to be able to position it so that when you take it elsewhere, you can say "look I've noticed

from your long-term plan you're really intent on trying to tackle X. We've actually got some experience; would you want to partner with us we'd like to explore it" and then you know progress it from that perspective." Quote C126.

(Followed up about training people for the innovation) "yeah or manage the behaviours is what I would say. Training people for the actual innovation, so this hysterectomy conversation I'm pretty sure it's not about "can I do keyhole surgery or not?", it's probably "what confidence level do I need to hit to do a keyhole surgery for that type of surgery that I would normally do as an abdominal surgery?", and at that point the workforce has a decision...and they talk about this, when your surgeon retires the new innovation technique will come in. So at that point – and you see this all the time – this person is making this decision: "I'm three years away from retiring, am I really going to risk my clinical career over a procedure I'm not confident about, and riskier, in my view?" As a surgeon it's riskier, as a woman it's less risky if your surgeon knows what they're doing. So you're making a lot of...so the contextual decisions have to be looked after, so if you're a leader, you'd be going "who have I got as my surgeons?", "are they going to put some behavioural barriers in?" and if they are it's going to take me a while to work through it and I can't just make them work through it and change their mind overnight, sometimes I have very good reason, and you don't want them to learn not to do it. But once you've worked that out, you then have to think "who do I bring in?", so you have a lot of conversation decision points you have to get to do, so you do that behavioural barrier" Quote F125

An individual's experience, expertise, skills, knowledge, and awareness of/with a specific innovation/technology that is being positioned/pushed for adoption, can be an influence its adoption. However, do the relatively few times it was mentioned by interviewees it is probably less of a significant influence in the adoption stage. Interviewees B, D, E did not have any statements recorded under this code, the others had 1-2 and one had 3 (Interviewee C). The quotes above give some examples of where expertise in a specific technology may influence innovation adoption.

This could be due to the fact that having a high level of experience or expertise with an innovation (i.e., the innovator or someone else who works closely on the innovation) may not translate (easily) to improving or driving its adoption. It is likely a more important factor in earlier stages in the innovation process, especially in the R&D phases, but for the adoption phase it appears that other factors are more important. Indeed experience with innovation in general, as with the above factor 'Experience with innovation', seems to be much more important in terms of adoption as it has many more mentions than this code (38 vs 8). As that code encompasses an individual's experience with all aspects of innovation, from funding to understanding how to drive adoption and wider spread, and these individuals will also have experience with different circumstances and situations and be able to have a more nuanced approach to innovation, they will likely be able to drive or support adoption more easily.

This is not to say that having a good understanding and knowledge of the specific innovation that is being positioned for adoption is not important, merely that it is less influential in the adoption process. This also suggests that it does not necessarily need to be the innovator(s) that drive adoption, but that support from other individuals experienced with the innovation process and all that may entail would be useful in supporting adoption.

8.8.2. Organisation Factors

This section includes all codes assigned to the "Organisation" context. In order for a code to be assigned to the Organisation context (either solely or in combination), it

was related in some part to organisations and their internal characteristics as well as their external relationships and characteristics.

Of the 44 factors, **27** were coded as an Organisation related factor (includes O-only factors and any O combination factor). This means **61.4 %** of all factors contained a O coding.

Note: PO factors have been previously covered in 8.8.1 'People factors' so will not be covered under organisation section. POE, POT and OET factors will be included in "Section 8.8.5. Factors with 3 or more Context codes".

8.8.2.1. Organisation-only (O) Factors

As shown in the table in Section 4.2.2., there were 9 O-only codes out of the 44 codes (20.5 %), making it the joint second most numerous coding (with P-only factors). Factors which were given O-only code were considered only related to or affected by organisations and their characteristics and there was no overlap with people, environmental or technological considerations.

O-only factors included:

- Bureaucracy and Administration
- Organisational Culture/Structure
- Investment in the System
- Difficulty to Change Existing Practice/Systems
- Systems and Processes of Organisations
- "Getting the right people"
- Continuity/Retention of Staff
- Top-down plus Bottom-up
- Support & Guidance vs Forcing Implementation

The following subsections gives a summary of the data that supports each coding as well as the basis for these codes remaining distinct.

8.8.2.1.1. Bureaucracy and Administration

This factor was encoded for by statements from interviewees that were concerned with the influence of bureaucratic, administrative, and other related systems on the innovation and adoption process. A total of 32 statements by interviewees were recorded under this code.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B134-B140; C134-C135; D134-D138; E134-E139; F134-F135; G134-G143. The following statement(s) give examples of this code:

"I think this is the massive issue for me there's a huge amount of potential but all the structures, cultures and bureaucracy in universities don't help the translation of good research good ideas into tangible products that produce benefits." Quote B135

(Discussing a 3rd sector organisation) "what they've done is, as with many private sector companies do they've taken their research innovation improvement department outside the organisation and spun it out into a different companies different models so they're not bogged down in the bureaucracy and the higher management and their demands they look at it from an external-internal perspective and they allowed them to build their own network interactive those different people without being associated with the major body of the organisation" Quote B137

(Asked if issue of fragmentation of work/jobs affects all sectors)
*"It depends, I think that the large pharmaceutical companies - you know this more than I - there's more kind of bureaucracy and levels and jobs for people than universities and health boards and that says a lot, so getting them together is challenging but the SMEs, they seem to be some of most fleet of foot because I'd imagine what the situation is physically is you're sitting across the desk, or in the next room from somebody, you knock on the door and say "hey David I need this signed off", David says "what's the context", and Sally tells him and I think Ah great, let's have a discussion about it, yep it's fine by me, fine by you, check with the CEO, **small, agile, communication. And it gets signed off, that's***

missing obviously in larger organisations there's obviously a reason for it but that's just the way it is.” Quote G139

*(Continuing to discuss health system) “So we can have, and [Redacted company] for instance had unquestionably the best technology in the world for doing this, and gained great column inches about it, but could you get hospitals? No you couldn't have hospitals, you could get doctors who would support it, but the hospitals wouldn't support them to introduce innovation. So I have seen first-hand several examples of world leading technology, you know, ground on the rocks when it tries to engage with the best - what should be the best adopter, and the government have stated, should be the best adopter and the best process of adopting innovation. But it doesn't. It is because too many... you know I think it's probably one the greatest truisms again and the truism is that **in Britain, people in senior roles within large organisations see their opportunity to be to demonstrate power by saying no, in America they demonstrate power by saying yes. And that has been our experience and the businesses we were involved in, their experience with NHS, time and time and time again. And academia is not too distant behind that either.”***

Quote E136

As can be seen by the content of the statements above and the number of statements recorded under this code, bureaucracy and administration within organisations is significantly influential in the innovation adoption process. All Interviewees spoke about it (except Interviewee H), in different ways in different examples. However, the common thread is that the more bureaucracy and administration in the path of innovation, the more of a barrier to adoption there is. Bureaucracy and administration obviously exists for a reason, but according to the Interviewees statements, it usually acts as a barrier to innovation and adoption.

Therefore, a review into whether administration processes within an organisation is fit for purpose could be a recommendation to give if innovation adoption is to be better supported by and within organisations. There does need to be administration and bureaucracy but it has to be working efficiently and not causing areas of inertia and hampering progress or necessary change.

There were differences in how Interviewees saw bureaucratic and administrative effects on adoption (&innovation) between different kinds of organisation, such as size of organisation and structures within organisation (this is linked to “Organisational Culture and Structure”), as well as between different sectors. For example, smaller organisations (e.g. SMEs) were seen as more effective and agile in this sense as there was less administrative process than in larger organisations (see quotes B137, B138, G139). There is also seems to be a difference between different sectors, with public sector and universities being seen as more bureaucratic and the private sector being seen as less so (see B134, B135, B139, D138, D141), and there was some discussion about the difficulty working between sectors due to bureaucracy or administration (see C134, E136, G136). There was also talk about specific structures within organisations that cause slow down or hindrance to innovation and adoption due to excessive or unnecessary or ineffective bureaucracy (e.g. B136, D134, E137, G137, G138, G140), often specifically discussing the UK & NHS as the issue (see E138, E139).

There weren't entirely negative or barrier related entries into this code. A couple of statements discussed different ways of doing things or ways of getting around problematic bureaucracy (see B137, D136, E135, G135).

One thing that come up a few times is that the acute crisis situation that was the COVID-19 pandemic in many cases forced sped up decision-making and the removal of unnecessary administrative or bureaucratic barriers (e.g. see B140, D137), which raises the question, if that can be done properly and appropriately during an acute crisis such as that, why can it not be carried forward to 'normal' times, in which arguably the health system is in a more 'chronic' crisis. The below quote highlights how things changed in Interviewee B's circumstances with COVID-19:

(Talking about COVID changing things) “Regulations have been relaxed and processes have been sped up and sped through. And so obviously the admin and barriers so even within the university things didn't have to go to six boards, they may have to go for one board to get approval. As the bureaucracy was we wiped out almost and it goes back to that point just “get it done apologise later”, and I think the mindset of the country went to that. when crisis arises, you need to come up with solutions quickly and, and I think it really streamlined the process, in terms of that and then it identified where the necessary steps were and where the inhibitory or unnecessary steps were also.” Quote B140

There was a difference between interviewees in the number of statements they had recorded under this code, and therefore likely how much importance they place on it. Interviewee B (7), D(5), E (6), and G (10) had more statements than C (2), F (2) and H (0). This could potentially be due to fact that the first group place more importance on this factor as an influence in adoption than the second group, or it could potentially be because the first group have a lot more experience in dealing with bureaucracy directly in their own work, as many statements were from their own direct experiences.

8.8.2.1.2. Organisational Culture/Structure

This factor was encoded for by statements from interviewees that were concerned with the effects of the structure and culture of an organisation on the innovation adoption process. A total of 52 statements by interviewees were recorded under this code, making it the most frequently recorded of all 44 codes (7 more statements more recorded than second most frequent).

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B158-B167; C158-C161; D158-D168; E158-E164; F158-F166; G158-G166; H158-H161. The following statement(s) give examples of this code:

"I think there's significant roles, in terms of, establishing culture and organisations so culture and structure come together so mixing up teams so using multidisciplinary approaches cross organisational cross-boundary approaches. so you bring different professionals together, who have different ideas and different ambitions so you also you're creating sandboxes there where ideas can develop" Quote B159.

"people that look at the NHS from outside is they think it's a national system and that therefore it should be really easy to adopt, you know and diffuse immediately through the whole system, whereas in reality, we know that it's very fragmented, with lots of different cultures and organisations within it - hundreds and whether again, moving to a more integrated system so with the integrated care systems with 42 systems that will become the legislation next spring, whether that will eliminate some of the variation in adoption of innovation, I don't know I mean it might polarise it even more, but you know you then have systems that are having to connect up which might be, you know more of an enabler." Quote C159.

(Asked what has worked to overcome a barrier to NHS adoption)
*"I've never seen it work. What I've seen is businesses raise more and more rounds of funding and spend more and more time, generating more and more data, chasing ever and ever smaller returns to try and break through. And I don't know if you have ever read James Gleick's book Chaos Theory, but he talks about, I'm not sure if he talked about it, but it's true that: **you look at the coastline of the UK, on a 1:1 mill map and you just think I can trace the distance that's great, And then, when you click down a magnification and you now go down to a 1:500 thou map,***

there's a few more bays appeared. And then you click down to 1:50 thousand, geez there's an awful lot more bays appeared, and then you keep going and suddenly you end up at the pebble level, and this coastline just keeps getting longer and longer and longer, and that is the challenge of getting in innovation into someone like the NHS. People lose the will very, very early on to deal with an organisation like that.” Quote E161

*“I think I think both in all of that. I think the system has been developed to do a thing, and it does that thing to, in a very transactional way, develop these things. And **that is why things like value-based healthcare, why is it such a paradigm shift because the system was never built to do that.** And for that, then you’ve got to ask the question, in terms of innovation and adoption, it's tricky because you've got, not to say a monolith, but you've got a way of doing things. If you were to then go in and I know that they've been discussion around having a sort of value-based hospital where it could be sort of piloted in one, and that'd be the pilot, you develop, you learn what works, what doesn't work, you iterate and then you roll out, but if you're gonna have a uniformity in what you deliver, which is what the NHS is all about, it's a challenge. Also yeah you're going to have something which is inherently scalable, that is different challenge but it's something which has the values of the NHS but still allows that to happen is the goal and it's not giving ‘Pest Fix’ a 150 million pound PPE (personal protective equipment) contract - that's not the answer.” Quote D163*

(Asked about how to fund innovation) it's still a guarded world, but I think that people are still expecting cash returns on innovation and I don't think that's right and it's never been. Like start-ups never could do cash returns so why should innovation do

it and that's the first thing. but I think that we shouldn't talk about funding we should talk about investment in health and care. So we shouldn't be comparing innovative work to funded work, we should comparing it to how do we invest in this for the future. I think the dilemmas for health and care is it's only got a small pot and clearly where the venture capitalists are financing, you know they're going to lose 80% but make good money out of 20%. I don't know if healthcare is going to afford to do, that's where the risks come in. **My take on it is people do a lot with very small amounts of money so actually the culture and the support is so invaluable. that sometimes it's not the money, often it's not the money that we've seen play out - if someone's telling you they can't make a business case because it's the money, it's not always true.** That's what I've observed anyway." Quote F166

(Discussing whether university issues are broadly applicable) "I couldn't comment, I'd imagine so because you'd imagine as a public sector or charity we are aren't we, but then **you need to be seen growing jobs for the local region. The way you do that is cutting up enough, the system for lots of different little jobs, that lots of people can do so there's a bigger, I think it's a bigger question that I could ever answer really. That's the way I think of it, they need to fill jobs, they need to be seen growing even in times like this and I think one of the outcomes of that is that there's more people to do one job and therefore more fragmentation and therefore more chances for miscommunication therefore things done more slowly.** Honestly, and I love the university sounds like I'm sniping them, but I really do think it's a place for doing good shit, but it's that element of it which takes people who should be focusing on academic activities, makes them not want to do it, so disincentivises, that's a barrier, disincentivisation because of fragmented processes." Quote G166

*(Discussing leadership) No, no, I'm getting what you mean. My view is that you can have all the structure, I mean you can have all the structures in the world, but if you get the wrong... So, you need to be clear on what is the culture that you want of course, and then once that is clear then you can have all these structures, but if you have the wrong people, particularly in leadership positions, but in general, if you have the wrong people it's going to be very difficult. So I think you need to then **people need to know what the culture is**. And I think, then the leadership need to embody the values that makeup that culture, and they need to lead by example, and they need to be steadfast in in that. And then I think people need, then I think you, of course, and when you're building an organisation, then I think of course **you can recruit people in - they know very well what the culture is and what the values are and they need to come in and be selected according to that and they know that**. And I think, of course, you want the **structures and incentives in place to... so that people are rewarded in line with the values and the culture**. So they need to support each other. But you of course really want to get people that that truly align with this ideally, but of course it's very **helpful to have the structures and incentives**. But of course **when you're then changing an organisational culture and particularly a massive organisation, clearly you're going to potentially have loads of people that don't necessarily align with the evolving values and culture**. And that's where I think people again need to know what it is and what the vision is and what's going to happen, and then I think you definitely need the structures and incentives again to align with that, so that people can work according to it. And I think you need to get the key people within key parts of the system or organisation that truly do believe in it and I think, because if you don't have that authenticity people see through it.*

So I think, but you also have to recognise that not everybody's going to going to truly sign up to it. Which is where the structures and incentives come in, just to help encourage them to do that."

Quote H160.

Due to the fact that this code had more statements recorded under it than any other, included here is a quote from each Interviewee. These quotes highlight how diverse and distinct the ways in which an organisation's culture and structures can influence innovation and adoption.

This code had a variety of enabler and barrier focused statements, as well as statements that were discussing both or neutral, suggesting that it can act as both a barrier or enabler depending on the circumstances. Due to this and the large number of statements under this code, it can be inferred that this factor is significantly influential in adoption either acting as a barrier or enabler.

In the Interviewee statements there is a diverse set of views and examples where organisational culture and structure has an impact on adoption, but a common thread seems to be that the structures and culture in the NHS as a whole as it is today is 'fragmented' and 'diverse', and generally do not (easily) support innovation or adoption, for a number of reasons.... They may be directly due to the culture and structures acting as a barrier to innovation in the majority of circumstances, or it may be how the structure and culture influences other factors which affect adoption – see the paragraph below on linked factors.

The Organisational culture & structure code (and any other Organisational context code) is not limited to the NHS, but also includes any organisation which has an influence or involvement in the innovation and adoption processes.

As you might expect being the most common factor, Organisational Culture appears to be linked to and/or influence many of the other factors, including but not limited to: "Systems and Processes of Organisations" (16 links), "Difficulty to Change Existing Practice"(15), "Bureaucracy & Admin" (14), "Alignment

(Actors/Objectives)”(13), “Empowerment” (11), and “Trust, Reliability, Relationships”(11) (from Section 6.8).

Ways in which structure and or culture of organisations can influence adoption according to Interviewee statements include: fragmentation or coherence of culture (or structures) (e.g. C159, D161, D166, E159, E164, G164, G166, H158, H159, H160, H161) (linked to ‘vision and culture’), alignment of cultures between organisations (e.g. C161), presence or lack of support programmes or structures (e.g. B163, F159, F164, F166) (linked to ‘empowerment’), being heavily administrative or not (e.g. B158, B164, B166) (linked to ‘bureaucracy and administration’), ability to react to things more quickly or slowly (i.e. size and structure, flex/slack) (e.g. B165, B167, E158, G159, G163), presence or lack of organisational collaboration culture (e.g. B159, G158, G160), presence or lack of organisational innovation culture (e.g. B161, B162, C160, E160, E162, E163, F161, G165), perception of organisational culture(s) (e.g. C158), difficulty in interacting with or changing structures (linked/similar to ‘difficulty to change existing practice’) (e.g. D158, D159, D163, F160, H159), different ways of structuring parts of organisation (to benefit innovation)(e.g. D162, D164, G161, H160), complexity and/or inertia in structure (e.g. D168, E161, E162).

A takeaway from all this is that a lot of these factors overlap a lot and a very linked that it’s very difficult to divide and conquer with them likely, you have to consider the whole. But the usefulness of splitting into factors is clear as easier to discuss and address them that way.

