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Interorganizational Innovation and Collaboration in the UK Medical Device Sector

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Doctor of Philosophy

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Submitted December 2014

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Aston University

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Doctor of Philosophy (PhD)

2014

Interorganizational team research is a growing body of literature and research has started to examine team related factors such as interorganizational trust (i.e. Stock, 2006) in the interorganizational setting. This research applies insights from the *intraorganizational* team field into the interorganizational team setting in order to determine the team related factors pertaining to effective collaboration in medical device innovation projects.

Interorganizational collaboration has been a persistent feature within the interorganizational relations literature, due to the added benefits that can come with working collaboratively towards a common goal (Berg-Weger & Schnieder, 1998). While much research has explored the structures and performance outcomes of engaging in this cross-boundary working, the literature is sparse with respect to interpersonal relationships, practices and processes leading to effective collaboration (Bergenholtz & Waldstrom, 2011; Majchrzak, Jarvenpaa & Bargherz, 2015).

An interpretivist perspective has informed an exploratory mixed methods approach to data collection, with contextual insights informing each phase of data collection. Three exploratory phases of data collection have provided (1) qualitative ethnography data, (1i) qualitative interview data and (2) quantitative survey data.

The NHS has recently set out agendas to increase innovative procurement (Department of Health, 2008), work more closely with industry and SMEs (Innovation and Procurement Plan: Department of Health, 2009) and to increase innovative practice (IHW: NHS, 2011). SMEs developing novel medical devices require input from the NHS to ensure that their devices are clinically applicable and therefore will be adopted by the NHS. These contextual insights provide the backdrop for Studies 1i and 2.

The findings suggest that the *intraorganizational* team literature can be extended into the interorganizational collaboration literature, whilst also explaining the factors relating to effectiveness and success of interorganizational team innovation.

KEY WORDS/PHRASES: interorganizational team, SME, mixed methods

Dedication

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“A Cœur vaillant rien d'impossible” Jacques Cœur

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Chapter One: Introduction

“Innovation can be defined as —the intentional introduction and application within a role, group, or organization, of ideas, processes, products or procedures, new to the relevant unit of adoption, designed to significantly benefit the individual, the group, or wider society.”

(West & Fahr, 1990: pp.9).

The increased importance of academic innovation in research mirrors the need for organizations to stay constantly up-to-date with advances not just in technology, but also in management and capabilities (Powell, 1995). In doing so, organizations are able to compete in the market place and sustain competitive advantage (Smith, 2006). Innovation can be of vast benefit to the success, sustainability and competitive advantage of the organization. Innovation used to be most vital to obtaining and maintaining competitive advantage. However with such colossal and ongoing universal technological advances, organizations are finding that they must be involved in innovation to even enter the market place, not solely to remain there (Kline & Rosenberg, 1986). In the widening global economy, organizations must compete with producers and suppliers around the world as well as with the ever changing and progressing technologies. Organizations must therefore seek to exploit inputs and resources much more effectively, continually innovating to maintain competitive advantage in their ever changing market place (Porter, 1998).

While internal input and resources are extremely beneficial to large organizations, the immediate external environment also plays an essential part in the innovation process for many organizations (Porter, 1998). As innovation can require several areas of expertise and many different types and levels of capabilities, networks have also been utilised as a vehicle to support innovation strategies. These networks often involved organisations originating from similar or complementary technologies, products or consumers and have the advantage of bringing more and varied areas of expertise and ways to solve problems than would have been present within

the individual organizations if working alone. Moreover organizations often seek out help by joining a network of organizations as this can provide a rich resource for the innovation process (Gulati, 1999; Ahuja, 2000).

External knowledge creates the centrepiece of the innovation process (Cohen & Levinthal, 1989). Innovation in the bio-technology sector has been shown to be driven by interorganizational collaboration due to the availability of diverse and novel knowledge sources. Within such interorganizational collaboration the diversity of available knowledge facilitates the innovation process in several ways; providing a stronger foundation for learning, more chances of new knowledge connecting to existing knowledge and increasing the formation of associations.

This increased complexity in the environment relies heavily on effective interpersonal interaction within the interorganizational group to reduce uncertainty and improve knowledge sharing, in turn leading to effective interorganizational performance (Flowers, 2004; Ellram, Tate & Billington, 2008; Araujo & Spring, 2006; Terho, Haas, Eggert & Ulaga, 2012). Understanding these interpersonal dynamics is essential in fostering successful interorganizational relationships with longevity.

The aim of the research is to extend the *intraorganizational* team literature to encompass interorganizational teams and in doing so to explore the antecedent and emergent factors which have a significant impact upon interorganizational team effectiveness. The organisational team literature and interorganizational collaboration literatures are examined through the contextual lens of innovation, and both are expanded to overlap with the emerging body of interorganizational team literature.

1. Interorganizational Team Innovation

Innovation occurs increasingly frequently across organizational boundaries, i.e. interorganizational innovation. This research focusses on the vehicle through which this occurs – the interorganizational innovation team. These interorganizational innovation (project) teams are defined for the purpose of this thesis as teams made up of individuals from several different organizations, and working across organizational boundaries on a project basis. Namely, the vehicle through which the innovation occurs when it involves individuals from several organizations. The thesis explores the ways in which these interorganizational teams work together with differences in approaches and agenda. The research examines the antecedent and emergent factors which contribute towards effective interorganizational innovation projects.

These teams can be formed of individuals from a Small and Medium-sized Enterprise (SME) with a medical device design and design expertise, academics developing the novel technology/device, consultants with expertise in the technology or the materials as well as experts from the healthcare field (these can be procurement/adoption professionals as well as medical practitioners and consultants) who adopt boundary spanning roles (Stock, 2006). By adopting *intraorganizational* team insights and translating them into understanding the small group of individuals working together across organizational boundaries, we can gain a novel insight into the interorganizational innovation project. This involves collecting data from the individual perspective in order to gain a clear understanding of the different individual experiences each member has within the team. This data will enable the exploration of the ways in which individual factors (including attitudes, behaviours, and outcomes) and team factors (size, longevity, diversity) can contribute to the overall performance of the project.

The frameworks of the Input-Process-Outcome (McGrath, 1964) and the Input-Mediator-Outcome (Ilgen et al., 2005) models of team effectiveness are overlaid and used to

begin to apply findings from the vast literature on organisational team effectiveness and innovation and extend these findings to encompass teams within the interorganizational setting.

2. Interorganizational Collaboration for Innovation

Innovation is traditionally defined as one of the following activities: the introduction of a new product; the change to an existing product; changes in process; introduction of a new market; the development of use or supply of materials; and the change in organization within industry (Schumpeter, 1934). In the case of this thesis we focus on complete innovation of a new product, the incremental innovation of an existing product as well as innovation as an activity and outcome of interorganizational working. Interdisciplinary collaboration is defined as “an interpersonal process through which members of different disciplines contribute to a common product or goal” (Berg-Weger & Schneider, 1998; pp. 98). This definition is of use for understanding the partnerships and liaising which occurs, particularly in the context of innovation and product development, in the medical device sector.

Organizations increasingly engage and collaborate in innovation projects with other organizations, particularly in the medical device sector. Innovations, particularly new product innovation, often come from SMEs. The collaboration of several organizations on the project allow for the harnessing of expertise and knowledge from several organizations to be used to mutually benefit each organization. In the context of this research, innovation is seen to occur between several SMEs in order to generate an idea and/or product, as well as further down the development phase where the needs of the end users are also incorporated; for example, when healthcare professionals and National Health Service (NHS) employees are also involved in product development and innovation of medical devices and technologies. SMEs have been chosen as the focus instead of larger suppliers as the effectiveness of the innovation and its successful implementation is vital to the economic success of the SME, therefore more emphasis and importance will be placed on the interactions with NHS staff. The involvement

of the NHS is important from a sustainability perspective for SMEs in keeping the project moving forward as a result SMEs become reliant on the NHS in order to both keep the development project afloat through funding, through access to medical expertise and through opportunity to network with key influencers, ensuring the device is not only clinically applicable and useful but is also adopted.