8.8.2.1.3. Investment in the System

This factor was encoded for by statements from interviewees that were concerned with the time, resource or funding invested in innovation and adoption in the health system. A total of 24 statements by interviewees were recorded under this code.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B186; C186; D186-D191; E186-

E187; F186-F189; G186-G189; H186-H190. The following statement(s) give examples of this code:

*“Really not trying to sound like a left wing loon on this but **I think the biggest barrier is the chronic underfunding of the system, and that is the point, and again this will be more of a sort of [Redacted Name] type perspective: operations management, running any system you know, at or beyond capacity or even over the sort of 80% capacity. COVID being case in point, why did Germany deal with it so much better than us well their health system wasn’t creaking at the seams when the once in a century event hits it. And that in itself, sort of are innovating and sort of flexing and changing well it's that is a major barrier, everybody, we you know we in a more sort of structural and transformative sense, trying to work, I’m sure you will put this more sensitively in your work was that you know, working with [Welsh health board], you know people like [Redacted Name 2] have been there in [healthcare initiative] banging their heads against the wall, because they’re constantly up against whether it's a winter crisis or before COVID, that they can never sort of look up and think whether it's in terms of strategic planning or bringing teams into sort of plan around whether it's service design delivery, or what might we say partnerships with the private or other sectors, because there isn't **there isn't the slack in the system, for the headspace, let alone... just to sort of move around. That's at the sort of the system level, it is the same, you know if you went into a particular pathway, or clinic, or the hospital or whatever it's just chronically under resourced and everything's a sticking plaster not a transformation.**”*** Quote D189.

(Asked about how to fund innovation) "it's still a guarded world, but I think that people are still expecting cash returns on innovation and I don't think that's right and it's never been. Like start-ups never could do cash returns so why should innovation do it and that's the first thing. but **I think that we shouldn't talk about funding we should talk about investment in health and care. So we shouldn't be comparing innovative work to funded work, we should comparing it to how do we invest in this for the future.** I think the dilemmas for health and care is it's only got a small pot and clearly where the venture capitalists are financing, you know they're going to lose 80% but make good money out of 20%. I don't know if healthcare is going to afford to do, that's where the risks come in.

My take on it is people do a lot with very small amounts of money so actually the culture and the support is so invaluable. that sometimes it's not the money, often it's not the money that we've seen play out - if someone's telling you they can't make a business case because it's the money, it's not always true. That's what I've observed anyway." Quote F188

(Discussing social care) "it's so complex and so I think they've tried a few things so they've tried putting in consultant social care workers which part of their remit is research, innovation, improvement activity and so that's one thing they've tried to do, but ultimately so **overstretched, the staff don't have the time to add on the back of their caseloads to pursue some these sorts of things, and so I think it's investment in social care workforce it's your ultimate thing, modelling off of social [meaning to say 'health'] care roles.** yeah and I also [don't think there's] as much as many incentives, at all for them to, and it's the same as healthcare almost. What is the incentive for them to take on this

additional piece of work is not in their job descriptions, not in their PDR (personal development review), and it's just adding additional work for them and which we all know the innovation, the results of this will be longer term. So, whether they're there or not, within that period, because they have a quick turnover in social care is the other thing so it's just there's just no incentives for them to engage.” Quote B186.

Investment in the health and care systems, be that monetary, time, or another resource has an influence on the ability of those organisations to participate in and/or adopt innovations. The statements above show how it can be influential. The Interviewees discussed investment in the system in a number of scenarios based on their background, but the consensus between them seem to be that there is a lack of investment in the system generally, by whichever metric you choose, and that this is a detriment to innovation and the adoption of innovation.

This factor was quite consistent in number of statements under the code by all Interviewees, with the exception of Interviewee B who only had one statement under it.

There were instances where effective investments were mentioned and discussed, be it money, time, or other resource, and how that positively influenced adoption of an innovation or allowed space for innovation. Therefore, this factor was not entirely a barrier but could be an enabler as well if the investment was in a direction that enabled innovation, for whatever reason. However, the reverse is also possible where the investment wasn't enough or adequate or in the right direction or simply didn't exist to support innovation, and so it can act as a barrier.

Some Interviewees spoke about where or how investment should be directed (e.g., Quote F188, E187).

Most Interviewees spoke directly or indirectly about *how* investment in the system or lack thereof, or the direction of investment affected innovation and adoption, Interviewee D spoke directly about *why* they thought that there was lack of

investment or poor investment, and that due to politics and political reasons (see B189 etc). This led to the creation of the POE code “Political” which is discussed further under Section 6.6. Others may have implied why there may be lack of investment or taken it as a given, but Interviewee D appears the outlier to mention it directly.

This factor was noticed to be linked to the PO factor “time and capacity to innovate” early on in the interviews, as the cause of lack of investment or due to lack of investment, people within the system feel they lack the capacity to innovate because it is not built into or allowed for in the system. Indeed, when performing the factor interrelatedness assessment, the two factors were found to be linked 6 times. “Investment in the system” was linked more strongly to other codes as well, including: “Organisational culture and structure” (10 links); “Political” (9 links); “Finance and Funding” (8 links); “Clear Vision/Culture” (8 links). See section 6.8 for more information on links between factors.

8.8.2.1.4. Difficulty to Change Existing Practice/Systems

This factor was encoded for by statements from interviewees that were concerned with the capability or capacity of an organisation to change their existing practice, systems, or technology use, in order to adopt a new innovation (e.g., entrenched practices). A total of 33 statements by interviewees were recorded under this code, making it the 9th most frequently recorded code.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B199-B202; C199-C203; D199-D210; E199-E203; F199-F201; G199-G200; H199-H200. The following statement(s) give examples of this code:

“There are a lot of systems within healthcare services that aren't evidence-based - don't work but kept there because there's nothing else there and So a massive thing moving forward in terms of effectiveness of care and efficiency of work spending and costs and is to identify these and sort of - One of my biggest things

is yeah they may be identified but have never been communicated to people who can solve it. So how do you communicate sort of inefficiencies in the systems to third sector to private sector to broader public sector partners that can then work together to overcome this and without that communication which we don't have the moment things just gonna continue to drain money out systems and effective treatments for the patients.” Quote B199

“it is so tricky isn't it because it's like boiling the ocean because health is so vast, how do you make those decisions, and they are working much, much more on horizon scanning to say you know these are the areas, and there is, you know within the long-term plan all of the critical therapy areas are covered then there's always that challenge of managing the NHS resource, finite resource in a way that actually means that you manage the health and wellbeing of the population, which is, I think Well, no, it is the intent of the alternate you know the whole redesign of the health system to try and tackle that” Quote C202

(Talking about level of decision-making for innovation adoption)
*“So I say that in my view at least half of our innovations exemplars sit in that category of ‘clinical team can make a decision’. But there's an APP, for example, for dementia triage, which is verging on the type of technology that I think will be prevalent in about three to four years - if it comes in - because they already exist in different guises, but basically the **biggest problem there for that particular exemplar was that the clinical team didn't buy into it. So the clinical team had to believe that a machine would do some triaging, where a professional [would have done] it. You've already got that immediate barrier that's going to hit, whereas the family intervention I'm talking about, it's not saying we lose something we already do, it's saying layer it up because***

likelihood is you were never doing it. The same with that heart failure one actually layer it on because you were never doing it before - this is a “stop doing what you're doing right now and bring in an APP”. Obviously you don't do it to 100% but even if you are doing it to 10%, it's still a “stop doing what you were doing”, you are not going to double them up because that costs too much. And actually it didn't go very far because clinical team said no, so in that situation...my view is that the health board should have stepped in. So while they didn't need money, it probably needed senior level support to tell the clinical team that this had to happen, or at least a tested scenario had to happen.”

Quote F201

The interviewee quotes above show how the difficulty of changing an organisation's practice(s) or system(s) influences the ability of that organisation to adopt the innovation that would cause the change. All interviewees mentioned this code numerous times and there were many different kinds of examples from the Interviewees, often owing to their diverse backgrounds. These examples included different levels of changes within the organisation, from a single clinic's practice to the health system as a whole.

This factor was consistently mentioned by all interviewees with a range of 2-5 statements recorded under it for all interviewees except Interviewee D, who had 12 statements recorded under it.

There were examples where the level or type of change required to adopt an innovation played a factor in adoption, such as in F201 where an innovation which requires switching a task from a healthcare professional to a technology finds resistance, whereas an innovation which works alongside or is layered on top of what already exists, and requires less change to structures or practices can be more easily adopted by that standard.

There were also examples where practice or systems that are entrenched in other ways and/or for other reasons can act as a barrier to adoption or change, even where what is currently in place is not evidence-based (e.g. B199). Interviewees discussed a number of circumstances where existing practice was either inadequate or could be enhanced, but the characteristics of the organisations: their ability or inability to change to adopt innovative technology or practices acted as a barrier or an enabler in this process (more often a barrier).

There were also statements under this code which discussed much higher-level system change – the requirement for it and the difficulty in doing it. This suggests this code works at every level of an organisation. Examples of system level include C202, H199, H200, G200, E203 and more (see statements).

The Interviewee statements under this code taken together suggest that the ability of an organisation to change and innovate or accommodate innovation (for the right reasons) at every level is an important factor in the adoption of innovation. In general, per the Interviewee statements, it seems the health system in the UK struggles to change existing practice and accommodate innovation.

8.8.2.1.5. [Systems and Processes of Organisations](#)

This factor was encoded for by statements from interviewees that were concerned with factors related to characteristics of the systems and processes of an organisation or sector as a whole (i.e., the health system) which affect the adoption of innovation (e.g., the NHS procurement system). A total of 26 statements by interviewees were recorded under this code.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B211-B215; C211-C212; D211-D219; E211-E215; F211-F212; G211; H211-H212. The following statement(s) give examples of this code:

“Procurement systems in in all their glory they prevent innovation & adoption, they put people off and it's so complex, they have to go to tender to however many different people, you

have to follow a strict procurement rules, and you can get shut off before there even if you do have a good idea. and when it comes to adoption, obviously, is a massive thing.” Quote B211

“The other thing that I think people that look at the NHS from outside is they think it's a national system and that therefore it should be really easy to adopt, you know and diffuse immediately through the whole system, whereas in reality, we know that it's very fragmented, with lots of different cultures and organisations within it - hundreds and whether again, moving to a more integrated system so with the integrated care systems with 42 systems that will become the legislation next spring, whether that will eliminate some of the variation in adoption of innovation, I don't know I mean it might polarise it even more, but you know you then have systems that are having to connect up which might be, you know more of an enabler.” Quote C211

As can be seen by the statements, systems and processes of organisations taken as a whole can act as an influence in innovation and adoption in a number of ways.

Statements in this code were regarding how the characteristics of systems or processes of organisations as a whole affect adoption and innovation in health and care. A common example was the NHS's procurement system acting as a barrier to adoption and innovation (B211, D214-217). Other examples included discussing the way the NHS (and its related sub-organisations or systems) was and is set up, with a suggestion it was never built to do things in certain ways, which act as a barrier to innovation adoption (C211, D218, G211), and what may be required in transforming the system or creating ways in which it can engage more easily in and support innovation for better health outcomes (C211, E215, H211) but that is a very difficult task (B213, B214).

This factor was fairly consistently mentioned by all Interviewees (range 1-5), with the exception of Interviewee D who had 9 statements recorded under it (a significant proportion of which were discussing the NHS procurement system).

This factor is very strongly linked to two others: “Organisational Culture and Structure” (16 links) and “Difficulty to Change Existing Practice” (14 links) but had no other links more than 10 with other factors. It was considered whether this factor could be absorbed by one of these other two but since it had 26 statements under it, and there was enough nuance under this code, it remained as a separate code. The distinction between this code and “Organisational Culture and Structure” is that it refers to systems and processes of an organisation (the way things are done) rather than the structure and culture of an organisation (how the organisation is arranged), and the distinction between this code and “difficulty to change existing practice” is that that code refers to how easy it is for the organisation to change what it is doing to accommodate an innovation.

Reasons for the high links and interrelationship between these factors may be due to the fact that they are all related to Organisation’s characteristics and context which were often spoken about in the same quote by Interviewees. Factor interrelationships are explored more in the interrelatedness Sections of the Results (4.5) and Discussion (5.5).

8.8.2.1.6. “Getting the Right People”

This factor was encoded for by statements from interviewees that were concerned with the importance of acquiring/hiring/working with specific individuals with the relevant characteristics to drive the innovation adoption process. Direct quote from interviewees. A total of 30 statements by interviewees were recorded under this code.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B286; C286-C290; D286-D289; E286-E290; F286-F288; G286-G295; H286-H287. The following statement(s) give examples of this code:

*“firstly, we needed to **identify who was necessary**, and **who would be required** in this and then **identify** sort of **relevant people** that could be approached and, for me, the key to all of this is strong relationships and trust and so, if you can leverage your network or others close network and successfully, much the possibility [is] much greater.” Quote B286*

*(Asked about any more barriers) “The **barriers to any business are having the right people. Not just the right people start with, the right people at each stage** - so that becomes the right sales people, the right product developers, medical people to make sure it's fit. It's a dynamic environment, so as the business grows as the technology twists and turns and faces new opportunities, new challenges, new countries, you've got to have the right team in place to do that. **I've seen lots of slips and trips where that hasn't happened because a business can't afford to necessarily think too far in the future and invest against something that it doesn't know that it needs**, as it were. So the people, **the people, not just now, the people in two years' time.**” Quote E286*

*(Asked about why Wales was different in supporting value-based healthcare) “Well, I think, **it's probably to do with people actually**. What I think Wales has been very fortunate about, **it's been very fortunate in Wales is that a number of very senior people with the power to, with the hard power and the soft power, the hard power to actually direct resource in the direction of this type of work and the soft power to be able to influence colleagues and to build up and excitement and support for this, I think has been tremendous in Wales**. And so there has there has really been that initial, back almost about eight years ago, there has been that initial core group of people who got it*

going and I think have remained with it actually all the way through. And I think the other reason was that there was, I think the strategy for doing it Wales was a really good strategy. Started off very, very small, in one little area of one health board, a small disease area. That was shown to be successful, and then it has gradually scaled since then, in parallel with, trying not, I think, to force people, but to create this movement almost and I think there has been a movement, and that has created quite a lot of excitement nationally and that has enabled some more top-down, structure and processes to be put in place where, and I think it has actually worked very nice, so the two have, both top and bottom [have come together]”. Quote H286

The Interviewees all spoke about the importance of identifying, hiring/acquiring, and working with individuals with the relevant characteristics to support adoption of innovation, with Interviewee G having more statements under it than the others (10). The statements above give examples where this code was influential.

Interviewees had examples from different relevant parts of the innovation process, owing to their different backgrounds, be it more the business/industry side of things (e.g. C, E), academic (e.g. B, D, G), or health system (e.g. F, H), or a mixture of sectors. This suggests that it is important to get the right people to enable adoption at every part of the innovation process and in each group of stakeholders.

Conversely, if the right people cannot be identified, acquired/hired, or worked with then this is a barrier that is likely to inhibit adoption.

This factor is similar to People-only and People-combination factors that are concerned with how individual's characteristics, what they are, and how they influence adoption. Indeed, it was linked strongly to some important PO and P-only factors (see Section 4.5, and Appendix K). However, this factor is concerned with the organisational level, in terms of acquiring or working with these individuals, i.e. “Getting the Right People”. It looks at this idea from more of a workforce planning perspective and is less concerned with what the characteristics of people are and

how they influence adoption, rather how/when/where to acquire these people in the adoption process and why is it important to do so.

8.8.2.1.7. Continuity/Retention of Staff

This factor was encoded for by statements from interviewees that were concerned with the importance of the continuity and retention of staff in the innovation adoption process. A total of 13 statements by interviewees were recorded under this code, making it the 8th least frequent coding.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B298-B299; C298; D298-D300; E298; F298-F300; G298-G299; H298. The following statement(s) give examples of this code:

*Asking about personality drive in healthcare: "How personality driven is healthcare and more health care than social care, in my view, so yes, it's all personality driven, especially when you start to talk about **specialist teams who are hard to replace** so all my career's workforce development workforce planning world. there's you know **it's going to take you under [over] seven years to replace that person as a minimum**, so from that point of view where does this sit. So I think that's you know **that's the scary part and also if you're in a part of the country where you can't recruit them easily where does that sit, so you get scared of upsetting your workforce and health and care is all about workforce, less about technology, it's 70% [inaudible]**. So I think that personality plays a role, but I think this is where the good conversation about culture and supportive environments can actually make a massive difference." Quote F300*

*"...The other point is **high turnover of staff**. Somebody comes, they get a lot of work done that usually probably a small group of people getting the work done, they get really annoyed when they*

*leave - they think "I'm spending too much time helping everybody else out, what are we doing?" **At a new job all that knowledge is lost** even though they're the one doing the hard yards. And then **somebody new comes on and they need to get trained up and it's time learning process.** That's evident inside the university, the mediation between certain mechanisms that look after the pot of money to sending the money to partners that have already signed the legal agreement which is countersigned by these people that speak to his boss alright, and **the miscommunication is incredible and that's what takes the most amount of time that kills projects.**"* Quote G298

*Asked about why Wales was different in supporting value-based healthcare: "Well, I think, it's probably to do with people actually. What I think Wales has been very fortunate about, it's been very fortunate in Wales is that a number of very senior people with the power to, with the hard power and the soft power, the hard power to actually direct resource in the direction of this type of work and the soft power to be able to influence colleagues and to build up and excitement and support for this, I think has been tremendous in Wales. And so there has **there has really been that initial, back almost about eight years ago, there has been that initial core group of people who got it going and I think have remained with it actually all the way through...**"* Quote H298

The ability of an organisation to retain staff and reduce turnover has an influence on adoption and innovation activities, which is highlighted by the example statements above. The consensus with the Interviewees is that if an organisation can retain employees/staff for longer periods of time, then that is beneficial for innovation and adoption. Conversely if an organisation has high turnover, then it will be a detriment to innovation.

This could be due to a number of reasons. For example, high turnover means that new employees have less knowledge of when/where/how to innovate or participate in innovation, it also means that you are losing those with knowledge of the organisation/system to elsewhere (e.g. G298). There is also the issue of retaining highly specialised or key staff (e.g. F300), as if these individuals aren't incentivised to stay, then how would they be incentivised to innovate. However, in areas where staff have stayed for longer periods and been able to participate in or drive innovation, it was discussed to be a benefit to adoption (e.g. H298)

This factor is similar to "Getting the Right People" and there is a bit of overlap (4 links – see Section 4.5, and Appendix K). However while that factor is concerned with acquiring and working with the right people, this is about the importance of keeping/retaining staff so there is continuity in the workforce, and how this influences adoption and innovation activities.

It was not a very commonly recorded code, but it was a consistent code: all Interviewees had at least one statement under it, and the range was 1-3 statements.