Much of the interorganizational relations and networks literature has focussed on structural and operational modes and their development (Provan, Fish & Sydow, 2007), recent movements in the interorganizational studies literature have seen a growing interest in interpersonal dynamics and relationships (Bergenholtz & Waldstrom, 2011). Group processes and affective factors, with theory originating from the psychology literature, have become particularly useful in understanding the behaviours, processes and practices that occur at the interpersonal level within the interorganizational setting. This research therefore aims to learn more from the psychology literature, in applying the most relevant findings from the team psychology school and exploring whether these antecedents, emergent affective states and behaviours and their impact upon team effectiveness are replicable in the interorganizational team setting.

3. Contextual Motivation

“These strengths alone are not enough to keep pace with what’s happening <globally> - we’ve got to change radically – the way we innovate, the way we collaborate, the way we open up the NHS.”

- David Cameron (2011) Prime Minister

“We need to create the right environment for scientists and business to work together and translate research into new, cutting-edge technologies and medicines. This will boost our economy, create new jobs, and lead to better treatments for patients.”

- David Willetts (2011) Minister for Universities and Science

A key challenge for the NHS identified by many of the speakers at the NHS Healthcare Innovation Exposition 2013 was how the NHS can collaborate more effectively with industry, particularly within innovation in the medical device sector. There is a consistent theme found in various recent government and Department of Health (DH) strategies, initiatives, announcements and publications – that collaboration and innovation is vital to the NHS in all of its’ practices. In particular it has been acknowledged that there is value in widening NHS relationships with the outside environment in order to provide leading quality healthcare. Specifically, relationships with SMEs are an area of interest.

The contextual setting of this PhD thesis is the articulated challenge that the NHS faces. The PhD sets out to understand how these relationships are formed between SMEs in the medical device industry and the NHS. Additionally the exploratory research will examine the factors leading to interorganizational team effectiveness and in doing so will develop a deeper understanding of the barriers, challenges and success factors associated with instigating and maintaining these relationships in this particular context.

The medical device sector relies on input from healthcare professionals with expert knowledge of the practical setting. Meanwhile, purchasing and utilising suitable medical devices requires production, manufacture and development expertise from business. It is through collaborating with many partners that SMEs in the medical device sector are able to ensure that the development and innovation of a medical device can be fruitful. Innovation is the “process whereby organizations transform ideas into new/improved products” (Baregheh, Rowley & Sambrook, 2009). Joint innovation ventures in turn are likely to elicit a valuable product both in terms of healthcare provision and also in monetary terms, despite the tensions surrounding many actors working successfully together and the length of time an SME must await a return on investment.

This PhD thesis and project has been partly funded by the Department of Health, and was originally set up through the now reorganized NHS Procurement and Supply Agency (NHS PASA), and partly funded by the Engaging Research for Business Transformation partnership (EREBUS) between Aston Business School, Birmingham University Business School and Warwick Business School. The brief of the project is to explore contemporary interorganizational innovation projects in the medical device sector which involve partnerships and collaborations between organizations. In particular the focus is on Small and Medium Sized Enterprises.

The Review of Innovation in the NHS in December 2011, encouraged and demanded a more open, innovative and collaborative NHS. Having explored the context, and following project development, the first key objective of this thesis is to gain a clear understanding of how innovation and collaboration occurs between the NHS and SMEs in the medical device sector and what the setup of these projects look like. The second objective is to understand the individual and organizational factors that can promote the most productive working environment for successful innovative collaboration. That interorganizational innovation can be fostered through creating the optimum environment and working relationship seems likely (Willett, 2011) but the specifics of what this might entail are not yet clear. Successful innovation can be viewed as both an output and a process or activity (West & Farr, 1990). In this project how to support the process of innovation as an activity and how to facilitate successful innovation outputs from the project are both examined. Therefore objective one examines the 'process' while objective two focusses on the 'outcome' of innovation. There are many implications for the SMEs (who produce the medical devices) as well as for the NHS trusts and institutions partnering the SMEs in the project. The implications of cross-boundary collaboration are discussed in the following sub-sections.

4. Data Collection and Key Findings

The study initially employed an exploratory ethnographic approach, seeking to understand the context, how these interorganizational relationships are formed and the different forms that they may take. This also uncovered some factors that may explain performance and ultimately successful innovation within interorganizational teams, as well as some of the challenges and barriers associated with NHS and SME relationships. This initial exploration into the context is vital given the limited attention that the research context has previously received. This phase included direct observation, engaging in discussion, attending events and conferences as well as information collected from a variety of documents, publications and websites related to the medical device sector and innovation.

This preliminary exploration of the practical setting indicated whether certain measures, originally developed for organizational teams within the organizational boundary, could be adapted and translated to the interorganizational team working context. For example it is clear that such groups may be highly diverse. Diversity has been found to affect team effectiveness in organizational innovation teams, as innovation requires a diverse knowledge base (West, Hirst, Richter & Shipton, 2004).

Using an ethnographic approach through attendance at events and informal conversations with a wide range of individuals involved in the context from Department of Health executives to Medilink managers led to insights into the setting and complexities of the project working group. Furthermore, documents and policies were read closely alongside website based research to further the institutional level of contextual understanding.

The ethnographic data from the exploratory data collection Phase (One) was collated into a diary of key events and notes. These are presented and narrated utilising three different lenses in order to better aid the understanding of the multi-level perspectives within the research

context. These three lenses allow for attention to be paid at the macro-, meso- and micro- level, thereby also allowing focus to move from Government strategy, to NHS strategic implementation and to the effects of this implementation at the interorganizational project level.

In the exploratory phase key findings supported the assertion that the complexity of the NHS structure made it difficult for SMEs to access the appropriate support and champions to help in the development of their innovation. Additionally once a project had developed a successful innovation and a medical device that could demonstrate both a clinical need and clear effectiveness there was a significant delay whilst the implementation of necessary care pathway changes occurred. Furthermore policy and documentary evidence demonstrated the strategic intentions of the NHS to save money via procurement but also to encourage the strategies of innovation and working alongside industry and SMEs. It was evident there were many barriers and contrasting messages.

This accumulated evidence was then used to inform the development of the interview schedule in Phase 1i and the questionnaire for Phase 2 and to engage in access negotiations with projects identified during the ethnography. This intense and detailed period of data collection allowed for assertions and observations made about the context to be applied in order to ensure a questionnaire that was suitable was developed, using existing published measures to explore what constitutes successful project innovation.

Part of this initial qualitative Phase One included in-depth qualitative interviews (Phase 1i), which were informed by background information collected during exploratory and access negotiation periods. The interviews were semi-structured in order to obtain some similarity of discussion topics and to examine factors measured by the questionnaire in more depth. However the semi-structured style meant that the interviewer guided the conversation to explore these variables whilst also allowing the interviewee to discuss other emerging themes. The transcripts were examined and using a set of common structural themes they were explored through a

narrative approach to each of the cases. After many iterative cycles of data reading and coding (Kotlarsky & Oshri, 2008; Kotlarsky, van Fenema & Willcocks, 2008), themes emerged from each of the cases, some of which were then found to be common threads running between them. A cross-case comparison was then also performed in order to understand the differences and similarities being experienced by interorganizational teams facing varying levels of performance and success.

From the interview narratives and cross-interview comparisons a range of themes emerged. Contextual change, political change and change within the NHS were widely felt to have influenced the project outcomes. Frustration with the NHS was reported, with inertia and lack of driving forces being reported as the most frustrating issues being faced since the restructure. The origin of the innovation, leadership, innovation champions, market research, entrepreneurship and structure were all found to be emergent themes as were team characteristics and variables such as psychological safety, boundedness, interdependence, creativity and trust. This served to confirm suitability of constructs for the Phase 2 survey.

During the second phase a questionnaire was administered to 15 interorganizational innovation project working groups. The questionnaire collected responses on an individual basis, with 71 full individual responses collected in total. Following the questionnaire and some initial correlation analysis, semi-structured qualitative interviews were carried out amongst a selection of the 15 interorganizational groups based on the questionnaire analysis. Four case-studies were selected, adding depth to the questionnaire analysis and also allowing for a semi-exploratory approach in order to identify phenomena that had not been picked up in the previous quantitative phase.

The questionnaire data was analysed first at the individual level and then utilising project means to analyse from the interorganizational team level. At both levels descriptive statistics and correlation analyses were performed. However, regression analyses were

performed at the individual level whilst a non-parametric ranking analysis was performed at the team level.

The analysis of the second phase data demonstrated that demographic diversity was extremely low in the sample. There was a positive correlation between the Team Diagnostic Survey (TDS) subscale (measuring three defining intraorganizational team characteristics: boundedness, stability and interdependence) boundedness and the number of members in the working group, so the larger the project working group, the more clearly defined the membership is. In addition intrinsic motivation was found to be positively correlated with the number of members in the project working group from the NHS, with more intrinsic motivation reported in a larger project working group.

Progress with the innovation project was found to be significantly correlated with having a higher number of collaborating members from the NHS and another organization (including academic institutions). In addition significant positive correlations were found between Progress and the average number of meeting attendees, number of small group meetings, the composite TDS measure (boundedness, stability and interdependence). However there was a negative significant correlation between progress and intrinsic motivation and creativity.

Alliance Performance was found to positively correlate with higher numbers of members from commercial collaborating organizations as well as NHS and academic (other). A negative significant correlation was found between alliance performance and the three variables: regularity of whole group meetings, creativity and intrinsic motivation. Positive significant correlations were found between alliance performance and: the TDS measure as a whole but not the boundedness subscale; and psychological safety.

5. Contributions of the Research

The PhD thesis rationale has been discussed in relation to the academic and practical settings. Furthermore there is a methodological contribution to be ascertained from the research and the issues in interdisciplinary research are also explored.

5.1 Contribution to Academic Knowledge

The team literature is associated with teams that operate within the boundaries of the organization i.e. *intraorganizational* teams (i.e. Anderson & West, 1998; Edmondson, 1999; Bechtoldt, De Dreu, Nijstad, & Choi, 2010). In the context of this thesis the interest is in small groups of people working together *interorganizationally* with the groups spanning one or more organizational boundaries. This approach brings together individuals from separate organizations. Inevitably, two or more organizational cultures (including management practices) and two or more areas of knowledge and expertise are involved in the group's functioning. The interorganizational groups in question bring together individuals from different organizational contexts (SMEs and the NHS) with varying priorities (sales & profits vs. Patient care and procurement budget). As a result, their aim of generating the innovative ideas needed to resolve complex technological and medical challenges comes with the added challenge of working effectively with a diverse range of individuals.

The team literature has provided valuable insights into questions around intraorganizational work activity and interpersonal dynamics, practices and processes as well as behaviours (Scott & Bruce, 1994; Edmondson, 1999; Wageman et al., 2005; Anderson & West, 1998; Van der Vegt & Bunderson, 2005; Kirkman & Shapiro, 1997; West, Hirst, Richter & Shipton, 2004; Schippers, West & Dawson, 2015; Liu, Cheng, Chao & Tseng, 2012). The research has expanded the team literature to include interorganizational teams by demonstrating that although environmental conditions may be different from teams operating within the organisational boundary, the way in which antecedent and emergent factors impact upon team effectiveness is similar. In doing so, the team literature is expanded and encompassing rather

than perpetuating disparate and divisive approaches to team literature (Mathieu, Travis, Rapp & Gilson, 2008).

The interorganizational innovation literature has examined the nature of the collaboration between organizations and the performance of these alliances (Provan & Milward, 1995; Knight & Pye, 2005; Ramstad, 2009; Blindenbach-Driessen & Van den Ende, 2006; Huggins, Johnston & Thompson, 2012; Gardet & Mothe, 2012), however this has been limited and has rarely beyond antecedent conditions and structural factors (Carlile, 2002).

Much of the innovation research focuses on interorganizational networks and ways of working, but not on the interpersonal interactions occurring as a result of the network and the behaviours, attitudes and practices engaged in (Beeby & Booth, 2000) although some do focus on trust (Newell & Swan, 2000). Recent movements into understanding these interpersonal interactions have utilised findings from the psychology literature. This thesis aims to begin addressing the gap in the literature with respect to interorganizational teams, by translating concepts from team psychology literature into the interorganizational setting thereby providing a focussed approach to understanding interpersonal dynamics involved (Bergenholtz & Waldstrom, 2011).

This project is inherently multi-disciplinary, in that it spans several areas of literature. The practical context is a novel setting for research due to the unique nature of the resulting sample and access negotiated, as well as the NHS/SME interaction remaining an under-researched context when examining medical device innovation and interorganizational collaboration. Meanwhile, the research also provides novelty in the empirical and methodological setting, by applying insights from the *intraorganizational* team literature to the interorganizational team and collaboration setting. By applying these insights, the small group interactions occurring across organizational boundaries can be further examined, in particular

enabling attention to be paid to the “black box” of collaboration practices, behaviours and processes (Carlile, 2002).

Additionally, this thesis utilises a mixed methodological approach from an interpretivist perspective, taking the stance that context can affect the selection of suitable research methods. In order to better understand these forms of interorganizational collaboration, the research brings organizational psychology based perspective and insights together with a mixed method approach. The research extends the existing findings from the team literature to include interorganizational working groups and also brings an interorganizational innovation perspective to the research, through the use of mixed methods. This will help to guide future research with overlapping contributions, as well as strengthening the mixed methods approach.

5.2 Contribution to Policy and Management Practice

Due to the contextual setting and basis of the research problem, there are many contributions that can be made by this research including contributions to both policy formation and implementation in the practical setting. This may help to inform SMEs that are intending on engaging with the NHS to develop their innovative medical devices.

Innovation is vital for all organizations in reaching their organizational and strategic goals (Martins & Terblanche, 2003). Traditionally innovation and being innovative have both been considered as vital to organizational survival and differentiation in the economy or marketplace (Smith, 2006); particularly given the amplified competition in the increasingly global marketplace. However, this is most traditionally applicable to the private business arena and those organizations interested in profits and sales. In the public healthcare sector, innovation is also vital to fulfilling different organizational goals and is a constant feature in Department of Health strategy and policy.

Here the emphasis tends to be more on budget and spending and less on profit. Moreover there is growing focus on patient satisfaction with service and quality of patient care and less

on customer satisfaction with a product. An example encountered in the course of data collection is that of the Doppler Cardiac output and fluid management system – a single system used for monitoring blood flow and heart rate as well as managing fluid supply to tissues during major surgical procedures. This product is desirable as it requires a single machine but also reduces length of stay in Intensive Care Units, as well as overall length of stay – therefore contributing to savings in several areas as well as patient satisfaction and increased recovery speed. Hard work between NHS Technology Adoption Centre (NTAC) and the organization developing Doppler had led to these successful discoveries and demonstrable clinical need and effectiveness. However, the challenge was for the organization (the main stakeholder SME) to sustain themselves whilst clinical pathways were discussed and the slow process of change in the NHS was negotiated. The SME partners often became frustrated and the NTAC team had to work hard at maintaining motivation and enthusiasm.