8.8.2.1.8. Top-down Plus Bottom-up

This factor was encoded for by statements from interviewees that were concerned with the simultaneous approach of top-down (management-led) and bottom-up (grassroots, employee-led) influence that signifies an organisation has a consistent approach to innovation adoption. A total of 12 statements by interviewees were recorded under this code, making it the 7th least frequent coding.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B312-B313; C312; D312; E312-E313; F312-F313; G312-G313; H312-H313. The following statement(s) give examples of this code:

"I think the ultimate thing is you can't just change the minds of one or two, you've got to start a movement effectively, it can't just be bottom-up approaches it's got to be top-down and bottom-up

approaches, where they meet in the middle, if you if you can convince the managers to get and to sort of one point where they're more open, but you can't convince the people on the grassroots – it's not going to happen, and vice versa. If you can convince them both and demonstrate the value when they meet in the middle, to work together that is that's the way, I believe, has to be. And it can't just be grassroots, However anyone says it should be bottom-up, you can't do anything [without management] effectively” Quote B312

*“for me **success only comes when you reach consensus** and one of the really important things is: **you have to have the senior clinical leaders on board**, because if not you can sometimes get buy-in at a board level or a senior level where they really came to drive this forward and can be strong it occurs, but **it can all unravel when you operationalise it if you haven't got the clinical team engaged as well**, so has to be you know the communication and engagement is really important there's a huge amount of cynicism, as to why would the industry do it, why, why are you bringing this what's in it for you?” Quote C312*

The presence of a coherent ‘top-down’ and ‘bottom-up’ approach to innovation and adoption appears to be influential in adoption. This code specifically covers statements which discussed how the approach to innovation and adoption included or did not include a combination of top-down or management-led initiative and bottom-up or grassroots or employee-led initiative, and how that influenced adoption in a positive or negative way. The consensus from Interviewees statements was that you needed engagement, buy-in and drive from both to increase the likelihood of success, and if you only had one or the other that chance of success was reduced. The quotes above from two interviewees give examples of this.

So, the linking up of all levels, and having a coherent approach seems important. Indeed, this code linked relatively strongly to 'Clear Vision/Culture' (7 times), 'Leadership' (7 times) and 'Alignment of Actors/Objectives' (6 times) (see Section 4.5, and Appendix K).

This code covers a relatively small niche, and that may be why there are few statements recorded under it relatively speaking. However, it is consistently mentioned by Interviewees, with most having two statements recorded under it and two Interviewees (C & D) mentioning it once. To be recorded under this code the statement must have mentioned the different levels, either where both were a positive influence, or where one or the other was a negative influence which hampered the process, or potentially where neither were a positive influence (though there were no codes with both negatively spoken about, rather the lack of cohesion between the two was highlighted).

8.8.2.1.9. Support and Guidance vs Forcing Implementation

This factor was encoded for by statements from interviewees that were concerned with how the type of approach to introducing an innovation affects its successful adoption, i.e., soft (support and guidance given) vs hard (mandating/forcing implementation). A total of 11 statements by interviewees were recorded under this code, making it the 6th least frequent coding.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B314; C314; D314; F314-F318; H314-H317. The following statement(s) give examples of this code:

(Asked about any more factors come to mind) "So I think...I came...I guess connectors, so I'm just going to use that word. So constantly need connectors whether it's between innovators and adopters, adopters, and doctors, all of those connections need to be made, and these connectors need to be open, they shouldn't be judgemental and they're not here to decide whether you're going to pass or fail, they're not here to decide whether you need a

*priority or not, they're there just to connect and get you to your next destination. Your next destination decides whether you pass or fail. So **connectors who are only there as a supportive coaching type approach, it will lead through a lot more things that might be valuable to health and care that might not get through the gateway at the moment if you put all these barriers in.***" Quote F318

*(Asked about level of implementation of innovation to food provision in health system) "No I mean, I think it depends on the system, I think with NHS England we're doing it at a national level. **Not telling people what to do, but providing them with resources to help enable them to take these types of decisions if they want to, and again I think this sort of thing people generally want to, it's just a matter of hopefully supporting that. And the same in NHS Wales actually, that again at a national level to support people in this direction as in health boards in this direction.**"*

Quote H316

As can be seen by the statements, the type of approach to introducing an innovation: empowering the adopter and giving support and guidance versus dictating, mandating, or forcing the implementation of the innovation was discussed by most Interviewees in relation to its influence on the success of an innovation's adoption. The consensus was that while mandating something may work in certain cases, it was more important for success if people bought into the direction and it's easier to do that if you bring them on board with you and give support and guidance on why adopting the innovation is a good idea, rather than forcing it on the adopter/users without their input. Of course, this may not be an ubiquitous rule but it has some influence on adoption.

This code was relatively inconsistent between the different Interviewees, with three having only one statement under it (B, C, D), two having none (E, G) and two having more (Interviewee F had 5 and Interviewee H had 4).

8.8.2.2. Organisation-Environment (OE) Factors

There were no OE codes out of the 44 codes (0 %). A factor given the OE context code would be considered related to or affected by both organisations and their characteristics, in addition to the environment and its characteristics. A factor that came under this code would not overlap with people or technological considerations.

Even though there were no OE codes, there were two OET codes and one POE code. These 3-context codes are discussed under Section 8.8.5.

8.8.2.3. Organisation-Technology (OT) Factors

There were no OT codes out of the 44 codes (0 %). A factor given the OT context code would be considered related to or affected by both organisations and their characteristics, in addition to the technology or innovation and its characteristics. A factor that came under this code would not overlap with people or environmental considerations.

Even though there were no OT codes, there were two OET codes and one POT code. These 3-context codes are discussed at the end of this Appendix (Section 8.8.5.).

8.8.3. Environment Factors

This section includes all codes assigned to the “Environment” context. In order for a code to be assigned to the Environment context (either solely or in combination), it was related in some part to the environment in which the innovation operates, and which people and organisations related to the innovation therefore also operate within, and its characteristics.

Of the 44 factors, **7** were coded as an environment related factor (includes E-only factors and any E combination factor). This means **15.9 %** of all factors contained a E coding.

Note: PE and OE factors have been previously covered so will not be covered in this section. POE and OET factors will be included in “Section 8.8.5. Factors with 3 or more Context codes”.

8.8.3.1. Environment-only (E) Factors

As shown in the table in Section 4.2.2., there were 3 E-only codes out of the 44 codes (6.8 %). Factors which were given E-only code were considered only related to or affected by the environment and its characteristics and there was no overlap with people, organisational or technological considerations.

E-only factors included:

- Local vs Regional vs National
- Policy/Regulatory Effects
- "Crisis" (COVID-19)

The following subsections gives a summary of the data that supports each coding as well as the basis for these codes remaining distinct.

8.8.3.1.1. Local vs Regional vs National

This factor was encoded for by statements from interviewees that were concerned with how the spatial scope affects innovation adoption: i.e. local: narrower adoption focus to a national: broader adoption focus. A total of 20 statements by interviewees were recorded under this code.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B227-B229; C227-C229; D227-D232; E227-E228; F227-F230; G227-G229; H227-H229. The following statement(s) give examples of this code:

“I think there's also different needs to different contexts so taking place based approaches and is an interesting approach, because obviously the needs of Powys is different to needs of Cardiff and Vale so you're sort of adoption and support strategy to focus on smart specialisation approaches in one health board in one different contexts, or do you try and do the all-encompassing

thing getting adopted trans/pan-Wales. I think that that's one of the barriers that many people try to go really broad with these and all the health boards but effectively you've got to pick one and adapt to local context, if it doesn't fit local context not gonna be adopted.” B227

“I would expect so as a as a director within [Redacted company name] **I would expect my team to have understood the local base the annual plan**, but the strategic plan for that particular whether it's the health board in the future will be the integrated care system or the hospital trust, whatever that is **to have really understood it**, and then within that **looked at, where there are a number of potential shared opportunities** so if cardiovascular is a priority. If respiratory is a priority, if oncology is a priority, so whatever those areas are if they are something that they're looking to tackle and within our toolkit regard and I still do that now if I'm representing a particular company understand their portfolio understand a system that actually has a hole in that space and needs that kind of intelligence and support and then bring those entities together to have a conversation and early conversations take time, but if, if I can that you have to have you have to have senior leaders that start with you need the endorsement, the buy-in and the time and to ensure that for success that there is a shared their shared values it's almost cultures have to align.” Quote C227

“when I ran for a couple of years, a programme across 16 countries in Europe, to encourage scaling. And I used to describe it to them, I used to say to them that you know, although **people will say, well, Italy is different, or you just don't understand Germany is different and we need something different**. I used to say to them **all look it's a bit like and you'll think this is weird but,**

like a sausage or it's a bit like beer, you know you all have the concept and you all like sausages and you all like beer, but the ingredients are subtly different and actually that's the important thing that we need to understand because the pathways in different health systems are different. You're still treating rheumatoid arthritis or cardiovascular disease or and you're also doing a fantastic job, but they will be subtly different based on the demographics, based on the infrastructure." Quote C228

"That would then, for anything, well if you deal with that once for our university and local health board, why not then use that for another health board and another health board, so this is what they're looking to do now is to have a not necessarily a common IP policy, but at least a harmonised one." Quote D231

Being mindful of how broad or narrow your innovation adoption targeting is, as well as understanding of the different local, regional, or national circumstances (spatial scope) of healthcare can have an influence in the success of the innovation's adoption. The quotes above give examples of this.

From the Interviewee statements, it generally seems that most agreed starting with a smaller scope for adoption and then scaling higher would be more likely to be successful, but it was not a definite rule, starting more broadly could work in certain instances also. What was clear is that for adoption, it was important to understand the specific circumstances where you are aiming to have the innovation adopted into, both locally all the way up to nationally (or even internationally).

There was also discussion of linking up approaches between different local areas, finding the similarities and differences to approach it in the right way for each place but still be able to scale it as needed. See quote D231, not necessarily a 'common' approach, but a 'harmonised' one.

For the national scope, specifically Wales, there were statements which talked about a 'Pan-Wales' approach vs regional or more local approaches (or the reverse,

to start small with the aim to achieve a pan-Wales adoption), and how you could harmonise that. For example, see quote G227, H227 and others.

This code was relatively consistent between Interviewees, with all having two to three statements recorded, except Interviewee D who had six.

8.8.3.1.2. Policy/Regulatory Effects

This factor was encoded for by statements from interviewees that were concerned with the role of policy and regulations on the innovation process and the adoption of innovations. A total of 32 statements by interviewees were recorded under this code.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B248-B249; C248-C252; D248-D255; E248-E256; F248-F249; G248-G252; H248. The following statement(s) give examples of this code:

*(Asked about effects of regulation) Regulatory change, first of all, you have got to have an environment where you can apply - you have a lever for regulatory change - the government's in charge of regulatory change. And in the pension sphere, for example, you use it to say that people can only take their personal pensions when they're 55, so that's a regulatory thing. You could change that to say 60, so in an instant you can just introduce a law which applies to regulatory and your regulatory authority then applies it and oversees it and makes it happen. So make sure that the industry can do it, and my world of finance is one which is very, very heavily regulated. So is the medical world, and that's **part of the problem in many cases there's the regulatory burden upon adoptees of technology is that you need massively high levels of assurance that the technology is not going to do any harm. That's fine.** So Med-tech, you have things like, can't remember what it is now, you have in Europe, you have categories that*

medical devices have to fulfil, America has the same. So those are regulatory burdens. So **there may be situations where you can reduce a regulatory burden, if you think it's being inappropriately challenging for a technology to come to market.** And that's one of the situations when I referred earlier to, where things like white light. White light is finding a much more commercially successful route in things like the beauty and fashion, rather than the medical because **the regulatory burden placed on the medical environment is perhaps too great."**

Quote E254

(Continuing discussion ways around difficult systems) "The other thing which we saw in terms of the workaround and it does come back to this vex thing of procurement. Where you've got, Something might be better than what's already there but it's almost "how do you buy it?". And particularly, if the best or better ideas are going to come out with your organisation and potentially from the private sector, how do you engage with it or buy it, because that is immediately a procurement dimension, well, you can, not to say obfuscate it, you can look at it instead: well actually it is a partnering. So you have there, and it used to be the **public procurement regulations 2006, section 5, paragraph K, which said you didn't have to go through procurement in the same way for an R&D collaboration,** so if you draw something back to being, **this is now collaborative you can co-invest in something.** But it only takes you so far and I've seen a few places where you know **that has been used, not as a foil, but it's been used to sort of get momentum into an opportunity but it only gets momentum into it, it never gets over the line.** But that's been **one of the ones which there's a workaround."** Quote D255

(Continuing to talk about regulation) "One of the things as an innovation business you need to look at is what regulatory challenges lie ahead and it's far too difficult to try and become a challenger to regulatory environment, to try and get the regulatory levers changed. But that's what I'm trying to do, I'm trying to use regulatory levers to support venture, by educating people who are in control of those levers to say actually if you apply this to the institutional pension world, we can free up capital to come into venture. If you do that it's like opening the lock gates or the damn gates and water will flow where it's needed. And actually then, if you take a view on venture, if you invest now, within eight to 10 years you'll see a return on that capital, certainly at the scale we're talking about, and the whole thing becomes a self-fulfilling prophecy. That's really what you're aiming to achieve. So regulation is a good thing, but you need to make sure it's not over tight and it needs to be checked for its fitness for purpose on a regular basis and I don't see that happening that often." Quote E256

*(After asked about how industry differs in their approach to innovation adoption) "Industry have a different dilemma, so what I saw in industry is that they...so I had a lot of phone calls with people who...so one of my roles is to triage these other people who needed to receive support a bit like Agor IP might do. I think that feels close to what they might do, and so I used to have these conversations where they were like and I still have them where they like we build Apps, "so why the hell haven't we got an APP for – I don't know - picking up a prescription from pharmacy?", "that exists already thanks very much" and then, "why don't you have an APP for doing the Self-management for diabetes and reporting it all back?" and it was just like...and I **had this lengthy***

conversation with someone who just didn't understand the context, he was working in. And what people...so if I put the outsider view on, what they sometimes think is healthcare professionals and governance and regulation getting in the way - it's actually things that are protecting us. So you end down a conversation, which is really frustrating for them. You know, which is like "yes, but!", but you don't do that so much with health & care. So that's the difference, I would say, their [people within health system] in-depth understanding of what's happening is just beyond anything that I think a start-up or an external can have but, equally, it is also the reason why they might not push the boundaries as much. So, I do...I'm not saying that this is all the same, but I do think...I would wonder if what they come up with are incremental changes and something that's a little bit more safeguarded and boundaried [than what] an innovator might do. But equally with that I think what they come up with can move faster whereas an innovator might still need that five -10 years."

Quote F248

The policies and regulations that healthcare is subject to play a large role in innovation and influence innovation adoption strongly. There were diverse views on regulation in healthcare and examples of where it affects innovation and adoption. Per the statements there was no strong consensus whether policy or regulation was inherently beneficial or detrimental to innovation adoption in Wales and the UK, rather it appeared to be contingent on the specific circumstances. The interview statements above give some examples where it can be influential.

The effect of policy and regulation on adoption was affected by numerous things per the statements, for example: how the regulation(s) were employed; people's understanding of them (linked to 'Understanding of Environment' and 'Experience with Innovation'); people's ability to work with or around them; how supportive or burdensome they are toward innovation both in general or in specific

circumstances. The majority of interviewee statements covered at least one or usually more of the aforementioned points.

This factor was relatively strongly linked to others (see Section 4.5, and Appendix K) including 'Finance and Funding' (11 links), 'Understanding of Environment' (9 links), 'Networks and Collaboration' (8 links), 'Bureaucracy and Admin' (8 links), 'Organisational Culture/Structure' (8 links), 'Experience with Innovation' (7 links), and 'Difficulty to Change Existing Practice/Systems' (7 links). Understanding of Environment includes understanding of regulatory environment which was often the reason for the overlap between these two. Regulatory burden often was talked about causing difficulty with financing innovation and this is likely why it overlapped with 'Finance and Funding' a lot.

Interviewees talked about regulations being there for our protection and that while it may be a barrier to innovation, it is often a necessary barrier (e.g., F249). The Interviewees appear to all agree on that, but there it is also clear from most Interviewees that there could be ways to improve regulation or the approach to it to help support innovation while keeping the protections etc that regulation is there for (e.g. D255).

Some Interviewees spoke about the difficulty for industry and/or smaller businesses etc to overcome regulatory challenges and this acting as a barrier to innovation in UK healthcare (e.g. E255, F248 etc). This can be due to the burden of evidence gathering required to show the safety and efficacy of the innovation (of course a very necessary thing to show) (see Interviewee E's statements) but also for other reasons such as how does the health system then purchase and procure the innovation (and how does it justify it) (see Interviewee D's statements) or regulations around working or collaborating with the health system (e.g. C251, G250 etc).

Another interesting point mentioned a few times was how the COVID-19 influenced policy and regulations and how that affected innovation and adoption. Per the statements, the crisis of pandemic caused the reduction of extra or unnecessary steps, speeding things up from a bureaucratic or administrative standpoint (see 'bureaucracy and administration') while still observing all the important points of

why the policy or regulation was there to do. It is summed up by the quote: “nothing was skipped, nothing was left out, there was nothing, whether it was ethics or anything else which was a risk to patient safety or whatever. Everything, all those regulations and everything was observed, but just quickly” (from D252). See also B249.

This code was relatively inconsistent in terms of number of statements per Interviewee: Interviewees B, F and H had 1-2 statements, Interviewees C and G had 5, and Interviewees D and E had more with 8 and 9 respectively.

8.8.3.1.3. “Crisis” (COVID-19)

This factor was encoded for by statements from interviewees that were concerned with the effect of an acute event or crisis on innovation and the adoption of innovation (using the example of the COVID-19 pandemic). Any statement which discussed COVID-19 as an influence in innovation adoption either directly or indirectly (by influencing other factors) was recorded under this code. A total of 21 statements by interviewees were recorded under this code.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B267-B272; C267-C270; D267-D271; E267-E268; F267; H267. The following statement(s) give examples of this code:

“I think on both sides of the coin there’s been enablers and facilities and barriers and so over actually I think it’s been a huge catalyst for change, both internally in terms of health and social care systems, but externally in terms of system private and third sector organisations reacting to it. And I think the value of the third sector has been massively realised, and so, in terms of that cultural piece, on how ecosystems work. People now have much greater trust in the ability of third sector partners to develop innovative solutions to challenges and in terms of generic stuff obviously finance become a lot more available. Regulations have

been relaxed and processes have been sped up and sped through.

And so obviously the admin and barriers so even within the university things didn't have to go to six boards, they may have to go for one board to get approval. As the bureaucracy was, we wiped out almost and it goes back to that point just "get it done apologise later", and I think the mindset of the country went to that. when crisis arises, you need to come up with solutions quickly and, and I think it really streamlined the process, in terms of that and then it identified where the necessary steps were and where the inhibitory or unnecessary steps were also." Quote B267

"I think it's had a huge impact on: The doors are open to the industry so there's a much more willingness. And you know, a greater respect I think you know the industry worked really, really hard to ensure that the supply of medicines was not interrupted, and if you think we were going through Brexit particularly, at the same time as the pandemic and making sure that you know no hospital had a shortage of supply of medicines throughout that. I think that's really driven you know huge amount of respect in terms of you know, and then you know how fantastic it's been you know the UK were the first to you know launch the vaccines and I think that's created a significant amount of opportunity for the industry to be seen in a different light and you know, to move on from that." Quote C267

*(Discussing how we emerge from COVID, what changes what remains) "I think there is a serious risk we return to it but I don't think we can and the you'll have read and heard elsewhere about the waiting lists, you know what's happening there and **if COVID was a crisis what is coming next is going to be even worse the in terms of the backlog of things.** On slightly tangential note I think there's almost the existential risk for the health system, not in*

terms of it collapsing, but of it being privatised because it will be the part where 'oh look at this we'll this mobilise the private sector let's sell off part of the waiting list to Company X' and well company X actually going to employ people you know whether they are nurses, surgeons or whatever well, where are they going to come from so it's only going to exacerbate the staff shortages within the NHS and it becomes it doesn't actually it's not actually a solution to anything apart from privatisation.

*So I think that there needs to be, **all the positive lessons need to be grasped at, things like the video consultations for GPs, or telephone consultations - making that more mainstream**, I think for patients it's been forced upon them, it was the only way they can access things so it's now more accepted or people have realised, it does work. Some of those things need to change and what would interest me would be what that then enables - so do you need the chaos of outpatients in singleton? No, if most of it was being done online and there are wider societal benefits then: people not needing to take time off work to go to appointments in quite the same way, they could do it, you know, obviously somewhere sort of confidential, but in a workplace, because it's online. What does that do in terms of travel, transport, pollution, we don't need as big a car parking singleton, so those are things to keep but **I'm just worried that the response will be looking for other innovations to get out of the backlog crisis which might be, not necessarily unpalatable, but end up creating a different problem down the road, which would be: no longer having a public health system.**" Quote D269*

The above interviewee statements show how the pandemic was talked about in many different ways regarding its effects (both direct and indirect) on the health system, innovation, and adoption. The Interviewees had a diverse set of examples

from their personal and wider work experience and diverse views on the impact the pandemic had in innovation. There is no clear consensus that COVID-19 was either wholly either detrimental or beneficial for innovation and adoption, but per the statements it had an impact both ways in different circumstances.

Some examples of the impacts include: different sectors being viewed in a new positive light due to their response to and problem-solving during the pandemic (e.g. B267, C267, C268); communication and relationships between sectors (e.g. B272, C270); the streamlining of regulatory or administrative barriers (e.g. B267, D267, D268, D271); the allocation of funding (e.g. B268, G268,); the shutdown or change of services or existing projects (e.g. B269, D268, F267); the prioritisation of COVID-19 related work (e.g. B270); creation of opportunity for innovation (e.g. E267, G267); effects related to working from home such as less travel, or reduced communication (e.g. B271, H267); identification or highlighting issues already present in system (e.g. C269); exacerbating issues already present in system (e.g. D269, D270).

As can be seen in the statements, most don't mention the COVID-19 pandemic's direct effects on innovation and adoption in isolation, but rather speak about how it has influenced other factors that influence innovation adoption, such as in the examples of impacts above.

This factor is interesting as if the study had been done one or two years prior it likely would not have come up at all. It is obvious that the pandemic changed many things significantly and of course innovation in healthcare was one of things that was affected both acutely and long-term, per the Interviewees responses.

About half the interviewees had more statements recorded under this code than the rest: Interviewees B, C and D had 6, 4 and 5 respectively, and Interviewees E, F, G and H had 1-2.

8.8.3.2. Environment-Technology Factors (ET)

There were no ET codes out of the 44 codes (0 %). A factor given the ET context code would be considered related to or affected by both the environment and its characteristics, in addition to the technology or innovation and its characteristics. A

factor that came under this code would not overlap with people or organisational considerations.

Even though there were no ET codes, there were two OET codes. These 3-context codes are discussed under Section 8.8.5.

8.8.4. Technology Factors

This section includes all codes assigned to the “Technology” context. In order for a code to be assigned to the Technology context (either solely or in combination), it was related in some part to either the specific innovation or technology and its characteristics, or to characteristics of innovations/technologies in general.

Of the 44 factors, **7** were coded as a technology-related factor (includes T-only factors and any T combination factor). This means **15.9 %** of all factors contained a T coding.

Note: PT factors have been previously covered so will not be covered in this Section. POT and OET factors will be included in “Section 8.8.5. Factors with 3 or more Context codes”.

8.8.4.1. Technology-only (T) Factors

As shown in the table in Section 4.2.2., there were 2 T-only codes out of the 44 codes (4.5 %). Factors which were given T-only code were considered only related to or affected by the innovation/technology and its characteristics and there was no overlap with people, organisational or environmental considerations.

T-only factors included:

- IP
- Measurement/Metrics

The following subsections gives a summary of the data that supports each coding as well as the basis for these codes remaining distinct.

8.8.4.1.1. Intellectual Property (IP)

This factor was encoded for by statements from interviewees that were concerned with the role of intellectual property in the innovation and adoption process. A total

of 6 statements by interviewees were recorded under this code, making it the least frequently recorded code of all of the 44 codes.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B155; D155-D157; E155; G155.

The following statement(s) give examples of this code:

*“So this App, it was you know was created, worked in terms of an MVP or minimum viable product and you think: well, this is great let's do more of it. Well, that is when **it started hitting the barriers so because there was already private sector company involved the ongoing development there was an intellectual property dimension to it.**” Quote D155*

*“the person developing it wasn't a company, she wanted to see the greater good, she didn't care about economic impact, revenue streams and so that, in a sense, made it a lot easier and she was just she just wants to see patient outcomes be better and there was no real economic driver to it, but then obviously the **companies come in and they taking some portion of the IP of this so then that turns into that commercial focus.**” Quote B155*

As can be seen by the statements, Intellectual Property (IP) can have an influence in innovation adoption. It seems that it can act as a barrier that needs to be overcome before innovation can progress to adoption and scaling, but likely in scenarios where IP is more difficult to work out/sort out. There was one example where having a clear IP policy can help to overcome this potential barrier or even act as an enabler if IP is relatively easy to transact (see D156).

Interviewees C, F and H had no records under this code, and Interviewees B, E, G had one apiece. Interviewee D had more than the others with 3.

Due the relatively low number of statements recorded under this code (it was the least frequently recorded code), it could be suggested that IP plays a relatively minor role in innovation adoption. This may be because as with other factors, IP may be more important in earlier stages of innovation process and may come into play less frequently (but not never) when looking to get the innovation adopted and scaled. It could also be that IP comes to mind less when considering innovation adoption, so the Interviewees mention it less often. However, the low number of statements by some interviewees and no mentions by others suggests that IP is a much less important factor to consider than others when looking at innovation adoption, and may only be necessary to consider in specific circumstances where IP needs to be sorted out/decided upon/transacted.

8.8.4.1.2. Measurements/Metrics

This factor was encoded for by statements from interviewees that were concerned with how relevant measurement or metrics surrounding an innovation influences its adoption. A total of 14 statements by interviewees were recorded under this code, making it the 9th least frequently recorded code.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B273; C273-C275; E273-E275; G273; H273-H278. The following statement(s) give examples of this code:

“two things for that I guess. there's services don't measure the efficiency for much of this, so there's no systems in place to say we got this system here, Is there better systems, or is it inefficient for what we're doing, and the second point to, that is, they don't communicate any of that anyway, so, if you were able to identify, communicate and provide solutions through , partners, the adoption process would then almost be a tick box, because you would have proved that value case you'd identified the need, you would have got partners involved and so it's that and I think it just

because it's such a big system these aren't getting identified and definitely not communicating.” Quote B273

*“The right tools and for the **right tools that's about having some form of system that can measure the outcomes** so, You know what's the infrastructure what's that how are you going to make manage data, how can you look at if you're going to **if we're going to make a statement that by transforming this pathway it's going to release X amount of savings. How are we going to measure that** what we're going to do so, making sure that there is some form of ability” Quote C274*

*(Continues [system-wide innovation discussion] discussion): “Well, I think you know it's I think there's a there are probably a number of reasons, one is that it's the way... There has just been a big focus on.... and so, what happened, I think, in health care is that you had a revolution around the development of evidence-based medicine, whereby you developed, through rigorous study, evidence and that evidence was then has been typically translated into guidelines, which is partly what NICE has been doing for the past 20 years and those guidelines are then used to support clinical practice. So there has been this real focus on doing that for good reasons, because it was thought that this would be a very, it's a good way to ensure that we're acting according to the best evidence. **That's led to this big increase in the measurement of process and structure**, all of which I think is important but that has, then I think highlighted and as we've started to see, and as I said at the beginning, **there is still a gap, because you can apply the best evidence, but it doesn't mean you're necessarily going to get the best outcome**, and I think the other reason probably is: it's quite difficult, **it's easier, I think, to measure process/structure. But to actually capture these outcomes and to***

do it in a way that is meaningful, is technically quite hard, but the other thing that I think is an impediment for sure, because it takes a lot of time it takes a lot of investment and, of course, a lot of people in the NHS have very little time and from an investment perspective, of course, there is never enough money in in the health service so it's difficult to make significant investments. And I think probably the third reason is, it does help to further empower patients with choice and preference and equalising the conversation, and I think a lot of people want that in healthcare, but it probably does challenge, some people who are not used to that to that sort of thing, and that might have also just contributed to slowing up its adoption.” Quote 274

The measurements taken and the metrics recorded that relate to an innovation can have an influence on that innovation’s adoption. While not a very frequently recorded code, the Interviewee statements highlight the importance of using the right measures and metrics to support the innovation, as well as the detriment caused by measuring things that are less relevant to the success of the innovation (before, during or after adoption).

Interviewee statements suggest that currently, many things are measured, and much data is gathered, but more useful, important, or relevant measures could be taken in theory, and where this would be implemented adoption would be supported. For example, focus on measuring patient wellbeing outcomes or ‘value’ vs other clinical e.g. physiological data (discussed by Interviewee H in numerous statements). It is suggested that this is the case because it is more difficult to measure these other things and so there is a tendency to measure easier things that are more readily quantifiable (e.g. H278)

It was a relatively inconsistent code, with two Interviewees not having any statements recorded under it (D and F), two having one statement recorded (B and G), two having three statements (C and E) and one having six (H).

8.8.5. Factors With Three or More Context Codes

There were few factors assigned three or more Context codes. This included **1 POE** factor (**2.3%** of total), **1 POT** factor (**2.3%** of total), and **2 OET** factors (**4.5%** of total). Even though there were few 3 or more Context codes, these factors were significant, with two of the four (“Demonstration of Value: POT” and “Finance and Funding: OET”) being the joint 7th most frequently recorded codes.

The four 3-Context code factors were:

- Political (POE)
- Demonstration of Value (POT)
- Finance and Funding (OET)
- Trialability and Testing (

The following subsections give a summary of the data that supports each coding as well as the basis for these codes remaining distinct.

8.8.5.1. Political (POE)

This factor was encoded for by statements from interviewees that were concerned with the role of political decision-making in the innovation and adoption process. A total of 16 statements by interviewees were recorded under this code.

It was considered a P, O and E code because politics and political decision-making in the situation of innovation and adoption is related to or affected by people and their views and actions, organisations and their actions, and the environment in which they both operate that shapes or serves as the background to the factor.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: C258; D258-D266; E258-E260; F258-F259; G258-G261. The following statement(s) give examples of this code:

(Asked about resource issue political only or influenced by other factors) “It is purely political, and I'd say, this is going to sound more like a daily mail reader, or sort of further right than that. But it is the honest conversation with the public and no politician dare go near it because of the 5 year electoral cycle and or whatever

it's going to be, and that is where you can see **well you got the choice, more needs to be paid in taxes, by somebody, and you can see distribution of where that should be, or your expectations about what the system can offer and I'm not saying that we withhold care from every octogenarian and say no you've had your money's worth out of the public system, but that that does need to be that that honesty** I think the public will come down, as we saw over the Brexit referendum before, that people won't see more money go into the health system, quite generally they don't want it to be their money. But they do want to see that resource go in, they want to see that health system.

But it's just that honesty - it's solvable. **In terms of GDP percentage of that we spend on health and social care compared to other countries, countries which are behind us in terms of what would be considered wealth. The US spends a damn sight more and gets a lot less out, sides but that's because it's quite a regressive in terms of access to service, so it is purely political."**

Quote D261

(Discussing appetite for changing system, what needs to happen)

"Well, on that, and I'll abstract this, but **it goes back to the political bit**, because there were proposals for [third sector hospital], again independent, a third sector organisation, not private sector, to co-locate in [public hospital]. It was Pooh poohed or **blocked on a basically a political piece and say "Ah, we can't have the private sector there"**. Well first of all it isn't private sector, and [second] why not, because they're going to go somewhere, do you just want them out of sight and out of mind? And this is the part where I can attest, I'm not a mad red flag waving Corbynista, because it was a sort of **a Labour Party dimension which blocked that. It was against it, almost as if it was a completely incompatible ideology: either NHS or not NHS.**

and it's all, "no, what you should focus on is what is best for patients, what maintains the values: it is still free at the point of care, it's still accessible, we're not lining the coffers of shareholders in the US or something or some hedge fund, so it is acceptable". And it works, it gives opportunity to staff: the best clinicians will be attracted because they can see there is scope for extra work beyond their NHS contracts. So you think well just have the honest discussion with the voters of saying, if they ask, "well why is there a private hospital in [public hospital]?" And if you say, "well actually they're subsidising the bedding plants and, by the way, that is part of our waiting list reduction, Oh, and it is a charity, and there is this engagement with the NHS." I think that the man in the street or the one who will be putting his cross next to it [ballot box], wouldn't see that as being a travesty to their sort of socialist values, they'd see actually that's a way of preserving it." Quote D264

(Asked whether miscommunication plays role in hampering things) "No, I think it's everything which is divisive in politics, and it's the thing, where honesty gets trampled on so it's why you can put 350 million on the side of the bus, it's why you can say we will build 60 new hospitals, it's why you can say we will have 50,000 new nurses. That drowns out any well-reasoned discourse. So that that is, that is the problem where would you have that conversation with the public? If you're you know politician and you're going to be honest and say 'higher taxes, lower expectation' and someone will be saying 'ah, but I'll give you the moon on the stick, you won't have to pay it', that is where democracy is broken, that's what I think the difficulty is, and that is why it needs that leadership, you know, to create the conditions, then for what might be the lower level innovations,

that would be more like continuous improvement, rather than what is the sort of the paradigm shift.” Quote D265

(Continuing to discuss health system) “So we can have, and [Redacted company name] for instance had unquestionably the best technology in the world for doing this, and gained great column inches about it, but could you get hospitals? No, you couldn't have hospitals, you could get doctors who would support it, but the hospitals wouldn't support them to introduce innovation. So, I have seen first-hand several examples of world leading technology, you know, ground on the rocks when it tries to engage with the best - what should be the best adopter, and the government have stated, should be the best adopter and the best process of adopting innovation. But it doesn't. It is because too many... you know I think it's probably one the greatest truisms again and the truism is that in Britain, people in senior roles within large organisations see their opportunity to be to demonstrate power by saying no, in America they demonstrate power by saying yes. And that has been our experience and the businesses we were involved in, their experience with NHS, time and time and time again. And academia is not too distant behind that either.” Quote E259

The statements above give examples of how politics and political decision-making can have an impact on innovation and adoption. This factor could act as a barrier or enabler to innovation adoption depending on the circumstances, based on the way political power is wielded, but it appears that in the current environment, it is acting as a barrier to innovation adoption.

As mentioned, this factor was encoded for by any statement which discusses the influence of politics and political decision-making in innovation. This could be the way in which the government directs resource / invests in or supports innovation

activities and/or the health system, enabling or disabling innovation to occur (e.g. C258, D260, D261, F259, G258,); the political impact on the interactions/relationship between sectors and the effect that has on innovation (e.g. C258, D258, D259, D264, G259, G261); the impact of leadership in politics, and of politics in leadership (e.g. D262, D263, E259, E260); the divisiveness inherent in politics (e.g. D265); the ideological impact of politics on the health system and innovation (e.g. D266); the impact of 'arm's length' public organisations which can operate regardless of politics/government at the time (e.g. E258); potential conflicts of interest by being connected to government in certain ways (e.g. F258).

It was most often talked about as a barrier, but there were statements that suggested that political decision-making in favour of innovation, adoption and so on would act as an enabler, but that is not generally the case currently. See statements D262, D263, E258, G261 for example.

This factor was relatively inconsistent between Interviewees, with two having no statements recorded under it (B and H), most having relatively few (1-4 statements for Interviewees C, E, F and G) and Interviewee G having more than the others with 9 statements.

Interviewee D brought up politics many times and it was involved in many of their responses to different points and questions, suggesting it was a very important factor to them. This could be based on their background, experience, and views. It could also be because they were more open in discussing politics than others, as it is an often-avoided topic. Therefore, it could be possible that others have strong views on politics but were less likely to share them explicitly. Some may have shared them more implicitly and so a deeper analysis into Interviewee responses could possibly gather their views on the politics surrounding the health system and innovation.

8.8.5.2. Demonstration of Value (POT)

This factor was encoded for by statements from interviewees that were concerned with the communication and demonstration of the evidence base or value or business case regarding an innovation to the potential adopters of it. A total of 37

statements by interviewees were recorded under this code, making it the joint 7th most frequently recorded code (with “Finance and Funding”).