Regardless of what the end result of the innovation is (or is intended to be) for the organization, innovation often requires outside involvement, which can take place in many forms (Powell, Koput & Smith-Doerr, 1996). Large multi-national organizations may easily be able to innovate without external resources, but often will still seek outside knowledge or resources to enrich innovation (Cohen & Levinthal, 1990). A key feature of much of the innovation literature in recent years has been ‘networks of innovation’ (Powell, Koput & Smith-Doerr, 1996). The networks involve organizations working together on innovative solutions to problems or novel innovations in products. This thesis focuses on the interorganizational project working groups, formed as a product of innovative collaboration and acting as the vehicle through which innovation can occur. The research aims to shed light on the factors, antecedents and behaviours occurring in and around these interorganizational working groups with a view to identifying the conditions which foster working group effectiveness, which ultimately is indicated in the success of the overall innovation project.

The National Innovation and Procurement Plan (2009) produced by the Department of Health was a response to the warning that the NHS will hit an extreme budget shortfall by 2014 if procurement practices and processes are perpetuated. The Chief Executive of the NHS recommended that more innovative procurement would help not only to improve the service quality and productivity of the NHS, but would also contribute to averting this budgetary crisis. The Darzi Report (2008) gave impetus for this proposition, as it recommended that those involved in NHS procurement and management should “seek to foster a pioneering NHS”. Moreover stimulating innovation and innovative procurement occurring within the NHS and its network of suppliers has become a local and national priority. That said, in light of the more recent target set by the comprehensive Spending Review (Her Majesty’s Government, 2010) to cut spending on NHS procurement by £1.2 billion by 2015, innovative procurement and new medical device innovation have proven to cause a large barrier for adoption to overcome. Since, medical device innovation projects must ensure that there is an “unmet need” (NHS National Innovation Centre (NIC), 2013) that the device or technology is addressing in order to side step these apparently irreconcilable tensions within the NHS – of the need to decrease spending but also increase innovation.

Understanding how best to foster innovation of suitable medical devices is having an impact on the extensive review and revision of the procurement process occurring between the NHS and its associated suppliers, the restructuring process introduced under the Innovation, Health & Wealth Review (2012) has set out to deliver the previous commitment to fostering and aiding innovation of medical devices in conjunction with NHS and healthcare trusts previously seen in the National Innovation Centre (NIC), National Technology Adoption Centre (NTAC) and events such as the “Wouldn’t it be good if?” where workshops were held and current clinical needs were presented on a nationwide basis to designers and engineers. The update has measured that this is underway but acknowledges that even more focus is required (NHS, 2013).

At the time of Phase 1 and 2 data collection, NHS involvement in innovative collaboration of medical devices in SMEs were few and varied. Indeed the best way to approach and seek involvement with the NHS was not clear for SMEs – this was repeatedly cited to the researcher during the exploration Phase 1 of data collection. There were a small number of NHS and Department of Health led schemes, which were limited in the number of companies they could provide with help, advice and resources. For example the NHS National Innovation Centre had funding available to enter into joint ventures with a certain number of SMEs that were working on development and innovation of medical devices. The NHS Technology Adoption Centre worked alongside businesses in finalising medical device designs and provides advice and resources as well as useful access to contacts that could be involved in the adoption of their products.¹

Often a company already has ties with healthcare professionals, who can provide support and expertise in development phases or may even invent a solution to a problem. In fact there are many ways in which medical devices are developed, each suited to the particular circumstances of the organization. However, the reality is that many SME based medical device development projects lose momentum due to lack of funds and resources, as the road from development to adoption can be extremely lengthy. If these phases can be strengthened with the right expertise and help, then many valuable products may make it down the pipeline towards adoption at a quicker pace. Many companies seek advice, resources, support, representation (and more) from the NHS in some form, resulting in a project working group made up of several actors from different organizations including from different organizations sitting under the NHS brand.

¹ The NHS restructure resulted in the organizations absorbed into the regulatory body NICE in April 2013. This precipitated the introduction of regionally based Academic Health Science Networks which are set up to provide the resources, advice, support and representation to organizations involved in research, development and innovation of medical devices and technologies.

The project working groups or teams are the primary focus for this research; in particular the focus is on the functioning and performance of interorganizational project working groups and the project on which they are working. The research explores the contributing factors to the success of the collaboration on the project and the innovative process itself. Inevitably the performance of the group and the innovation for which they are responsible has direct consequences for the SME, in terms of the longevity of the interorganizational team and in many cases for the SME organization itself. There are also inevitably impacts upon the uptake of the product, the NHS being able to provide a solution to an “unmet need” as well as ensuring the procurement strategy is implemented and government policy achieved.

6. Conclusions and Implications

This research can help managers and innovation project members involved in these interorganizational working groups to better understand the functioning of their innovation teams. In doing so, there is also the opportunity to gain an understanding of how to maximise the positive outcomes of these interactions. There will be more clarity for managers dealing with these groups, by creating awareness of the factors that are needed to improve innovation and group work. An end result for the NHS is improved innovative procurement, patient and clinician satisfaction, engagement with SMEs and industry as well as a reduced budget shortfall. The project contributes to these strategic goals. For the SMEs involved, there are economic benefits such as improving customer satisfaction, differentiation in the market and ultimately increasing sales and improving partnerships with the NHS.

The findings of the thesis are arranged using a merged framework of the Input-Process-Output (IPO; McGrath, 1964; Stock, 2014) in combination with the Input-Mediator-Outcome (IMO; Ilgen et al., 2005) model of team effectiveness. The case for applying *Intraorganizational* team insights into the interorganizational team setting has been supported throughout the data collection phases and the implications that building team relationships, practices and process,

such as boundedness, stability, interdependence and psychological safety have been evident in the performance and progress of projects. This in turn addresses the question of the interpersonal dynamics and interaction related practices, processes and behaviours (Carlile, 2002) that are linked to interorganizational collaborative effectiveness. These two conclusions address the research question and provide insight into the overarching research question of: **What are the antecedent (input) and emerging factors (process and mediating) that impact upon interorganizational team effectiveness?**

7. Outline of Thesis

The first section of the thesis is comprised of three chapters focussing on examining the existing literature that is relevant to the research and their associated literature gaps. Chapter Two examines the Organisational team literature, identifying a framework to use as an aide in the exploratory survey, and factors that contribute to team effectiveness and innovation within the boundaries of an organisation. Chapter Three then examines the Interorganizational Collaboration literature and the gaps in understanding that exist at present in this inherently multi-disciplinary field. Chapter Four then explores the budding literature on interorganizational teams and seeks to pull the relevant findings from the previous chapters in order to understand interorganizational team effectiveness in greater depth. The common vein that runs through these chapters is innovation, which is the literature context and the lens through which the literature is examined. At the end of Chapter Four the research question is articulated and a framework to aid the exploratory research is positioned.

Chapter Five presents the detail on the research paradigm, strategy, method and procedure. The exploration of the context is in parallel with engaged scholarship (Van de Ven, 2007) and the interpretivist, mixed-methods, exploratory approaches to research are examined in more detail. Also within this chapter detail regarding the research strategy, procedure and sample is given.