It was considered a P, O and T code because demonstrating the value of an innovation is related to or affected by the technology itself and its value, and the people and organisations who have to communicate or be communicated to regarding that value.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B99-B101; C99-C102; D99-D100; E99-E103; F99-F105; G99-G104; H99-H105. The following statement(s) give examples of this code:

“my biggest thing for them, for each of the partners actually, was demonstrating the evidence-based the data driven and almost producing that value or business case to protect[present] them on the desk that they couldn't deny. We have the evidence to suggest this works, and there is scope, and this is how we could make your lives easier, this is how we could save you money in the long-term, and if you can get that across to each of the partners, it almost presents on the situation which they can't not engage with and that was quite a big part of it.” Quote B100

“clinical advocacy as we've talked about the evidence base, making sure that the individual that is positioning the innovation or the proposition to wrap around the innovation, understand so and is credible in the way that they're positioning that so that it's compelling so whatever that messaging in that is around it and not just you know this, you know this tablet will you know cure this, but what else what what is it that it would do that's different than the current standard of care, so the more that.” Quote C100

(Continues discussion on factors influencing adoption) “...So **you need to form an effective business case. you need to show the product, first of all, meets the market needs** so in their context, what they want to do is develop a medical technology device which can be given through the/procured by the NHS or social care or charities to give to aging populations, with or without cognitive impairment or dementia, but **what they fail to do is to connect with health board in developing the case for it really, how do you show that there is value in this product.** At the moment, you get a lot of marketing – “I know best, I know there's not quite any product like this on the market”, blah blah blah - **but it isn't developed with the people who probably know best i.e. the support network for a person who's going to use in the end, the end adopter.**

Here so and **what you see, time and time again, is there's very similar products on the market, there's no differentiating factor for why one might be adopted another might not be adopted is under the plastic under the hood they all do the same thing, they've all got the same CE mark and all of the approvals.** So that's when it becomes about you know **what influences a clinician to adopt a certain technology,** what do you imagine if it's already socialised and co-developed with them, then it's going to meet the need of the clinician, the practitioner because they've informed the bloody development so that's again another example of bringing the right people on board at the right time, probably sooner, than most companies care to admit.” Quote

G103

(Asked about how you get people on board with a significant healthcare innovation) “Yeah I think **people just need to know and understand what value-based healthcare is,** because it isn't

any... I mean it resonates with most people, because who would not agree with trying to get better outcomes at a lower cost. So the idea resonates, the reality of us not doing it is, up until now in general, is a fact, so I mean again people generally agree with that. So then it's a matter of saying how do we do this? What's the approach? And that's where we then need to get specific, and of course these types of case studies that you've just asked about are helpful I think in persuading being in showing people that can be done... (Interviewer: like the cases in Wales and Germany?) ... Yes exactly." Quote H101

The communication or demonstration of the evidence base, value or business case of an innovation can influence that innovation's adoption. The consensus from the Interviewees is that is very important to communicate or demonstrate the value of an innovation (and to communicate it well) to potential adopters and stakeholders to enable adoption. The inverse, a lack of good demonstration of value or poor communication will act as a barrier to adoption. The quotes above give examples where this can be influential.

A good understanding of what information/evidence/value adopters and stakeholders need to have demonstrated/communicated to them to support adoption (e.g. B100, C100, G103, H101 and more) is also important. This can be a number of things including the evidence supporting the innovation's use; the benefit to the organisation and individuals within it; examples of its successful use in other places; the costs (and potential savings) involved in implementing the innovation; potential risks associated with the innovation and mitigation of these; as well as any other salient points surrounding the innovation and/or that may go in a business case.

As briefly mentioned, another important point for this factor is that demonstrating the value is important for all stakeholders in the innovation and adoption process, you cannot 'just change the minds of one or two' (see H101). This can be clearly

seen across many of the different interviewee statements, suggesting this plays a significant role in this factor's influence.

It was a relatively consistent code between Interviewees. Interviewees B and D had fewer statements recorded, 3 and 2 respectively, but the remainder of Interviewees had a range of 5-7 (see Section 4.4, and Appendix J).

8.8.5.3. Finance and Funding (OET)

This factor was encoded for by statements from interviewees that were concerned with the role of finance, funding, and other costs in the innovation and adoption process. A total of 37 statements by interviewees were recorded under this code, making it the joint 7th most frequently recorded code (with "Demonstration of Value").

Finance and Funding was considered an O, E and T code because when it comes to innovation and adoption was related to or affected by organisations to either require or give funding, the environment such as with how easy funding is to secure in the current climate/ certain circumstance/environmental context, and technology, i.e., how easy is it to secure funding for a technology based on that technology's characteristics.

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B144-B146; C144-C148; D144-D147; E144-E154; F144-F148; G144-G149; H144-H146. The following statement(s) give examples of this code:

*"it's about understanding the environment and almost looking to those within the systems that are already willing to partner and innovative so there's no point in going into systems that are hostile to the industry actually, in reality, although it will be great to do if you had abundance of resource, the **industry is perceived as cash rich , but in reality you've got a finite resource**, so if you're going to invest, because those programmes disproportionately cost a huge amount to invest in: You **need to***

***be able to back a winner** in a backup pedigree somewhere that there's proven willingness and desire to work together so firstly, an analysis of the environment to say where across the UK are their organisations that are willing to partner with the industry and co create to deliver shared value . Because, ultimately, and **you want to be able to have a transparent conversation that actually says there's a benefit for us as well, because if not, why would we do it and reality if we can't drive up and support innovation being adopted patients don't benefit for it from it, and neither do we realise the value from the medicine** and they're beautiful, as you know, reinvest it back into research to innovate the future cures, so you need to be able to have that legitimate conversations” Quote C146*

(Discussing funding innovation) “No it's always a problem, anybody with money has a responsibility either to themselves or somebody else to establish a return on that funding. And that return, it can be a moral, ethical based return, they want to see some good out of it, at one end of the spectrum, the other end of the spectrum, they want a return. And that first engagement with the business is either because the business is talking to them or they’re talking to the business they've heard about it. And everybody has what I would call it a risk-return premium, as risk-reward premium and they are prepared to give money on the basis that it will generate a return for them and that's another truism that's a law, an immutable law of investing.” Quote E144

*(Talking about institutions understanding of funding innovation)
“Yeah some institutions are much better at it, the management schools that have much closer links with funding can be better at it, but I think it's done very poorly, because it's just not understood. You don't find people from the funding world cross*

over into academia. There's lots of people with technology experience who will go into academia, to talk about their technology they've done or other things, academia doesn't come and try and find funders. It's almost funding is almost a vertical, it is all enveloping but still it's a vertical that is very poorly understood by many people. It's just one of those things "Oh I'll just leave it". And, of course, academia is riven through with grant funded elements, and they know all about that. How many people in academia have actually done anything more than write about it, that it exists as an issue, how many practical, pragmatic and experienced operators are there in academia, who actually can talk first-hand about the experiences? That's what [Redacted name] and I've been trying to work on for years, is trying to get people involved or getting come along and talk to people on a regular basis. At least I try." Quote E153

(Talking about barriers) (asked about how to fund innovation) "it's still a guarded world, but I think that people are still expecting cash returns on innovation and I don't think that's right and it's never been. Like start-ups never could do cash returns so why should innovation do it and that's the first thing. but I think that we shouldn't talk about funding we should talk about investment in health and care. So we shouldn't be comparing innovative work to funded work, we should comparing it to how do we invest in this for the future. I think the dilemmas for health and care is it's only got a small pot and clearly where the venture capitalists are financing, you know they're going to lose 80% but make good money out of 20%. I don't know if healthcare is going to afford to do, that's where the risks come in.

My take on it is people do a lot with very small amounts of money so actually the culture and the support is so invaluable. that sometimes it's not the money, often it's not the money that we've

seen play out - if someone's telling you they can't make a business case because it's the money, it's not always true. That's what I've observed anyway." Quote F147

*(Continues talking about barriers) "I'll tell you **what's a proper barrier now is funding and the lack of funding**. That's a good one.*

***The lack of flexibility in resources** as well, so reallocation of money once you've got it. Projects are continuously evolving, they sell them linear, so it's having the right mechanisms to adjust and say "Okay, we can't pay for what we said we'd pay for in quarter 2 of 2021, can we pay for it in quarter 3?"*

(could that be built-in logistically?) It depends really, because we get money from lots of places, if you're talking about a grant from Welsh Government let's say, they're usually quite strict in terms of you need to have invoiced us by a certain date, the money's been shown to be spent so you can get the money back to us, effectively, spent and reclaimed.

*But an example where the university lost out five grand was for dissemination activity, so dissemination of research findings in open access journals, yeah I'm sure that we could have as a university put - and this is come back to **resource fluidity or kind of flexibility and resourcing** - if I found five grand to pay for something now and sent the invoice to Welsh government saying look "we've paid five grand for dissemination activities" and then either put it into a - I don't know if it's possible – but either put it into a subcode in the university to be used later, so there's no time limit on it, because papers don't get written in six months, when you're doing the research as well, and then you could revisit that and use the money, but that there wasn't that kind of...I suppose as a step change in thinking, radically change your thinking from the very kind of linear processes to thinking, there must be other*

ways of dealing with it.

So financial flexibility or resource flexibility is important and that comes from interdisciplinary working. People will go out on a limb if they trust you because you've built that relationship with them."

Quote G148

Finance and funding is clearly an important factor in innovation and adoption. This can include the ease or difficulty in securing funding, the way in which (how) innovation and adoption is funded, the reason it is funded (why), the amount of funding required and available, the flexibility in funding, the knowledge of how and where to secure funding, and any other points surrounding the financing and funding innovation in relation to, or that affects, adoption. The above quotes give examples of how this code can be of influence.

Per the interview statements, it seems that funding is always a factor that needs to be considered in innovation and adoption and may normally be a hurdle to overcome, but is not always necessarily a strong barrier, and there are ways in approaching finance and funding which may help to alleviate some of the difficulties which may make this factor trend toward being a barrier. Indeed, a fair number of statements talked about funding in a positive way, i.e. acting as an enabler (see positive green statements), if approached in the right way. It seems that the availability of funding for innovation enhances this, for example a few statements noted how COVID-19 increased the availability of finance in certain circumstances (e.g. B146, G144) and also bodies that are focused on funding innovation can be beneficial (e.g. B144, D144, F145)

This was a relatively consistent code between interviewees with a range of 3-6 statements each with the exception of one outlier, Interviewee E, who had 11 statements under this code, skewing it upwards in the total number of statements recorded under it. This is likely due to Interviewee E's background of finance and venture. They had numerous examples of different challenges that innovators face in securing funding, as well as trying to fund things on the adopter's side. They also

spoke a lot about the lack of knowledge and experience with the finance and funding side of innovation acting as a barrier in many instances.

All in all, the Interviewee statements suggest this is again a relatively complex factor with a lot of things that influence it, and it also can influence innovation and adoption in various ways

One may think that things are not possible due to money or cost, but this research shows that there's myriad other factors that have a strong influence on innovation and often cost is not prohibitive, or it may only be artificially or arbitrarily prohibitive if there is something blocking it.

8.8.5.4. Trialability/Testing (OET)

This factor was encoded for by statements from interviewees that were concerned with how easy or difficult it is to trial, test or pilot an innovation in different areas/circumstances before wider scale adoption is attempted. A total of 15 statements by interviewees were recorded under this code.

It was considered a O, E, and T code because the ability to trial or test an innovation before wider adoption was related to or affected by organisations and how easy they made it to test innovation, the environmental effects such as regulations which will modulate this, and the technology and its characteristics that would affect how easy it would be to test (e.g. the difference between and invasive heart pump requiring major surgery or a modification the service/practice delivery [e.g. speech therapy innovation] to improve outcome).

All interviewee statements which contain this code can be found in Master Data Display (see Appendix I) under the following cells: B240; C240-C241; D240; E240-E243; F240-F241; G240-G244. The following statement(s) give examples of this code:

(Talking about a company's innovation) "...They were able to pivot from looking and using the their technology for looking at cancer towards repurposing, redeveloping, and then conducting a study with us using the same type of technology, but looking at COVID in

ultrasound scans. So it's almost a step change with respect to the disease that you're looking for, however, the underpinning tools and technology was applicable across the board across disease settings which was really great. So we needed the right people on the team, on this multidisciplinary team to take it further. Essentially we needed access to the Health Board, which is important for trialling and evaluation and research and development of products, and we need the right people inside the partnering organisations who know how to circumnavigate and get the best out of internal processes.” Quote G240

(Discussing difficulty of getting innovation to market) “if you're going to be involved with anything to do with humans then, and I've/we were also involved in a business called [Redacted name] it [has a product which]... ...was the cutting edge of compound technology, you apply it and brilliant it killed super infectants, but **the development of that and the allowance of it to be used in humans and meeting the trials data, because as you can probably imagine, there are so many different twists and turns of clinical trials data required if only it was as simple as go out there and just do it and see if it works well, does it work?** For [redacted name] they had countless different challenges in trying to demonstrate, really what I call as a military pilot, the probability of kill, the pk ratio. And then, what percentage of the of the bug that it can kill it, needs to be pretty much close to 100% and they can demonstrate that on a Monday, could they do it on a Tuesday, could they do it on a Friday? and these sorts of things, so you think you just go and check demonstrate how it would work, but no, it **has to be different countries, different types of people, so the permutations of variety are almost infinite and that's very challenging for a business.** If we look at IPL (intense pulse light), now it's medical application, its beauty application, there's no...

It's not particularly surprising that technology can get on a beauty or non-medical application for commercialisation it will do it because it has significantly less obstacles to actually approving and generating revenue because it's all about ultimately generating revenue. Because it's actually all about generating revenue if you are going to keep the business alive and drive it forward, that was a challenge with [Redacted company name 2] and you can't commercialise it, because you can't get it into people therefore it's gonna take you a decade more before you can actually see some revenue coming back from it."

Quote E243

*(Discussing an innovation) "We worked with the academic and the company to develop the initial idea effectively about what the needs what the priorities are the functions are, we talked to care home staff we talk to players within the NHS, GPs to understand what their needs would be and to understand how they think best work and with them worked with the company, alongside the academic to **develop a prototype system and which has now been developed and is going into alpha testing phase, alpha & beta testing phases.**"* Quote B240

The example interview statements above show how the relative ease or difficulty of trialling and testing an innovation in practice prior to and potentially in support of wider adoption can have an influence on its successful adoption.

This code was influenced by a number of points as may be expected as it was assigned three context codes (O, E & T). The adopting organisation's view of and ability to test an innovation or innovations play a role, as well as the characteristics of the innovation or technology which may influence how difficult or easy it is to trial or test out prior to adoption, and this may be contingent on the regulatory

requirements placed on the innovation due to its category, in addition to other environmental factors.

For example, Interviewee E had a number of statements which discussed the difficulty for smaller businesses to get medical technologies adopted due to the need for trials data (clinical or otherwise), and some seek other routes for their technologies use (e.g., E243) due to the regulatory burdens making it difficult to get to market in healthcare- and even if they do get to market there is no guarantee for adoption.

From these examples it can be seen that characteristics of the technology can have a relatively strong effect on this factor. This could include: the invasiveness of the technology/innovation (e.g., a medical device implanted surgically versus an optimisation of a care pathway i.e. service improvement); the regulatory requirements affecting the technology (previous example works here also); whether the technology is disruptive or incremental change, or fits adjacent to existing practice (links to 'difficulty to change existing practice') (see F241);

The organisation also plays a role, often in granting access to allow for trialling or testing of technology (e.g., B240, G240), and also in the aforementioned point in how difficult it is for the organisation to change what is already doing to accommodate the innovation.

Each Interviewee, with the exception of Interviewee H, had at least one to two statements recorded under this code. Interviewee E and G had slightly more, with 4 and 5 respectively. Even though it was a relatively infrequently recorded code, it is clear per the statements that it can have influence on the adoption of innovation.

8.9. Appendix I – Master Data Capture Display

The Master Data Capture Display was an excel spreadsheet created to record all interview data related to the adoption of innovation in healthcare. Each quote from an interviewee, or ‘data chunk’, that contained a reference to a factor that influences innovation adoption (i.e., the 44 codes), was entered into the spreadsheet in a cell under the interviewee’s column and the code’s row. This meant that all data was in one location for the subsequent analyses to be performed (presented in Appendix J, K, and L).

Below is a screenshot example of some data chunks from three interviewees (columns) which contained the code “leadership”.

Leadership	<p>(talking about level of decision making for innovation adoption) So I say that in my view at least half of our innovations exemplars sit in that category of clinical team can make a decision. But there's an APP, for example, for dementia triage, which is verging on the type of technology that I think will be prevalent in about three to four years - if it comes in because they already exist in different guises, but basically the biggest problem there for that particular exemplar was that the clinical team didn't buy into it. So the clinical team had to believe that a machine would do some triaging, where a professional [would have done] it. You've already got that immediate barrier that's going to hit, whereas the family intervention I'm talking about, it's not saying we lose something we already do, it's saying layer it up because likelihood is you were never doing it. The same with that heart failure one actually layer it on because you were never doing it before - this is a “stop doing what you're doing right now and bring in an APP”. Obviously you don't do it to 100% but even if you are doing it to 10%, it's still a “stop doing what you were doing”, you are not going to double them up because that costs too much. And actually it didn't go very far because clinical team said no, so in that situation...my view is that the health board should have stepped in. So while they didn't need money, it probably needed senior level support to tell the clinical team that this had to happen, or at least a tested scenario had to happen.</p>	<p>(asked about skill level in innovation) I'd say, if it's on a maturity scale of (I'm definitely not the best person to place this) but I've met a lot of people that are doing this work in various positions I'd say, you know, we're doing really well, I say we're about two and a half, three out of five, in terms of maturity of doing that pan Wales, and the reason for the other projects like the accelerate project which endeavours to bring on universities and health boards and local governments together to do exactly what your project is about adoption of innovation into health and social care and that's fantastic. There's entities like agor ip, accelerators for commercialization and IP protection of certain products so things like that really have a kind of a pan Wales remit if you're talking to national level stuff that we're getting towards it.</p> <p>But the reason I haven't given it a four or five or five or five is because there's still a call from Welsh government, and I'm now part of a tender, where I need to develop the technical specification for how Welsh government can amend their policy to ease innovation/commercialization of innovation and that's inwards and outwards looking with respect to the health boards it's the health boards developing something going “is there a benefit? is there a value? can we deliver the right outcomes and benefits to patients at the same or less cost? or externally, is it cheaper to go elsewhere?” Do Oncolise realize, do they have a service we could procure, which would do the job just as well, or better for the same or less price. So it's that type of dynamic, I think that still isn't totally understood and part of that is because the processes for private versus public sector, you know just governance, finance, you name it, anything is completely misaligned because they don't work very well together and even if you look at inside those groups of public sector organizations, so the challenge of getting the university to work with a university health board, even though the university's on it, the challenge of bringing those two together to do anything, let alone, looking at the private sector influence, is a challenge in itself. There are processes there, but there aren't many people familiar with transcending the whole process of getting everything together, so this tender goes looking at what's available out there, what models are currently in existence for commercialization of innovation, either way, public to private, private to public whatever it is, and is there any alignment and how do we advise government to help us in terms of policy, to get there easier, faster.</p>	<p>(asked about why Wales was different in supporting value based healthcare) Well, I think, it's probably to do with people actually. What I think Wales has been very fortunate about, it's been very fortunate in Wales is that a number of very senior people with the power to, with the hard power and the soft power, the hard power to actually direct resource in the direction of this type of work and the soft power to be able to influence colleagues and to build up and excitement and support for this, I think has been tremendous in Wales. And so there has there has really been that initial, back almost about eight years ago, there has been that initial core group of people who got it going and I think have remained with it actually all the way through. And I think the other reason was that there was, I think the strategy for doing it Wales was a really good strategy. Started off very, very small, in one little area of one health board, a small disease area. That was shown to be successful, and then it has gradually scaled since then, in parallel with, trying not, I think, to force people, but to create this movement almost and I think there has been a movement, and that has created quite a lot of excitement nationally and that has enabled some more top down, structure and processes to be put in place where, and I think it has actually worked very nice, so the two have, both top and bottom [have come together].</p>
Leadership	<p>(Talking about decision making on innovation adoption, at higher levels) So, so I guess [redacted] has one view which is interesting that she's trying out, which is a doctor or justify why you're not, which I would quite like to play out, we haven't played that out. I'd quite like to play that out and see what it does.</p> <p>So there's one part of this conversation, if I say the dementia triage APP, for example, when a health board watches this play out and they need to be intelligently watching, because obviously this exemplar is not going to go back and say “Oh, you know my team member is playing up” [inaudible]. We heard it from an innovation lead who'd notice it. [So I interviewed the innovation leads as part of our project and she'd noticed it but didn't do anything about it, it might have felt too cumbersome, there's probably lots of other factors around this. But ultimately I think a health board has to decide whether they want to consider the role of, in this case technology in dementia triaging and, in my view, undertake a due diligence exercise that says clinical teams dismissed it, is this the right thing for the organization to dismiss it, regardless of who the exemplar is and they bought that concept in and I think that concept should have a fair hearing, and in that fair hearing if I turned up to it, I would say, well, they're talking about an APP but I left a project in Exeter, which was talking about artificial intelligence being used to do the triaging, right, so you're already down this technology route, whether you like it or not, and there's good evidence starting to emerge about it, so “what are you going to do?”, it doesn't have to be the APP: “what are you going to do to shift this scenario because it's inevitable?” That's what I would like to see anyway, in terms of what leaders would do.</p>	<p>(asked about how diff orgs work together for innovation) yeah I think it's getting the key stakeholders in all organizations, doesn't matter if you are large or small, notify at the earliest point, so processes get ticking in the background anyway, as the discussions are still forming. And everybody needs to be a part, everybody who is relevant to the process needs to be brought in when relevant.</p> <p>Because what happens is a really exciting idea, it gets the point where you write the project plan, but you haven't informed, perhaps finance, you haven't informed ethics and governance, you haven't informed, perhaps the department you thinking of running the research in. So, a lot of the time I imagine happens right at the end, after the ideas have crystallized, but what that means then, is those guys haven't had input and they could pick holes and/or complement to what you've already done, the plan. And it just means you got to do everything all over again, which doubles the time, you know what I mean, so that type thing is keeping people informed, the right people informed at the right time.</p> <p>(adds further comment) They've got a fantastic process all right in Hywel Dda or at least [redacted] who is the I suppose the chief investigator for the health board of the project, I think. He has a great process of pulling the right people into the right conversations at the right time and things sweep through and what you get, then, is because things are moving so swimmingly, so quickly, so smoothly, people start to question, people start to throw their opinions usually into the mix and get involved, stifling progress when things are all in hand because people who are very experienced know what does and what doesn't need to be done at the time, so they think bloody hell this is way too smooth, there must be a problem here and they grab onto it and they stop it moving and that's usually because of inexperience, not because they want to cause harm to anything, it is because they're not quite sure what the pathway is.</p>	<p>(asked about how the current system is with respect to professional autonomy) I think it varies by professional group, so I think most doctors definitely feel, I think this is the case, are generally trying to create new things, a lot of the time. I think they do feel as though they have the ability to do that, and my sense is that it's sometimes less in other health professionals operating within our health system, so I think it's probably good for us to be able to encourage that so that everybody has this feeling, not just the feeling, but this actual autonomy to get on and do things.</p> <p>And I think the other thing that we, we have to encourage and I think this is the culture, I think I mean with these cultures do evolve to as, And I think he probably is in a state of evolution what we obviously don't want is everybody doing their own little things and then you have millions of things and not very much cohesion. And I think then you do need systems – I think these systems maybe could be stronger, but where ideas, of course, are encouraged, but that we are all aware of the fact that we can't do everybody's idea and that's where leadership comes in, of course, that then hopefully people can coalesce that around a few things that we then drive forwards. But again, the key bit, I think that is everything, and it comes back to your point about innovation, everything has to be focused on how is that going to contribute to the outcome, and we have to measure that to actually see has it actually contributed in the way that we expected to the outcome.</p>

8.10. Appendix J – Relative Importance of Factors

8.10.1. Number of statements recorded for each factor for each Interviewee (in order of factor discovery)

POET #	Theme/Factor	Total	Interviewees						
			B	C	D	E	F	G	H
P1	Motivation (Why Innovate?)	28	3	5	7	3	4	3	3
P2	View of Other Sector	23	1	6	7	4	2	3	0
PO3	Clear Vision / Culture	24	3	3	3	2	4	3	6
PO4	Alignment of Actors/Objectives	38	3	5	6	4	7	12	1
PO5	Networks and Collaboration	42	5	7	5	1	5	15	4
PO6	Leadership	45	4	9	10	7	4	8	3
P7	Champions	18	2	4	3	1	6	1	1
PO8	Empowerment	30	1	1	5	2	9	6	6
PO9	Boundary Spanning	18	2	1	3	3	1	8	0
P10	Trust, Reliability, Relationships	42	4	4	6	4	9	13	2
POT11	Demonstration of Value	37	3	7	2	5	7	6	7
PO12	Identification & Communication Of Need	32	6	5	5	6	1	6	3
PT13	Experience of/with Innovation	38	6	2	5	12	2	11	0
PT14	Experience of/with Technology	8	0	3	0	0	2	2	1
P15	Personality	25	2	2	5	3	5	7	1
O16	Bureaucracy and Admin	32	7	2	5	6	2	10	0
OET17	Finance and Funding	37	3	5	4	11	5	6	3
T18	IP	6	1	0	3	1	0	1	0
O19	Organisational Culture / Structure	52	10	4	11	7	8	8	4

POET #	Theme/Factor	Total	Interviewees						
			B	C	D	E	F	G	H
P20	Understanding of Environment	29	2	6	6	9	2	4	0
PO21	Time and Capacity to Innovate	28	5	1	8	3	2	6	3
O22	Investment in the System	24	1	2	6	2	4	4	5
PO23	Attitude to Risk	17	2	0	2	2	7	4	0
O24	Difficulty to Change Existing Practice / Systems	33	4	5	12	5	3	2	2
O25	Systems and Processes of Organisations	26	5	2	9	5	2	1	2
PE26	Relationship Between Sectors	28	4	4	7	3	3	7	0
E27	Local vs Regional vs National	20	2	3	6	2	3	2	2
PO28	Training/Learning	19	1	2	1	5	7	1	2
OET29	Trialability/Testing	15	1	2	1	4	2	5	0
P30	Co-production	8	0	2	1	0	1	3	1
E31	Policy / Regulatory Effects	32	2	5	8	9	2	5	1
POE32	Political	16	0	1	9	3	2	1	0
E33	"Crisis" (COVID-19)	21	6	4	5	2	1	2	1
T34	Measurements/Metrics	14	1	3	0	3	0	1	6
P35	"People Who Get Shit Done"	25	3	3	6	3	1	7	2
O36	"Getting the Right People"	30	1	5	4	5	3	10	2
PO37	Reputational	7	1	1	0	1	2	1	1
O38	Continuity/Retention of Staff	13	2	1	3	1	3	2	1
PO39	Incentives	16	5	2	1	1	0	5	2
PO40	Openness to Change / Innovation	25	6	4	2	2	5	5	1

POET #	Theme/Factor	Total	Interviewees						
			B	C	D	E	F	G	H
O41	Top-down plus Bottom-up	12	2	1	1	2	2	2	2
O42	Support & Guidance vs Forcing Implementation	11	0	1	1	0	5	0	4
P43	Buy-in of a Few Adopters	9	1	3	0	2	2	1	0
PO44	Communication (General)	19	0	3	3	3	0	9	1

8.10.2. Number of statements recorded under each factor sorted by
Total number in descending order

POET	Theme/Factor	Total	Interviewees						
			B	C	D	E	F	G	H
O	Organisational Culture / Structure	52	10	4	11	7	8	8	4
P O	Leadership	45	4	9	10	7	4	8	3
P O	Networks and Collaboration	42	5	7	5	1	5	15	4
P	Trust, Reliability, Relationships	42	4	4	6	4	9	13	2
P O	Alignment of Actors/Objectives	38	3	5	6	4	7	12	1
P T	Experience of/with Innovation	38	6	2	5	12	2	11	0
P O T	Demonstration of Value	37	3	7	2	5	7	6	7
O E T	Finance and Funding	37	3	5	4	11	5	6	3
O	Difficulty to Change Existing Practice / Systems	33	4	5	12	5	3	2	2
P O	Identification & Communication of Need	32	6	5	5	6	1	6	3
O	Bureaucracy and Admin	32	7	2	5	6	2	10	0

			Interviewees						
POET	Theme/Factor	Total	B	C	D	E	F	G	H
E	Policy / Regulatory Effects	32	2	5	8	9	2	5	1
P O	Empowerment	30	1	1	5	2	9	6	6
O	"Getting the Right People"	30	1	5	4	5	3	10	2
P	Understanding of Environment	29	2	6	6	9	2	4	0
P	Motivation (Why Innovate?)	28	3	5	7	3	4	3	3
P O	Time and Capacity to Innovate	28	5	1	8	3	2	6	3
P E	Relationship Between Sectors	28	4	4	7	3	3	7	0
O	Systems and Processes of Organisations	26	5	2	9	5	2	1	2
P	Personality	25	2	2	5	3	5	7	1
P	"People Who Get Shit Done"	25	3	3	6	3	1	7	2
P O	Openness to Change / Innovation	25	6	4	2	2	5	5	1
P O	Clear Vision / Culture	24	3	3	3	2	4	3	6
O	Investment in the System	24	1	2	6	2	4	4	5
P	View of Other Sector	23	1	6	7	4	2	3	0
E	"Crisis" (COVID-19)	21	6	4	5	2	1	2	1
E	Local vs Regional vs National	20	2	3	6	2	3	2	2
P O	Training/Learning	19	1	2	1	5	7	1	2
P O	Communication (General)	19	0	3	3	3	0	9	1
P	Champions	18	2	4	3	1	6	1	1
P O	Boundary Spanning	18	2	1	3	3	1	8	0
P O	Attitude to Risk	17	2	0	2	2	7	4	0

			Interviewees						
POET	Theme/Factor	Total	B	C	D	E	F	G	H
P O E	Political	16	0	1	9	3	2	1	0
P O	Incentives	16	5	2	1	1	0	5	2
O E T	Trialability/Testing	15	1	2	1	4	2	5	0
T	Measurements/Metrics	14	1	3	0	3	0	1	6
O	Continuity/Retention of Staff	13	2	1	3	1	3	2	1
O	Top-down plus Bottom-up	12	2	1	1	2	2	2	2
O	Support & Guidance vs Forcing Implementation	11	0	1	1	0	5	0	4
P	Buy-in of a Few Adopters	9	1	3	0	2	2	1	0
P T	Experience of/with Technology	8	0	3	0	0	2	2	1
P	Co-production	8	0	2	1	0	1	3	1
P O	Reputational	7	1	1	0	1	2	1	1
T	IP	6	1	0	3	1	0	1	0

8.10.3. Percentage of Interviewees total number of statements – sorted
by mean percentage across all Interviewees

			Participants						
POET	Theme/Factor	Mean	B	C	D	E	F	G	H
O	Organisational Culture / Structure	22.8	18.5	8.2	27.5	20.0	33.3	21.1	30.8
P O T	Demonstration of Value	19.7	5.6	14.3	5.0	14.3	29.2	15.8	53.8
P O	Leadership	18.8	7.4	18.4	25.0	20.0	16.7	21.1	23.1
P O	Networks and Collaboration	18.6	9.3	14.3	12.5	2.9	20.8	39.5	30.8
P	Trust, Reliance, Relationships	18.4	7.4	8.2	15.0	11.4	37.5	34.2	15.4
P O	Empowerment	17.4	1.9	2.0	12.5	5.7	37.5	15.8	46.2

			Participants						
POET	Theme/Factor	Mean	B	C	D	E	F	G	H
O E T	Finance and Funding	16.7	5.6	10.2	10.0	31.4	20.8	15.8	23.1
P O	Alignment of Actors/Objectives	15.8	5.6	10.2	15.0	11.4	29.2	31.6	7.7
P T	Experience of/with Innovation	14.2	11.1	4.1	12.5	34.3	8.3	28.9	0.0
P O	Clear Vision / Culture	13.7	5.6	6.1	7.5	5.7	16.7	7.9	46.2
O	Difficulty to Change Existing Practice / Systems	13.6	7.4	10.2	30.0	14.3	12.5	5.3	15.4
P O	Identification & Communication of Need	13.4	11.1	10.2	12.5	17.1	4.2	15.8	23.1
O	Investment in the System	13.2	1.9	4.1	15.0	5.7	16.7	10.5	38.5
O	"Getting the Right People"	12.9	1.9	10.2	10.0	14.3	12.5	26.3	15.4
P	Motivation (Why Innovate?)	12.8	5.6	10.2	17.5	8.6	16.7	7.9	23.1
E	Policy / Regulatory Effects	12.7	3.7	10.2	20.0	25.7	8.3	13.2	7.7
P O	Time and Capacity to Innovate	12.4	9.3	2.0	20.0	8.6	8.3	15.8	23.1
O	Bureaucracy and Admin	11.6	13.0	4.1	12.5	17.1	8.3	26.3	0.0
O	Systems and Processes of Organisations	10.9	9.3	4.1	22.5	14.3	8.3	2.6	15.4
P	Personality	10.8	3.7	4.1	12.5	8.6	20.8	18.4	7.7
P	Understanding of Environment	10.8	3.7	12.2	15.0	25.7	8.3	10.5	0.0
P	"People Who Get Shit Done"	10.5	5.6	6.1	15.0	8.6	4.2	18.4	15.4
P E	Relationship Between Sectors	10.4	7.4	8.2	17.5	8.6	12.5	18.4	0.0
P O	Openness to Change / Innovation	10.2	11.1	8.2	5.0	5.7	20.8	13.2	7.7
P O	Training/Learning	10.0	1.9	4.1	2.5	14.3	29.2	2.6	15.4
T	Measurements/Metrics	9.3	1.9	6.1	0.0	8.6	0.0	2.6	46.2

			Participants						
POET	Theme/Factor	Mean	B	C	D	E	F	G	H
E	Local vs Regional vs National	9.1	3.7	6.1	15.0	5.7	12.5	5.3	15.4
P	View of Other Sector	8.5	1.9	12.2	17.5	11.4	8.3	7.9	0.0
P	Champions	8.2	3.7	8.2	7.5	2.9	25.0	2.6	7.7
O	Support & Guidance vs Forcing Implementation	8.0	0.0	2.0	2.5	0.0	20.8	0.0	30.8
E	"Crisis" (COVID-19)	7.8	11.1	8.2	12.5	5.7	4.2	5.3	7.7
P O	Attitude to Risk	7.7	3.7	0.0	5.0	5.7	29.2	10.5	0.0
P O	Communication (General)	7.7	0.0	6.1	7.5	8.6	0.0	23.7	7.7
P O	Incentives	6.7	9.3	4.1	2.5	2.9	0.0	13.2	15.4
P O	Boundary Spanning	6.7	3.7	2.0	7.5	8.6	4.2	21.1	0.0
P O E	Political	6.3	0.0	2.0	22.5	8.6	8.3	2.6	0.0
O	Top-down plus Bottom-up	6.1	3.7	2.0	2.5	5.7	8.3	5.3	15.4
O	Continuity/Retention of Staff	5.9	3.7	2.0	7.5	2.9	12.5	5.3	7.7
O E T	Trialability/Testing	5.9	1.9	4.1	2.5	11.4	8.3	13.2	0.0
P T	Experience of/with Technology	3.9	0.0	6.1	0.0	0.0	8.3	5.3	7.7
P	Co-production	3.8	0.0	4.1	2.5	0.0	4.2	7.9	7.7
P O	Reputational	3.6	1.9	2.0	0.0	2.9	8.3	2.6	7.7
P	Buy-in of a Few Adopters	3.5	1.9	6.1	0.0	5.7	8.3	2.6	0.0
T	IP	2.1	1.9	0.0	7.5	2.9	0.0	2.6	0.0

8.10.4.Comparison of factors rank of importance based on the two methods of calculating relative importance

Rank	Total Number of Statements data			Mean of Percentage of Total Statements data		
	POE T	Theme/Factor	Total	POE T	Theme/Factor	Mean
1	O	Organisational Culture / Structure	52	O	Organisational Culture / Structure	22.8
2	P O	Leadership	45	P O T	Demonstration of Value	19.7
3	P O	Networks and Collaboration	42	P O	Leadership	18.8
4	P	Trust, Reliability, Relationships	42	P O	Networks and Collaboration	18.6
5	P O	Alignment of Actors/Objectives	38	P	Trust, Reliability, Relationships	18.4
6	P T	Experience of/with Innovation	38	P O	Empowerment	17.4
7	P O T	Demonstration of Value	37	O E T	Finance and Funding	16.7
8	O E T	Finance and Funding	37	P O	Alignment of Actors/Objectives	15.8
9	O	Difficulty to Change Existing Practice / Systems	33	P T	Experience of/with Innovation	14.2
10	P O	Identification & Communication of Need	32	P O	Clear Vision / Culture	13.7
11	O	Bureaucracy and Admin	32	O	Difficulty to Change Existing Practice / Systems	13.6
12	E	Policy / Regulatory Effects	32	P O	Identification & Communication of Need	13.4

Rank	Total Number of Statements data			Mean of Percentage of Total Statements data		
	POE T	Theme/Factor	Total	POE T	Theme/Factor	Mean
13	P O	Empowerment	30	O	Investment in the System	13.2
14	O	"Getting the Right People"	30	O	"Getting the Right People"	12.9
15	P	Understanding of Environment	29	P	Motivation (Why Innovate?)	12.8
16	P	Motivation (Why Innovate?)	28	E	Policy / Regulatory Effects	12.7
17	P O	Time and Capacity to Innovate	28	P O	Time and Capacity to Innovate	12.4
18	P E	Relationship Between Sectors	28	O	Bureaucracy and Admin	11.6
19	O	Systems and Processes of Organisations	26	O	Systems and Processes of Organisations	10.9
20	P	Personality	25	P	Personality	10.8
21	P	"People Who Get Shit Done"	25	P	Understanding of Environment	10.8
22	P O	Openness to Change / Innovation	25	P	"People Who Get Shit Done"	10.5
23	P O	Clear Vision / Culture	24	P E	Relationship Between Sectors	10.4
24	O	Investment in the System	24	P O	Openness to Change / Innovation	10.2
25	P	View of Other Sector	23	P O	Training/Learning	10.0
26	E	"Crisis" (COVID-19)	21	T	Measurements/Metrics	9.3
27	E	Local vs Regional vs National	20	E	Local vs Regional vs National	9.1
28	P O	Training/Learning	19	P	View of Other Sector	8.5

Rank	Total Number of Statements data			Mean of Percentage of Total Statements data		
	POE T	Theme/Factor	Total	POE T	Theme/Factor	Mean
29	P O	Communication (General)	19	P	Champions	8.2
30	P	Champions	18	O	Support & Guidance vs Forcing Implementation	8.0
31	P O	Boundary Spanning	18	E	"Crisis" (COVID-19)	7.8
32	P O	Attitude to Risk	17	P O	Attitude to Risk	7.7
33	P O E	Political	16	P O	Communication (General)	7.7
34	P O	Incentives	16	P O	Incentives	6.7
35	O E T	Trialability/ Testing	15	P O	Boundary Spanning	6.7
36	T	Measurements/ Metrics	14	P O E	Political	6.3
37	O	Continuity/ Retention of Staff	13	O	Top-down plus Bottom-up	6.1
38	O	Top-down plus Bottom-up	12	O	Continuity/Retention of Staff	5.9
39	O	Support & guidance vs forcing implementation	11	O E T	Trialability/Testing	5.9
40	P	Buy-in of a Few Adopters	9	P T	Experience of/with Technology	3.9
41	P T	Experience of/with Technology	8	P	Co-production	3.8
42	P	Co-production	8	P O	Reputational	3.6
43	P O	Reputational	7	P	Buy-in of a Few Adopters	3.5
44	T	IP	6	T	IP	2.1

8.11. Appendix K – Interrelationships of Factors

8.11.1. The number factor pairs that were interrelated at each level of interrelationship

Level of interrelationship	Number of Factor Pairs linked this number of times
17	1
16	2
15	2
14	4
13	3
12	5
11	9
10	11
9	20
8	22
7	35
6	39
5	65
4	81
3	135

Level of interrelationship	Number of Factor Pairs linked this number of times
2	167
1	186
0	159

8.11.2. Factor Interrelatedness – Most Strongly Related Factor Pairs

The below table shows the most strongly related factors from the matrix.