The results of the ethnography Phase One data collection are presented in Chapter Six along the macro-, meso-, and micro- levels of insight through narrative collated from various documents, observations, discussions, policies and presentations. Exploratory qualitative interviews were part of Phase One of data collection (Phase 1i) and although they are presented in a chapter in their own right (Chapter Seven) they are very closely related to the findings presented in Chapter Six. The final chapter in the findings and analysis section of the thesis features the exploratory quantitative survey analysis (Chapter Eight). The findings and analysis chapters are all interlinked due to the heavy influence of contextual understanding woven throughout the exploratory research.

As a result, Chapter Nine summarises the findings and interprets the results over the qualitative and quantitative phases of the data collect and the two exploratory studies. The interpretations are then applied to existing theory. Finally, Chapter Ten summarises the findings from each section of the thesis and answers the overarching research question before presenting the implications and contributions made by this research. Finally the limitations of the research are discussed and suggestions are made for the direction of future research.

Chapter Two: Exploring the Organizational Team Literature

This section of the thesis, (including chapters Two, Three and Four), explores literatures originating from multiple overlapping disciplines. These literatures directly relate to the research project and have been selected for their contribution to furthering the understanding of the factors predicting interorganizational team effectiveness, particularly when collaborating on innovation projects.

The literature review is formed of three chapters. This first chapter discusses the most relevant literature from the field of organizational teams, which is one of three bodies of literature providing a foundation for the development of this research.

The following two chapters cover interorganizational collaboration and interorganizational teams. However, first this chapter capitalises on the established team literature concerning organizational teams i.e. teams within the organizational boundary (intraorganizational teams). The focus is on understanding the literature surrounding the definition of a team in the traditional organizational sense. First, the team is defined and the ways in which academics have approached evaluating team performance are explored. The antecedent conditions, mediators, team practices and processes all impacting on and predicting team innovation and ultimately organizational team effectiveness are presented and evaluated in terms of relevance to this research context of interorganizational innovation. This chapter is intended to present the most relevant findings from the existing literature on intraorganizational teams, to form a foundation for the following chapters which present the emerging academic field and literature gaps and ultimately extend the findings in this chapter into the boundary-spanning setting of the interorganizational team.

1. Defining the Organizational Team

Research into teams and team effectiveness within the (intra)organizational setting has been a common feature in much of the organizational behaviour and work psychology research (Fink, 2002; Robbins & Judge, 2007). Working in teams has long been considered an effective approach to managing employee motivation and productivity (Hackman, 1986; Peters, 1988; Tornatsky, 1986). This is particularly true in an economic climate, where organizations are constantly challenged by technology and competition (Neuman, Wagner & Christiansen, 1999).

There are many widely varying definitions of what constitutes a “team”, especially because “team” has different meanings to each individual team and team member, and is also perceived differently depending on the context (Hackman, 2002). A typical definition of a team is:

“A small number of people with complementary skills who are committed to a common purpose, set of performance goals, and approach for which they hold themselves mutually accountable.”

(Katzenbach & Smith, 1993: pp.112)

While this definition accurately describes the team within an organization or a ‘work’ team, it has a high specificity to a particular type of team, within a standard organizational structure. The definition does not give scope for individual differences between members within the team. There are many definitions of teams, and often these have been found to be either highly specific or not specific enough which is why Katzenbach & Smith (1993) suggested the above definition. With such a large variety of types of teams, let alone organizational settings for the teams, efforts were made to isolate the essential characteristics that teams have which make them a team.

Hackman (2002) identified six characteristics that were common across 40 team definitions and subsequently used these concepts in order to create a framework for coding. Shared objectives, interdependence, autonomy, bounded-ness and specified roles were identified as the

five key characteristics which differentiate a group of workers and a work team. A shared objective indicates the extent to which the group share, and are aware of, the same team objectives. Interdependence indicates the mutually dependent nature of the relationships that each team member has with the others. Autonomy is the extent to which the team has the authority to make a decision or complete a task without input from an authority figure outside the team. Boundedness refers to how well-defined the team boundaries are and how solid they are while specified roles refers to how clear the individual roles within the team are.

These 6 characteristics in the original Team Diagnostic Survey (TDS) criteria (Katzenbach & Smith, 1993; Katzenbach, 1998) were designed so that teams that fulfilled each criterion were classed as ‘real’ teams and those fulfilling a majority but not all were considered ‘pseudo’ teams. For example a ‘real team’ was so classified if it scored high on measures of shared objectives, boundedness, stability, interdependence, autonomy and specified roles; if some were present it was a ‘pseudo-team’. However, these characteristics do not capture the enduring and longitudinal nature of teams and team activities. It does not accept that teams are dynamic and change over time (McGrath, Arrow & Berdahl, 2000), learning from what has happened and using this in the future in order to improve. As such Richardson & West (2010) suggested that a further characteristic of reflexivity should be added to the TDS. Reflexivity is the process of reflecting upon and adapting in subsequent situations accordingly (Schippers, Den Hartog & Koopman, 2007).

When teams work together over a series of tasks or projects, reflexivity is a critical part of the activities occurring within the team, and is of particular importance in improving performance. As such, this adapted scale acknowledges that being a ‘real’ team is a case of having all criteria present, but some ‘pseudo-’ teams can display most characteristics but not all and as such should not be disregarded as teams but cannot be accepted as true (or ‘real’)

teams. Moreover, the scale uses the perspective of longevity, which could make a huge difference in identifying project teams as ‘real’ teams.

It is important to note that many of the definitions and studies involving organizational teams have observed subtle differences, and drawn attention to all teams not being alike. A key feature of a seminal review of team effectiveness (Mathieu, Maynard, Rapp & Gilson. 2009) was to focus on underlying commonalities in findings across the literatures. It is for this reason, and for the purposes of this chapter, that the focus is on themes and trends in the organizational team literature. Naturally there are key differences in functionality, objectives and longevity of teams, but the focus here is on the underlying factors that may directly affect team effectiveness regardless of team taxonomy.

2. Team Effectiveness

Many factors have been associated with increased effectiveness in teams, and over time there have been several models of team effectiveness proposed.

The input-process-outcome (IPO; McGrath, 1964) when developed was a radical framework for studying team effectiveness, which considered antecedent factors as “inputs” which created the boundaries and criteria affecting interpersonal interactions between team members. These antecedent factors were considered from individual (i.e. ability, personality, expertise), team (i.e. vision, objectives, task), organizational (i.e. culture) and environmental (i.e. market influence) levels. The IPO model posits these antecedents as having a direct impact on the processes and team interactions that drive a team towards achieving the valued “outcomes” expected of and by the team (Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers, 2000). In the same way as the “inputs” in the model can be considered from a range of levels, “outcomes” can be related to individual effectiveness (i.e. satisfaction) and team performance (i.e. the task is completed) (Mathieu et al., 2009).

There have been several minor adaptations and criticisms of the IPO model, since its development. The nature of the multi-level model results in interactive cycles of impact from the processes and tasks affecting more inner levels of “inputs”. For example, the external environment will have an impact on the task and therefore the individual requirements for the task (Cohen & Bailey, 1997; Klein & Kozlowski, 2000). This approach means that outer layers of inputs will always have impact upon the more insular layers, and this is a key criticism of the original IPO model. Likewise, with different levels of antecedent inputs, come different levels of process and outcomes, and whilst researching this in particular Ilgen et al., (2005) noted that not all of the factors affecting the movement of “inputs” to “outcomes” can be classified as processes.

This distinction between action based processes and individual and group affective, cognitive and psychological emergent states (Cohen & Bailey, 1997; Marks, Mathieu & Zaccaro, 2001) lead to the development of the input-mediator-output (IMO) model of team effectiveness (Ilgen et al., 2005). The IMO model of team effectiveness allows for a range of different factors to be positioned in the middle of “inputs” and “outcomes”, and for the different levels of factors to be recognised throughout the model.