Factor 1	Context code 1	Factor 2	Context code 2	# of times linked
Networks & Collaboration	PO	Trust, Reliability, Relationships	P	17
Leadership	PO	"People Who Get Shit Done"	P	16
Organisational Culture/Structure	O	Systems and Processes of Organisations	O	16
Alignment (Actors/Objectives)	PO	Networks and Collaboration	PO	15
Organisational Culture/Structure	O	Difficulty to Change Existing Practice	O	15
Alignment (Actors/Objectives)	PO	Trust, Reliability, Relationships	P	14
Alignment (Actors/Objectives)	PO	Leadership	PO	14
Bureaucracy & Admin	O	Organisational Culture/Structure	O	14
Difficulty to Change Existing Practice	O	Systems and Processes of Organisations	O	14

Factor 1	Context code 1	Factor 2	Context code 2	# of times linked
Alignment (Actors/Objectives)	PO	Organisational Culture/Structure	O	13
Networks & Collaboration	PO	"Getting the Right People"	O	13
Leadership	PO	Trust, Reliability, Relationships	P	13
Clear Vision/Culture	PO	Leadership	PO	12
Leadership	PO	Personality	P	12
Empowerment	PO	Trust, Reliability, Relationships	P	12
Trust, Reliability, Relationships	P	Relationship Between Sectors	PE	12
Demonstration of Value	PO T	Identification and Communication of Need	PO	12
View of Other Sector	P	Relationship Between Sectors	PE	11
Alignment (Actors/Objectives)	PO	Experience of Innovation	PT	11
Networks & Collaboration	PO	Experience of Innovation	PT	11
Leadership	PO	"Getting the Right People"	O	11
Leadership	PO	Empowerment	PO	11
Empowerment	PO	Organisational Culture/Structure	O	11
Trust, Reliability, Relationships	P	Organisational Culture/Structure	O	11
Finance & Funding	OE T	Policy/Regulatory effects	E	11
"People Who Get Shit Done"	P	"Getting the Right People"	O	11
View of Other Sector	P	Organisational Culture/Structure	O	10
Clear Vision/Culture	PO	Demonstration of Value	PO T	10

Factor 1	Context code 1	Factor 2	Context code 2	# of times linked
Clear Vision/Culture	PO	Alignment (Actors/Objectives)	PO	10
Alignment (Actors/Objectives)	PO	"Getting the Right People"	O	10
Networks & Collaboration	PO	Finance & Funding	OE T	10
Networks & Collaboration	PO	Leadership	PO	10
Empowerment	PO	Personality	P	10
Trust, Reliability, Relationships	P	"People Who Get Shit Done"	P	10
Identification and Communication of Need	PO	Understanding of Environment	P	10
Identification and Communication of Need	PO	Experience of Innovation	PT	10
Organisational Culture/Structure	O	Investment in the System	O	10
View of Other Sector	P	Difficulty to Change Existing Practice	O	9
Clear Vision/Culture	PO	Organisational Culture/Structure	O	9
Alignment (Actors/Objectives)	PO	Bureaucracy & Admin	O	9
Networks & Collaboration	PO	Relationship Between Sectors	PE	9
Networks & Collaboration	PO	Understanding of Environment	P	9
Networks & Collaboration	PO	Demonstration of Value	PO T	9
Leadership	PO	Experience of Innovation	PT	9
Empowerment	PO	Time & Capacity to Innovate	PO	9
Trust, Reliability, Relationships	P	Openness to Change/Innovation	PO	9
Trust, Reliability, Relationships	P	Personality	P	9

Factor 1	Context code 1	Factor 2	Context code 2	# of times linked
Demonstration of Value	PO T	Finance & Funding	OE T	9
Identification and Communication of Need	PO	Difficulty to Change Existing Practice	O	9
Experience of Innovation	PT	"Getting the Right People"	O	9
Experience of Innovation	PT	Understanding of Environment	P	9
Personality	P	"Getting the Right People"	O	9
Organisational Culture/Structure	O	Openness to Change/Innovation	PO	9
Organisational Culture/Structure	O	Time & Capacity to Innovate	PO	9
Understanding of Environment	P	Policy/Regulatory Effects	E	9
Understanding of Environment	P	Difficulty to Change Existing Practice	O	9
Investment in the System	O	Political	PO E	9
Motivation (Why Innovate?)	P	Personality	P	8
Motivation (Why Innovate?)	P	Empowerment	PO	8
Clear Vision/Culture	PO	"Getting the Right People"	O	8
Clear Vision/Culture	PO	Investment in the System	O	8
Alignment (Actors/Objectives)	PO	Understanding of Environment	P	8
Alignment (Actors/Objectives)	PO	Identification and Communication of Need	PO	8
Networks & Collaboration	PO	Communication (General)	PO	8
Networks & Collaboration	PO	Policy/Regulatory Effects	E	8
Networks & Collaboration	PO	Bureaucracy & Admin	O	8

Factor 1	Context code 1	Factor 2	Context code 2	# of times linked
Networks & Collaboration	PO	Identification and Communication of Need	PO	8
Trust, Reliability, Relationships	P	"Getting the Right People"	O	8
Trust, Reliability, Relationships	P	Bureaucracy & Admin	O	8
Trust, Reliability, Relationships	P	Experience of Innovation	PT	8
Demonstration of Value	PO T	Understanding of Environment	P	8
Experience of Innovation	PT	Finance & Funding	OE T	8
Personality	P	"People Who Get Shit Done"	P	8
Bureaucracy & Admin	O	Policy/Regulatory Effects	E	8
Bureaucracy & Admin	O	Difficulty to Change Existing Practice	O	8
Finance & Funding	OE T	Systems and Processes of Organisations	O	8
Finance & Funding	OE T	Investment in the System	O	8
Organisational Culture/Structure	O	Political	PO E	8
Organisational Culture/Structure	O	Policy/Regulatory Effects	E	8

8.11.3. Frequency That Factors Appear in Display 8.11.2

Factor	Number of times appears in 8.11.2
Networks & Collaboration	13
Organisational Culture/Structure	13
Trust, Reliability, Relationships	12
Alignment (Actors/Objectives)	10
Leadership	9
"Getting the Right People"	8
Experience of Innovation	8
Understanding of Environment	7
Difficulty to Change Existing Practice	6
Bureaucracy & Admin	6
Clear Vision/Culture	6
Personality	6
Empowerment	6
Identification and Communication of Need	6
Finance & Funding	6
Demonstration of Value	5
Policy/Regulatory Effects	5
"People Who Get Shit Done"	4
Investment in the system	4
Systems and Processes of Organisations	3
Relationship Between Sectors	3
View of Other Sector	3
Time & Capacity to Innovate	2
Openness to Change/Innovation	2
Political	2
Motivation (Why Innovate?)	2
Communication (General)	1

8.12. Appendix L – Barriers and Enablers - Number of Statements

Recorded for Each Factor With Enabler and Barrier Codes

POET	Theme/Factor	Total	Interviewees						
			B	C	D	E	F	G	H
P	Motivation (Why innovate?)	28 (8+/2-)	3 (2+/1-)	5 (0+/1-)	7 (2+/0-)	3	4 (1+/0-)	3 (3+/0-)	3
P	View of Other Sector	23 (0+/7-)	1 (0+/1-)	6 (0+/2-)	7 (0+/1-)	4 (0+/2-)	2 (0+/1-)	3	0
P O	Clear Vision / Culture	24 (5+/8-)	3 (1+/0-)	3 (0+/1-)	3 (0+/1-)	2 (0+/2-)	4 (0+/3-)	3 (3+/0-)	6 (1+/1-)
P O	Alignment of Actors/Objectives	38 (11+/12-)	3 (2+/1-)	5	6 (2+/2-)	4 (0+/2-)	7 (2+/4-)	12 (5+/2-)	1 (0+/1-)
P O	Networks and Collaboration	42 (18+/7-)	5 (4+/1-)	7 (2+/0-)	5 (3+/0-)	1	5 (3+/2-)	15 (5+/2-)	4 (1+/2-)
P O	Leadership	45 (13+/12-)	4 (3+/1-)	9 (1+/2-)	10 (3+/1-)	7 (1+/5-)	4 (1+/1-)	8 (3+/1-)	3 (1+/1-)
P	Champions	18 (17+/0-)	2 (2+/0-)	4 (4+/0-)	3 (2+/0-)	1 (1+/0-)	6 (6+/0-)	1 (1+/0-)	1 (1+/0-)
P O	Empowerment	30 (11+/4-)	1 (1+/0-)	1	5 (2+/0-)	2 (0+/1-)	9 (6+/2-)	6 (2+/1-)	6
P O	Boundary Spanning	18 (10+/3-)	2 (2+/0-)	1 (0+/1-)	3 (2+/0-)	3 (1+/1-)	1	8 (5+/1-)	0
P	Trust, Reliability, Relationships	42 (20+/9-)	4 (4+/0-)	4 (1+/0-)	6 (5+/0-)	4 (0+/1-)	9 (5+/3-)	13 (4+/4-)	2 (1+/1-)
P O T	Demonstration of Value	37 (13+/5-)	3 (1+/0-)	7 (5+/0-)	2 (2+/0-)	5 (0+/1-)	7 (2+/2-)	6 (3+/1-)	7 (0+/1-)
P O	Identification & Communication of Need	32 (9+/8-)	6 (2+/2-)	3 (0+/1-)	5 (5+/0-)	6 (1+/1-)	1	6 (1+/4-)	3
P T	Experience of/with Innovation	38 (9+/11-)	6 (0+/4-)	2 (1+/0-)	5 (4+/0-)	12 (0+/2-)	2 (1+/1-)	11 (3+/4-)	0
P T	Experience of/with Technology	8 (4+/1-)	0	3 (3+/0-)	0	0	2	2 (1+/1-)	1
P	Personality	25 (7+/5-)	2 (0+/2-)	2 (0+/1-)	5 (2+/0-)	3 (0+/1-)	5 (2+/0-)	7 (3+/1-)	1
O	Bureaucracy and Admin	32 (4+/15-)	7 (2+/3-)	2 (0+/1-)	5 (1+/1-)	6 (0+/4-)	2 (1+/0-)	10 (0+/6-)	0

			Interviewees						
POET	Theme/Factor	Total	B	C	D	E	F	G	H
O E T	Finance and Funding	37 (6+/12-)	3 (1+/1-)	5 (0+/2-)	4 (0+/1-)	11 (0+/3-)	5 (3+/0-)	6 (1+/5-)	3 (1+/0-)
T	IP	6 (1+/1-)	1	0	3 (1+/0-)	1 (0+/1-)	0	1	0
O	Organisational Culture / Structure	52 (6+/21-)	10 (5+/3-)	4 (0+/1-)	11 (0+/3-)	7 (0+/5-)	8 (0+/3-)	8 (1+/5-)	4 (0+/1-)
P	Understanding of Environment	29 (4+/4-)	2	6 (1+/0-)	6 (1+/1-)	9 (0+/2-)	2 (1+/1-)	4 (1+/0-)	0
P O	Time and Capacity to Innovate	28 (5+/11-)	5 (1+/4-)	1	8 (3+/3-)	3	2	6 (1+/2-)	3 (0+/2-)
O	Investment in the System	24 (3+/8-)	1 (0+/1-)	2	6 (0+/3-)	2 (1+/0-)	4	4 (0+/2-)	5 (2+/2-)
P O	Attitude to Risk	17 (3+/5-)	2 (0+/2-)	0	2	2	7 (3+/0-)	4 (0+/3-)	0
O	Difficulty to Change Existing Practice / Systems	33 (4+/18-)	4 (0+/4-)	5 (1+/2-)	12 (2+/3-)	5 (1+/4-)	3 (0+/2-)	2 (0+/1-)	2 (0+/2-)
O	Systems and Processes of Organisations	26 (3+/12-)	5 (0+/4-)	2 (0+/1-)	9 (1+/2-)	5 (1+/3-)	2 (0+/1-)	1 (0+/1-)	2 (1+/0-)
P E	Relationship Between Sectors	28 (6+/7-)	4 (2+/2-)	4 (0+/1-)	7 (1+/0-)	3 (1+/1-)	3 (0+/1-)	7 (2+/2-)	0
E	Local vs Regional vs National	20 (6+/3-)	2 (0+/1-)	3 (0+/0-)	6 (2+/0-)	2 (0+/1-)	3 (1+/1-)	2 (1+/0-)	3 (2+/0-)
P O	Training/Learning	19 (3+/7-)	1	2 (1+/0-)	1	5 (0+/4-)	7 (2+/2-)	1 (0+/1-)	2
O E T	Trialability/Testing	15 (7+/2-)	1 (1+/0-)	2 (1+/0-)	1	4 (0+/4-)	2 (1+/1-)	5 (4+/1-)	0
P	Co-production	8 (3+/0-)	0	2	1	0	1 (1+/0-)	3 (2+/0-)	1
E	Policy / Regulatory Effects	32 (3+/9-)	2 (1+/1-)	5	8 (0+/1-)	9 (2+/5-)	2	5 (0+/2-)	1
P O E	Political	16 (0+/6-)	0	1	9 (0+/4-)	3 (0+/1-)	2	4 (0+/1-)	0
E	"Crisis" (COVID-19)	21 (8+/7-)	6 (3+/3-)	4 (2+/1-)	5 (0+/3-)	2	1	2 (2+/0-)	1 (1+/0-)
T	Measurements/ Metrics	14 (2+/6-)	1 (0+/1-)	3 (1+/0-)	0	3 (0+/3-)	0	1	6 (1+/2-)

			Interviewees						
POET	Theme/Factor	Total	B	C	D	E	F	G	H
P	"People Who Get Shit Done"	25 (14+/2-)	3 (3+/0-)	3 (2+/0-)	6 (3+/0-)	3 (1+/1-)	1 (1+/0-)	7 (4+/0-)	2 (0+/1-)
O	"Getting the Right People"	30 (11+/2-)	1 (1+/0-)	5 (1+/1-)	4 (1+/0-)	5	3 (1+/0-)	10 (6+/0-)	2 (1+/1-)
P O	Reputational	7 (0+/3-)	1 (0+/1-)	1	0	1	2	1 (0+/1-)	1 (0+/1-)
O	Continuity/ Retention of Staff	13 (2+/3-)	2	1	3 (1+/1-)	1	3	2 (0+/2-)	1 (1+/0-)
P O	Incentives	16 (3+/7-)	5 (1+/4-)	2 (1+/0-)	1	1	0	5 (1+/3-)	2
P O	Openness to Change / Innovation	25 (12+/2-)	6 (3+/0-)	4 (2+/0-)	2 (1+/0-)	2 (0+/1-)	5 (4+/0-)	5 (2+/1-)	1
O	Top-down plus Bottom-up	12 (2+/2-)	2	1	1	2 (0+/1-)	2 (0+/1-)	2 (1+/0-)	2 (1+/0-)
O	Support & Guidance vs Forcing Implementation	11 (4+/0-)	0	1	1 (1+/0-)	0	5 (2+/0-)	0	4 (1+/0-)
P	Buy-in of a Few Adopters	9 (3+/1-)	1	3	0	2 (0+/1-)	2 (2+/0-)	1 (1+/0-)	0
P O	Communication (General)	19 (1+/7-)	0	3	3 (0+/1-)	3	0	9 (1+/6-)	1

8.13. Appendix M – Comparing Factors Found in This Study to Literature

8.13.1. Table comparing factors discovered in this study to factors in literature

POET code(s)	Theme/Factor	Present in other literature?	Stated as in other literature	Described as in other literature	Placed in context?	List/examples of key authors
O	Organisational Culture / Structure	y	Size (firm size and hospital size)	Organisation size.	Organisational	Grover 1993 DePietro et al 1990 Meyer & Goes 1988 Ramdani et al 2009
		y	Hospital complexity	Structural complexity of the organisation. Horizontal differentiation.	Organisational	Meyer & Goes 1988 Hall & Hord 1987
		y	Hospital market strategy	Aggressiveness with which hospitals in developing new services and penetrating new markets.	Organisational	Meyer & Goes 1988
		y	Organisational/system competency/readiness	The organisation's awareness, resources, commitment, and governance to adopt a technology.	Organisational	Tan et al 2007 Gangwar et al 2015 Lee & Shim 2007 Ramdani et al 2009 Greenhalgh et al 2004* (split into multiple factors)

		y	Centralisation	Centralisation (or the concentration) of decision-making activity, i.e. the extent of participation in decision-making.	Organisational	Grover 1993
		y	Formalisation	Extent of work or procedure definition, i.e., the extent of rule observance and job codification.	Organisational	Grover 1993
		y	Integration	The extent of departmental interaction.	Organisational	Grover 1993
		y	Structural determinants of innovativeness	How structure affects organisations' ability to adopt innovations.	Organisational ('system antecedents for innovation')	Greenhalgh et al 2004* (split into multiple sub-factors in this paper)
		y	Organisational structure	How adaptability, flexibility of organisational structure and devolution of decision-making affects adoption.	Organisational ('Implementation & Routinization')	Greenhalgh et al 2004*
P O	Leadership	y	CEO tenure	Years of service of organisation CEO.	Organisational 'Leadership'	Meyer & Goes 1988 Kimberly & Evanisko 1981
		y	CEO education level	Years of education and degrees awarded.	Organisational 'Leadership'	Meyer & Goes 1988 Kimberly & Evanisko 1981

		y	Top management support	Perceptions and actions of top officials on the usefulness of technological innovation in creating values for the firm.	Organisational	Salwani et al 2009 Gangwar et al 2015 (TAM/TOE)
		y	CEO support	CEO support for adoption of innovation.	Organisational	Yap et al 1994 Ramdani et al 2009
		y	Leadership & Management	Top management support, advocacy and commitment, involvement, alignment with adoption process.	'Implementation and routinization'	Greenhalgh et al 2004*
P O	Networks and Collaboration	y	Network structure	Influence of social networks (& their quality & structure) on adoption of innovations.	'Diffusion & Dissemination'	Greenhalgh et al 2004*
		y	Interorganizational networks	How interorganizational network effects innovation adoption.	'Implementation and routinization'	Greenhalgh et al 2004*
P	Trust, Reliability, Relationships	n				
P O	Alignment of Actors/Objectives	n				
P T	Experience of/with Innovation	n				

P O T	Demonstration of Value	y	Result Demonstrability	Tangibility of the results of using the innovation, including their Observability and Communicability.	Technological	Moore & Benbasat 1991
		y	Observability	Degree to which results of using innovation are visible to others, organisational members and external constituents.	Technological	Meyer et al. 1985 Moore & Benbasat 1991 Ramdani et al 2009 Greenhalgh et al 2004*
O E T	Finance and Funding	y	Organisational competency/readiness (financial readiness)	"Managers" perception and evaluation of the degree to which they believe that their organisation has the awareness, resources, commitment, and governance to adopt a technology - resources for implantation and use.	Organisational	Tan et al 2007 Gangwar et al 2015 Lee & Shim 2007 Ramdani et al 2009
		y	Cost	Cost in purchasing medical innovations.	Not assigned	Petkova et al 2010*
		y	Funding	Presence of dedicated or ongoing funding for implementing innovation.	'Implementation and routinization'	Greenhalgh et al 2004*

O	Difficulty to Change Existing Practice / Systems	y	Compatibility	The degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters.	Technological 'Innovation-decision'	Rogers 2003 Meyer & Goes 1988 Gangwar et al 2015 Grover 1993 Moore & Benbasat 1991 Greenhalgh et al 2004*
		y	Fuzzy boundaries	Adaptiveness of the organisational structures and systems required for full implementation of the innovation	Technological	Greenhalgh et al 2004* Rogers 1995
P O	Identification & Communication of Need	y	Compatibility	The degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters.	Technological 'Innovation-decision'	Rogers 2003 Meyer & Goes 1988 Gangwar et al 2015 Grover 1993 Moore & Benbasat 1991 Greenhalgh et al 2004*
O	Bureaucracy and Admin	y	Formalisation	Extent of work or procedure definition, i.e., the extent of rule observance and job codification.	Organisational	Grover 1993
		y	Administrative and bureaucratic barriers	Extent to which administrative or bureaucratic processes affect innovation adoption.	Not assigned	Petkova et al 2010*

E	Policy / Regulatory Effects	y	International and local regulation	How does the international vs local regulation affect innovation.	Not assigned	Petkova et al 2010*
		y	Regulatory	Regulatory influences on innovation.	Not assigned	Petkova et al 2010*
		y	Political directives	Effect of policies and mandates on adoption of innovation.	Environmental ('Outer Context')	Greenhalgh et al 2004*
P O	Empowerment	y	Top management support	"Top management commitment to providing a positive environment for innovation".	Organisational 'Support' factors	McGinnis & Ackelsberg 1983 Grover 1993
O	"Getting the Right People"	y	Human resource issues	Motivation, capacity, competence of individual practitioners. Involvement of staff at all levels. Job change frequency and clarity, quality of training.	'Implementation and routinization'	Greenhalgh et al 2004*
P	Understanding of Environment	n				
P	Motivation (Why Innovate?)	y	Context-specific Psychological Antecedents	Motivation and ability of adopter to use a particular innovation.	People	Greenhalgh et al 2004*

P O	Time and Capacity to Innovate	y	Organisational competency/readiness (technological readiness)	"Managers" perception and evaluation of the degree to which they believe that their organisation has the awareness, resources, commitment, and governance to adopt a technology - infrastructure and human resource for usage and management.	Organisational	Tan et al 2007 Gangwar et al 2015 Lee & Shim 2007 Ramdani et al 2009
P E	Relationship Between Sectors	n				
O	Systems and Processes of Organisations	y	Hospital complexity	Structural complexity of the organisation. Horizontal differentiation.	Organisational	Meyer & Goes 1988 Hall & Hord 1987
		y	Hospital market strategy	Aggressiveness with which hospitals in developing new services and penetrating new markets.	Organisational	Meyer & Goes 1988
P	Personality	n				
P	"People Who Get Shit Done"	n				
P O	Openness to Change / Innovation	y	Technology policy (Environmental interaction)	The aggressiveness of the company's technology policy.	'Policy' factor	Grover 1993

		y	General Psychological Antecedents	Individual traits associated with the propensity to try out and use innovation.	People	Greenhalgh et al 2004*
		y	Receptive context for change	Organisational features associated with its ability to embrace new ideas and face the prospect of change.	Organisational	Greenhalgh et al 2004*
P O	Clear Vision / Culture	y	Organisational orientation Includes 'competitive strategy'	Emphasised in terms of the need for well communicated corporate wide goals and strategies to encourage functional departments to resolve their parochial interests and cooperate in the interest of common and company-wide objectives.	'Policy' factor	Grover 1993
		y	Meaning	Meaning attached to the innovation to adopters, and the extent to which this matches leadership and other stakeholders meaning	People 'Adoption by individuals'	Greenhalgh et al 2004*
		y	Intraorganizational Communication	Communication across structural boundaries within organisation.	'Implementation and routinization'	Greenhalgh et al 2004*

O	Investment in the System	n				
P	View of Other Sector	n				
E	"Crisis" (COVID-19)	n				
E	Local vs Regional vs National	y	International and local regulation	How does the international vs local regulation affect innovation.	Not assigned	Petkova et al 2010*
		y	Cultural & social context	How does the cultural and social context of a place affect innovation adoption.	Not assigned	Petkova et al 2010*
P O	Training/Learning	y	Training & Education	The degree to which a company instructs its employees in using a tool in terms of quality and quantity.	Organisational	Schillewaert et al 2005 Gangwar et al 2015
		y	Expertise & Training	Importance of up-to-date medical knowledge and technical skill to operate. Learning curve for technology.	Not assigned	Petkova et al 2010*
P O	Communication (General)	y	Intraorganizational Communication	Communication across structural boundaries within organisation.	'Implementation and routinization'	Greenhalgh et al 2004*
P	Champions	y	CEO advocacy	The extent to which and organisation's CEO champions or opposes adoption.	'Innovation-Decision'	Beyer & Trice 1978 Daft & Becker 1978 Meyer & Goes 1988

		y	Championship	The presence and influence of a champion for the innovation.	'Support' factor	Grover 1993 Lee & Shim 2007 Meyer 2000
		y	Champions	Key individuals in organisations or networks that support the innovation.	'Diffusion & Dissemination'	Greenhalgh et al 2004*
P O	Boundary Spanning	y	Boundary Spanners	Individuals who have significant ties both inside and outside organisation, able and willing to link organisation to outside world in relation to innovations.	'Diffusion & Dissemination'	Greenhalgh et al 2004* Rogers 1995
P O	Attitude to Risk	y	Risk	Level of risk of injury, death, or malpractice liability; Perceived Personal risk based on uncertainty of outcome of innovation.	Technological	Meyer 1985 Meyer & Goes 1988 Greenhalgh et al 2004*
		y	Organisational orientation: Management risk position	Extent of organisational, management, and financial risk acceptable by top management.	'Policy' factor	Grover 1993
P O E	Political	n				
P O	Incentives	n				

O E T	Trialability/Testing	y	Trialability	The degree to which an innovation may be experimented with on a limited basis before adoption.	Technological	Rogers 2003 Moore & Benbasat 1991 Ramdani et al 2009 Greenhalgh et al 2004*
T	Measurements/Metrics	y	Feedback	Effect of data collection and review systems of innovation on innovations adoption.	'Implementation and routinization'	Greenhalgh et al 2004*
O	Continuity/Retention of Staff	y	"Brain drain/leak"	Emigration of qualified health practitioners elsewhere.	not assigned	Petkova et al 2010*
		y	Human resource issues	Motivation, capacity, competence of individual practitioners. Involvement of staff at all levels. Job change frequency and clarity, quality of training.	'Implementation and routinization'	Greenhalgh et al 2004*
O	Top-down Plus Bottom-Up	n				
O	Support & Guidance vs Forcing Implementation	y	Augmentation/Support	Level of support e.g., customisation, training, helpdesk associated with innovation.	Technological	Greenhalgh et al 2004*

		y		How the decision to adopt was made in organisation: contingent (dependent on decision of others in an organisation), collective (group decision), authoritative (individuals told to adopt by management).	People	Greenhalgh et al 2004*
P	Buy-In of a Few Adopters	n				
P T	Experience of/with Technology	y	Skill	Manual skill or specialised training requirements.	Technological	Rosenthal 1984
		y	Expertise & Training	Importance of up-to-date medical knowledge and technical skill to operate. Learning curve for technology.	Not assigned	Petkova et al 2010*
		y	Knowledge required to use innovation	Extent of knowledge required to use innovation.	Technological	Greenhalgh et al 2004*
P	Co-production	y	Linkage at development stage	Effect of linking development of innovation with the potential users of innovation at development stage on adoption.	'Linkage among components of the model'	Greenhalgh et al 2004*
P O	Reputational	n				

T	IP	n				
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8.13.2. Table of factors from literature that were not discovered in this study

Theme/Factor	Described as	Placed in Context	Author(s) (& Model)
Visibility	The visibility of the innovation.	Technological	Moore & Benbasat 1991
Relative Advantage	The degree to which an innovation is perceived as providing a greater organisational benefits than either the status quo or other innovations.	Technological	Kwon & Zmud 1987 Grover 1993 Gangwar et al 2015 Moore & Benbasat 1991 Ramdani et al 2009 Greenhalgh et al 2004
Complexity	Degree of difficulty users experience in understanding or using an innovation in understanding or using an innovation.	Technological	Kwon and Zmud 1987 Grover 1993 Gangwar et al 2015 Ramdani et al 2009 Greenhalgh et al 2004
Perceived ease of use	The degree to which the prospective user expects the target system to be free of effort.	Technological	Davis 1989 (TAM) Gangwar et al 2015 (TOE & TAM) Moore & Benbasat 1991 Awa et al 2015 (TAM, TOE, TPB)
Perceived usefulness	The prospective user's subjective probability that using a specific application system will increase his or her job performance within an organisational context.	Technological	Davis 1989 (TAM) Gangwar et al 2015 (TOE & TAM)
Perceived behavioural control	An individual's perceived ease or difficulty of performing the particular behaviour.	Technological	Awa et al 2015 (TAM, TOE, TPB)
Perceived service quality	Customer's assessment of the overall superiority or excellence of the service.	Technological	Awa et al 2015 (TAM, TOE, TPB) Zeithaml 2000

Perceived benefits	...of adopting innovation in relation to an organisation's specific setting.	Technological	Chau & Tam 1997 (TOE)
	Perceived benefits refer to the level of recognition of the relative advantage that a technology can provide to the organisation.	Technological	Rogers 1995 (Diffusion of innovations) Lee & Shim 2007 Kuan & Chau 2001
Perceived barriers	Obstacles or barriers to innovations adoptions.	Technological	Chau & Tam 1997 (TOE)
Vendor pressure	Vendor pressure or marketing activity of vendors, may affect adoption decision of organisations.	Technological	Frambach et al 1998 Rogers 1995 Lee & Shim 2007 (TOE)
Recency of staff's medical education	How recent staff had received their medical training.	Organisational	Greer 1988 Meyer & Goes 1988
Satisfaction with existing systems	Interpret as written. Low satisfaction with existing systems is referred to as performance gap & provides impetus to innovate.	Organisational	Chau & Tam 1997 (TOE)
Strategic planning (specific to information systems)	Establishment of link between organisation strategy set with the IS strategy set to establish the course for IS in organisational performance.	Organisational	Grover 1993
Implementation planning (specific to information systems)	Formality of IS project development (specific to IS).	Organisational	Grover 1993
Infrastructure (specific to information systems)	Existence of sophisticated telecommunication & database facilities within the firm (specific to IS).	Organisational	Grover 1993
Customer interaction (Environmental interaction)	Extent of involvement with customers.	'Policy' factor	Grover 1993
Competitor scanning (Environmental interaction)	Extent of competitor scanning.	'Policy' factor	Grover 1993

Perceived organisational resources	Perception of the levels of financial and technological resources of the firm.	Organisational	Iacovou et al 1995 Kuan & Chau 2001
Organisational perceptions of environmental uncertainty	Managerial perceptions of environmental uncertainty (perceived construct, not objective reality). Managerial perceptions may be more related to strategies, actions, and performance rather than objective attributes of the environment.	Organisational	Mishra et al 2007
IS experience	The level of experience in/of the firm with information systems.	Organisational	Ramdani et al 2009 Kuan & Chau 2001
Urbanisation	Average population density within the hospital service area.	Environmental	Meyer & Goes 1988
Affluence	Average gain in medium family income within hospital service area.	Environmental	Meyer & Goes 1988
Federal health insurance	Average proportion of Medicare/Medicaid recipients within hospital service area.	Environmental	Meyer & Goes 1988
Competitive pressure	The degree of pressure that the company feels from competitors within the industry.	Environmental	Zhu & Kraemer 2005 Gangwar et al 2015 Ramdani et al 2009
Trading partner support	Support from the provider of the innovation / technology / service in using it.	Environmental	Gangwar et al 2015
Market uncertainty	How uncertain the external market environment is, including its complexity and how rapidly it changes. Includes factors such as: the degree of competition in the market, the stability of demand for the organisation's products/services, the degree of loyalty of the customers, and more.	Environmental	Chau & Tam 1997 (TOE) Lee & Shim 2007

Industry maturity	The extent of industry maturity (Grover 1993). Maturity of an industry is characterised by fragmentation through competition and consolidation through innovation.	Environmental	Grover 1993
Competition intensity (in industry)	Extent of competition in industry (in this case price & quality: Grover 1993).	Environmental	Grover 1993
Information intensity	How information intense a product/service is i.e., how complicated to understand/purchase/ use it. In Grover 1993, it is suggested that adopting IS innovations improves the information dissemination. Operationalised as 'Information enhancibility of product/service'.	Environmental	Grover 1993
Adaptable innovations (in industry)	The existence and number of similar innovations in the industry (Grover 1993) (hypothesised if more, then that will reduce adoption of the new innovation).	Environmental	Grover 1993
Customer power	The power of buyers in the industry.	Environmental	Grover 1993
Vertical coordination	Natural degree of supplier-customer coordination/dependence in industry (Grover 1993). Also called asset specificity.	Environmental	Grover 1993
Perceived environmental pressure (industry, government)	Any external environmental pressure perceived by the firm/organisation.	Environmental	Kuan & Chau 2001
Performance gap	Perceived shortcoming of the organisation or processes that may be remedied by a change.	Environmental	Lee & Shim 2007
Industry	Industry in which the firm/organisation operates.	Environmental	Ramdani et al 2009
Market scope	The horizontal extent of a firm's operations.	Environmental	Zhu et al 2003

External IS support	Availability of support for implementing and using IS innovations.	Environmental	Yap et al 1994 Ramdani et al 2009
Spare parts	Lack of spare parts for repair of medical equipment.	Not assigned	Petkova et al 2010*
Consumables	Affordability and availability of consumables associated with the innovation.	Not assigned	Petkova et al 2010*
Infrastructure	The adequacy of infrastructure in place to support the innovation.	Not assigned	Petkova et al 2010*
Reimbursement	Is the innovation going to be compensated for by the health system (affects insurance-based health care systems).	Not assigned	Petkova et al 2010*
Reinvention	Ability of the innovation to be adapted, refined or modified.	Technological	Greenhalgh et al 2004* Rogers 1995
Task issues	Relevancy and improvement to intended users work and performance.	Technological	Greenhalgh et al 2004*
Concerns in preadoption stage	Intended adopter's awareness, knowledge and experience with innovation.	People	Greenhalgh et al 2004*
Concerns during early use	Adopters' continued access to information about innovation and sufficient training and support.	People	Greenhalgh et al 2004*
Concerns in established users	Feedback on consequences of adoption, adopters' opportunity, autonomy and support to adapt and refine innovation to improve fitness for purpose.	People	Greenhalgh et al 2004*
(Organisational) Assimilation	How the organisation assimilates innovation.	Organisational	Greenhalgh et al 2004*
Homophily	Influence of similarity of individuals on adoption (socioeconomic, educational, professional, cultural).	'Diffusion & Dissemination'	Greenhalgh et al 2004*

Opinion leaders	Individuals with particular influence on beliefs and actions of their colleagues.	'Diffusion & Dissemination'	Greenhalgh et al 2004* Rogers 1995
Formal dissemination programs	Presence of a formal programme to spread innovation.	'Diffusion & Dissemination'	Greenhalgh et al 2004* Rogers 1995
Absorptive capacity for new knowledge	Organisation's ability to identify, capture, interpret, share, reframe and recodify new knowledge; link it with own existing knowledge; and put it to appropriate use.	Organisational	Greenhalgh et al 2004*
Informal interorganizational networks	The influence of comparable organisations and their networks adoption of a technology on the spread of that technology to other organisations.	Environmental ('Outer Context')	Greenhalgh et al 2004*
Intentional spread strategies	Formal networking initiatives such as quality improvement collaboratives effect on adoption.	Environmental ('Outer Context')	Greenhalgh et al 2004*
Wider environment	Effect of environmental uncertainty on innovation adoption.	Environmental ('Outer Context')	Greenhalgh et al 2004*
Adaptation/reinvention	Adaptability of innovation to local context.	'Implementation & Routinization'	Greenhalgh et al 2004*
Role of the change agency	Linkage of change agency and adopters.	'Implementation & Routinization'	Greenhalgh et al 2004*
External change agents	Effect of change agents on adoption.	'Implementation & Routinization'	Greenhalgh et al 2004*