The IMO process is reflected in Edmondson (1999)’s model of team learning which also attempts to explain team performance in a range of different teams and team settings. Edmondson (1999) proposes a model that sees a trickle-down effect from antecedent conditions, to team beliefs, to team behaviours to finally the team performance outcomes. Through this framework Edmondson (1999) posits a view of environmental conditions having an impact on the beliefs and behaviours of the team which in turn affects performance. This acknowledgement of individual factors layers on top of the IMO model, as it explores team affective states, belief and behaviours.

However, in the traditional model of team effectiveness, there are no iterative cycles that reflect temporal dynamics or impact, which have been seen by many team academics as a vital contributing factor in team effectiveness (McGrath, 1991). This was considered by Ilgen et al., (2005) who represented this evolving, recurrent nature of impact upon inputs in the input-mediator-output-input framework.

The consideration of temporal factors has been more salient in the literature in recent years (Mathieu, Tannenbaum, Donsbach & Alliger, 2014) The focus has been on the complexities of how antecedents such as team composition factors affect outcomes, as well as defining how to measure effectiveness as an outcome (Mathieu et al., 2009).

In their meta-analysis Hülshager, Anderson & Salgado (2009) utilise a framework of team input, process and moderator variables to explore the extant literature on team innovation and its predictors. In doing so they carefully explore the two different frameworks previously discussed in conjunction. Following this example, throughout the next sections of this chapter the next sections, team inputs or antecedents and the process and mediating factors that have been found to affect team outcomes and effectiveness are explored. They are explored in relation to their impact on team effectiveness which for the context of this research is team innovation.

3. Team Inputs

Several attempts have been made to clarify which antecedent circumstances and defining characteristics are particularly influential to team effectiveness and innovation.

One such factor is group composition (Moreland, Levine & Wingert, 1996), which has many facets ranging from cultural background to personality type. There are huge volumes of research into personality and team effectiveness, and as much debate over how successful it has been (Driskell, Hogan & Salas, 1988). As such, it is ever increasing in popularity for work

psychology researchers. Driskell et al., (1988) found that Team Personality Evaluation (TPE) and Team Personality Diversity (TPD) both predicted differences in the team's performance ratings. Furthermore, each Big 5 Personality Trait was found to predict either TPE or TPD: TPE positively correlated with traits of conscientiousness, agreeableness and openness to experience; TPD correlated team performance with extraversion and emotional stability. Furthermore, extraversion and emotional stability have been found to be associated with social cohesion (the extent to which the team socialises and integrates) as well as team viability (Barrick, Stewart, Newbert & Mount, 1998). Another facet to group composition research is familiarity; if the group are familiar or strangers to each other it has been found to directly affect decision making and team performance (Gruenfield, Mannix, Williams & Neale, 1996). Furthermore, the size of the team has group composition effects, with the preferable number of members lying between 4 and 7 (Robbins & Judge, 2007).

Group composition has been found to have a large impact on highly innovative team outcomes. Heterogeneity amongst new ventures teams has been found to significantly impact entrepreneurial activity and innovation (Jin, Kellermanns, Xi & Crook, 2014), where direct and mediating effects on team performance and innovation were found with significant diversity in group composition. Furthermore Eesley, Hsu & Roberts (2014) reported that group composition cannot be ignored when creating founding teams in new venture contexts. Diverse founding teams were reported to produce high performance in a competitive commercial environment, but that less diversity in technically focussed teams lead to alignment with an innovative strategy and a cooperative commercial environment. This suggests that innovation strategy alignment in the future requires some level of diversity, particularly if the aim is cooperation rather than competition in the market place.

Group composition has been included in recent debates about temporal factors impacting upon the outcomes and interactions affecting team effectiveness. Mathieu et al., 2014, suggest

that group composition will impact upon team effectiveness in different ways and this will be dependent on the stage of group development. It is therefore vital that consideration is given to antecedent factors, particularly group composition, which may be confounded by temporal factors.

Group development has also been seen to impact on team effectiveness (Tuckman, 1965; Mathieu et al., 2014) with the length of time teams spend in each phase of group development and how well they cope with each stage affecting the progress on the task as well as the effectiveness of a team in working together. A further multi-faceted and widely researched factor affecting team performance and effectiveness is that of collective identification and group diversity (Van Der Veegt & Bunderson, 2005). The effect of personality diversity on team performance has already been discussed; however it is a key to considering how far the impact of diversity on team effectiveness goes.

Cultural diversity research indicating resistance to team work due to culture has shown that culture and its associated differences must be managed appropriately within the organization (Kirkman & Shapiro, 1997). Social category diversity has been found to positively influence member morale within a team. Diversity of values has been reported to decrease team-member satisfaction, intent to remain in the team and team commitment (Jehn, Northcraft & Neale, 1999). However, relationship conflict with another member of the team was found to have a mediating effect on the influences of value diversity. It is evident that a subtle and delicate balance of diversity must be met when teams are created within an organization, and this is still being addressed. Team learning has a mediating effect on the relationship between diversity and team-effectiveness (Van Der Veegt & Bunderson, 2005).

In 63 recent studies of diversity in teams, there were benefits and losses related to diversity across many organizational levels (Jackson, Joshi & Erhardt, 2003; Jin et al., 2014; Eesley et al., 2014). Jackson et al., (2003) also suggest that future research must have an emphasis on

how organizational change can incorporate diversity, for example in multi-disciplinary teams. They additionally recommend that diversity research is sparse at a higher whole organizational perspective, and while a lot of research is ongoing in team research they report no research on network or interorganizational team diversity and effectiveness.

There has been a proposal that “inputs” are involved in motivating effective team innovation and the organizational processes which are also involved (West, Hirst, Richter & Shipton, 2004). This model provides seven of twelve steps considered as “inputs” which can influence team and organizational innovation and change. The “inputs” are similar to those previously discussed; attributes of the members (knowledge, skills and abilities), team composition and organizational context. These are presented as a framework of steps which will foster innovation within the organization. Included in these steps are intrinsic and extrinsic reward management, selecting innovative people, setting up a learning and development climate, and promoting diversity at many levels. We can see that this pulls together the factors previously discussed and applies them to a whole organizational perspective.

Diversity is considered as important to both the team effectiveness (Van de Vegt & Bunderson, 2005) and on organizational effectiveness (Kirkman & Shapiro, 1997), particularly in relation to innovation outcomes in teams (West, Hirst, Richter & Shipton, 2004). However, as with the innovation literature, successful performance of a team is difficult to measure (Griffin & Page, 1996). The Team Diagnostic Survey (TDS; Wageman et al., 2005) has been developed based on the model of team effectiveness (Hackman, 1987, 1990, 2002; Hackman & Wageman, 2005) and aims to provide measures of the factors proposed in the model in order that a measure of overall team effectiveness may be obtained.

The TDS uses the five conditions of;

- i. The team is a 'real' team, complying with the criteria in the TDS (Richardson & West, 2010)
- ii. The team has a compelling direction
- iii. The team has a structure which facilitates their task
- iv. The team has a supportive organizational context
- v. There is the opportunity for coaching and team member development

The items for each sub-scale were selected from already existing measures and adapted before being administered to 2,474 individuals, belonging to 321 teams. The reliability and validity of the TDS has been found to be satisfactory, requiring testing in different types of teams in order to strengthen these measures and apply the survey confidently to *all* teams. However, this set of conditions can provide a good basis which not only identifies the team as 'real' but also considers the antecedent conditions surrounding the team which ultimately will affect their performance on the innovation project.

In exploring "real" team characteristics, Lyubovnikova, West, Dawson & Carter (2014) proposed that the distinction of real team characteristics in a group such as shared objectives reflexivity and interdependence would impact upon positive outcomes at each level. Using data from the NHS Staff Survey (n = 62,733), found that the presence of these characteristics within the team led to fewer reported incidences such errors, injuries, patient incidences, retention and absence and improved patient outcomes. The findings add weight to the importance of group composition.

The relationship between team interdependence and performance has been found to be mediated by team processes (Stewart & Barrick, 2000), with the statistical relationship strengthening when the team is engaged in conceptual tasks. This research also found that the team leadership being held within the bounds of the team, or self-leadership, worked alongside

interdependence as an input factor, leading to team processes that mediated team performance. This not only upholds the concept of team autonomy (Cohen & Bailey, 1997), allowing teams greater impact upon their own performance, but also builds on the IPO model. By utilising the socio-technical systems theory (Trist, 1981) that task demands impact performance, the research finds that if the team is solely behaving as a team as well as operating under authority from outside its bounds, the effect on performance is weaker. However if a team is allowed autonomy, can lead itself, is interdependent and therefore requires inputs from all members, as well as working on innovative and conceptual tasks, the effect on performance will be stronger statistically (Stewart & Barrick, 2000).

4. Emergent Team Factors and Effectiveness

This section explores the underlying factors impacting upon effective innovation within the team setting. Much work has sought to research the antecedent and moderating factors that lead to team effectiveness and predict team innovation (Hülshager, Anderson & Salgado, 2009). This section of the chapter explores the affective states and group processes, in alignment with the IMO/IPO models (i.e. Hülshager et al., 2009). The key characteristic that these factors share is the temporal dynamic. They are emergent, rather than present at the outset of a team project, and therefore whether they are mediators or processes, they have an impact on the relationship between input and team outcome.

In the literature, innovation has been defined as either a process or an outcome (West & Farr, 1990). Interorganizational innovation literature has been presented, where a project occurring between the boundaries of collaborating organizations can consider both the process of innovation and innovation itself as an outcome. In this section, innovation is taken as a topic from the team literature, in order to understand better how this may differ from the previous setting as well as to identify areas of overlap that this research project may examine more closely.

Much of the team effectiveness and team performance literature is underpinned by the move towards understanding the antecedents, factors, practices, processes, behaviours and attitudes, from the organisational to the individual level, that contribute to an effective team. This is mirrored in the team innovation literature, with innovation acting as both an outcome or success factor and also as a behaviour or practice engaged in by the team. This is a vast area of literature, and these insights may help to shed light on the practices and processes occurring within the interpersonal relationships within the interorganizational innovative collaboration teams within the context of this research.

4.1 Team Climate

Team climate has been extensively researched and revised over the decades (Anderson & West, 1998) however there are two conceptualisations that have been most prominent. The “Cognitive Schema” approach features team climate as an individual’s own representation of their working environment and has been particularly linked to research into how the individual makes sense of their work environment (James & Sells, 1981; Ashforth, 1985). On the other hand, the “Shared Perceptions” approach illustrates climate as the shared perceptions and ideas regarding the way the organization operates (Reichers & Schneider, 1990). There is considerable controversy regarding criteria for shared perceptions and thus methods for this approach have been a contentious issue (Patterson, West & Payne, 1992). These are not mutually exclusive approaches and can be used in parallel.

The four-factor theory (West, 1990) proposes that there are four key climate facets which affect the innovation of a work group; vision, task orientation, participative safety and the support for innovation. Within the context of this proposed research, it is suggested that using similar measures that are attempting to capture similar constructs, which are perhaps more up-to-date. However, Anderson & West (1998) suggest that the emphasis of future research lies in researching a particular aspect of team climate and relating it to a specific outcome as well as

whether particular constructs within the team climate produce more or less consensus between team members.

In recent years, team climate for innovation has remained a key measure utilised in the literature. Team climate has been found to have a significant positive relationship on team performance in teams with high fatigue due to shift patterns (Pisarski & Barbour, 2014), which demonstrates that team performance can still thrive in a positive climate, even under intense pressure and fatigue. Moreover, in periods of stress and insecurity, team climate for innovation is a moderating factor for team member creativity (Liu & Shi, 2014).

Team climate for innovation has also been found to moderate the relationship between multi-disciplinary team diversity and relational coordination, meaning that with positive climate for team innovation high levels of diversity can still maintain the dynamics and coordination required for delivering cross-disciplinary projects (Hartgerink, Cramm, Bakker, van Eijnsden, Mackenbach & Nieboer, 2014). When examining team climate for innovation in new product development teams (NPDs), team climate for innovation was found to significantly moderate the relationship between transformational leadership and NPD team performance (Sun, Xu & Shang, 2014). In this highly innovative and creative environment, the team climate therefore moderates how much impact a leader can have on team performance.

4.2 Psychological Safety and Trust

As suggested in the four-factor theory, participative safety has been accepted as an important part of team climate, particularly linked to innovation and innovative behaviour in teams (Anderson & West, 1998).

Psychological safety (Edmondson, 1999) is the feeling that individual team members sense it is safe for them to contribute to the team and to engage in risk taking behaviour. This could be particularly relevant to our research focus as teams involved with innovation and technology can easily map onto risk-taking behaviour in developing innovative medical devices.

Psychological safety is linked to where the blame lies once a decision has been made and if this decision later proves to have been the incorrect one. However, this construct extends further than where the blame lies and more towards the team climate; in particular the interpersonal relations. While this obviously links into team effectiveness factors as previously discussed, we must look at whether this construct can extend to the much more complex network team context. Additionally it is important that in the study where psychological safety was linked to team learning, so was team stability (Edmondson, Bohmer & Pisano, 2001). A further measure of team climate that could apply to this context is that of trust. Indeed Berwick (2003) recommends that trust is a vital focus for executives of NHS trusts hoping to speed innovation and diffusion of innovation in their organization.

Trust is inextricably linked to psychological safety and is a long established and extensively researched topic within the organizational psychology literature. Trust has been found to increase the speed at which the team reaches appropriate levels of interaction and in the presence of trust, co-operative behaviours have been shown as more prevalent (Jones & George, 1998). Sundstrom et al., (1990) proposes that trust is involved in the “values” that the team assume and that they demonstrate in their interactions and collaboration. When considered in the team context, Erdem, Ozen & Atsan (2003) propose that due to its effect on team member behaviours and subsequently on the team performance that trust is a “hygiene factor” for team performance, with the operational factors including the behaviours of the team. This would fit well with both the concept of team climate, and the team learning model proposed by Edmondson (1999) where antecedent conditions affect the team’s beliefs and then the behaviours. Trust has been found to moderate the relationship between conflict and task performance (Simons & Peterson, 2000).

Edmondson (2004) however, suggests that trust does not capture “a sense of how valued and comfortable an employee feels in that working setting” (pp. 240) and proposes the construct

of psychological safety lends itself to capturing the intricacies of this. Edmondson (2004) also found that several factors support the psychological safety of team members (the organizational context, leader behaviour, trust, and respect were among these). Particularly relevant to this research were Edmondson's (2004) findings that psychological safety can lead to team members seeking support such as help and feedback as well as being more inclined to engage in innovative behaviour and produce innovative outcomes as well as team learning outcomes. Furthermore, psychological safety has been linked to team boundary spanning (Edmondson, 2004). As a result it is clear that both team climate as a whole and psychological safety specifically are important factors to consider when looking at team performance with innovation as an outcome.

Edmondson & Lei (2014) thoroughly review the psychological safety literature and position psychological safety as an interpersonal construct that can be an antecedent, mediator, moderator and outcome. There is significant evidence that psychological safety has an impact on team performance when teams are dispersed and have complex boundaries (Gibson & Gibbs, 2006). Psychological safety is largely found to enable interpersonal relationships, team work, voice, collaboration, team learning and team performance (Edmondson & Lei, 2014).

4.3 Reflexivity

Reflexivity is a team behaviour whereby members take time to reflect on previous work and give or receive feedback both individually and collectively. Reflexivity complements the notion of psychological safety as well as the TDS (Richardson & West, 2010) as parts of the construct are referred to. However, reflexivity is considered as a team behaviour rather than as a team antecedent or as a team climate factor. The occurrence of reflexivity within a team has been a recent feature of the team research (De Dreu, 2002; Carter & West, 1998; Tjosvold, Tang & West, 2004; Schippers, Den Hartog & Koopman, 2007; Schippers, West & Dawson, 2015) and has not yet been applied to a team which spans organizational boundaries. As such, while it fits

well with innovation and psychological safety it is also a fundamental area of interest for this study.

More recently, team reflexivity has been found as a moderating variable between authentic leadership and team performance, suggesting that leadership based on honesty and legitimacy can have a deeper impact on team performance when the team engages in meaningful reflexivity activities (Lyubovnikova, Legood, Turner & Mamakouka, 2015). Reflexivity moderates the relationship between HPWS (high performance work systems) and team performance, suggesting that a strategy of alignment leads to a climate of seeking ways for future improvement in the team. Reflexivity is also seen to reduce failures to process information (Schippers, Edmondson & West, 2014), which suggests that performance is improved when time is given to engage in reflexivity as information can be processed and time is allocated for ensuring this processing leads to improvement and learning. Certainly, team reflexivity has been significantly linked to team innovation (Schippers, West & Dawson, 2015) and team performance over several decades.

4.4 Creativity

Further to the idea of team behaviours, it is clear that team creativity is an important behaviour to consider within this new context of the interorganizational team. Creativity is linked to problem solving (Rickards, 1997), which in this case is a measure of team performance for the innovation project outcome as well as for the team. Organizational and environmental factors which foster creativity include favourable work practices, work pressures, management style and reward systems. Typically creativity will occur less frequently in a risk-averse climate where individuals' new ideas will be criticised and where there is resistance to change (Rickards, 1997). As such the ideal creative climate is one of trust and where change and idea generation is encouraged (West, 2002; Isaksen & Lauer, 2002; Chen, 2006), ultimately an environment where innovation is fostered.

Creativity can be viewed as a team behaviour, process, outcome or antecedent. For example, Alahuhta, Nordback, Sivunen & Surakka (2014) suggested and tested several interventions and approaches to improving group cohesion and fostering creativity in virtual and disparate teams. Alahuhta et al (2014) suggested that communication and fostering the belief that the group is operating as a team, despite doing so virtually, significantly implicates on creativity as an outcome and behaviour. Likewise, reflexivity and team focus mediates the relationship between positive group affect and creativity, with positive group affect leading to increased reflexivity, improved team focus and therefore fostering the correct circumstances for team creativity (Shin, 2014).

4.4. i Creativity and Motivation

Creativity has been a widely researched topic in both the organizational literature as well as the team and innovation literatures in work psychology. Intrinsic Motivation has been established in much of the psychology literature as a predictor of performance, innovative behaviour, employee engagement, self-regulation, emotional intelligence and creativity (Amabile, 1996; Shalley et al., 2004). Intrinsic motivation is the internally sourced driving force behind an individual's willingness to engage, for non-extrinsic (externally sourced) rewards (Utman, 1997).

Amabile (1983) argued that intrinsic motivation would explain an individual engaging in a creative process, but did not provide enough of an explanation about the likelihood of creative outputs. An important issue in much of the literature is whether creativity is a process, a behaviour or an output (Shalley & Zhou, 2008; i.e. Drazin, Glynn, & Kazanjian, 1999; Mumford, 2000; Shalley et al., 2004). In this research creativity is processual—that is, to denote creativity as a behaviour occurring within the team. The use of this definition is important as in the context of the interorganizational project working group, although not all members are directly engaged in the process of creativity, the research seeks to ascertain whether it is an activity that transcends all roles and is inherent within the team's functioning.

Intrinsic motivation “makes the difference between what an individual *can* do and what an individual *will* do” (Amabile, 1988: pp. 133). Simon (1967) theorised that intrinsic motivation was closely linked to the level of attention and engagement an individual will naturally give to a task. Attention and engagement in a task leads individuals to seek out solutions and explore novel avenues, therefore to be more creative. Motivation is closely linked to Emotional Intelligence and self-regulation (Kanfer, 1990). As a result intrinsic motivation provides a driving force for individuals to easily maintain interest and effort in a project until completion (Shalley, 1995; Shalley et al., 2000).

Intrinsic motivation has been found to significantly impact upon team creativity in circumstances where there are no clear outcomes of radical innovation (Charness & Grieco, 2014), while external rewards are vital when the goal is already clear and ahead in the task. A review of the literature on creativity and innovation to date demonstrates that intrinsic motivation and creativity are clearly linked and proposes that they are integral pieces in the same process of innovation (Anderson, Potocnik & Zhou, 2014). Intrinsic motivation is a major constituent and psychological mechanism leading to creativity, and one which organisational context can affect (Anderson et al., 2014).

4.5 Innovation Champions and Communication

In line with these factors previously outlined in team innovation research, Howell & Shea (2001; 2006) explore the predictors of innovation projects involving intraorganizational teams. Howell & Shea (2006) conducted 47 interviews with innovation champions, following up this data collection with a survey of team members. The research was exploring the role that innovation champion behaviour has on the team potency, external communication, and project performance. It was found that not only does the innovation champion’s enthusiasm, support and motivation directly predict performance but so does the environmental scanning, positive framing of the innovation and the network and contacts of the champion (Howell & Shea, 2001; 2006). In addition in 2006, a further project explored the roles of individual differences,

environmental scanning, innovation framing and champion behaviour on predicting project outcome. It was found that the strength or potency of the team as well as quality of external communication also predicted performance outcomes for the team, as well as the champion's behaviour (Howell & Shea, 2001; 2006).

5. Summary

Overall it is clear that there are a wide range of different input and emergent factors contributing to team innovation and team effectiveness within an organizational boundary. At the beginning of the chapter the characteristics of a 'real team' were presented. If these characteristics can be identified within the interorganizational team context, then indeed the interactions occurring within the interorganizational team may also be ideal for the application of the factors associated with innovation performance of organizational teams. In doing so the currently separated literatures presented over these three chapters can overlap and provide a framework for understanding the innovative context of this research.

In order to explore the context of interorganizational innovation project teams which span organizational boundaries it is important to consider which factors are most likely to translate well into this setting of interorganizational teams engaging in innovation projects, so that the organisational team literature can expand to help understand more about small group working in a complex organisational setting.

Chapter Three: Interorganizational Collaboration

This chapter discusses the most relevant literature from the field of interorganizational collaboration in the context of innovation, which is one of three bodies of literature providing a foundation for the development of this research. The literature directly relating to these interorganizational innovative collaborations to date is presented. The chapter examines the antecedents, interpersonal processes and factors involved in engaging on an interorganizational basis. This is presented as an examination of how findings from the field of psychology have been applied to dynamics and interpersonal processes in the interorganizational setting (Bergenholtz & Waldstrom, 2011; Majchrzak et al., 2015; Marion et al., 2015). The contentious issue of how to measure interorganizational performance is discussed, and the gap in the literature for team psychology findings to be extended in their application to interorganizational relationships is positioned.

1. Interorganizational Collaboration

The literature examining interorganizational collaborations is vast, and encompasses many distinctions such as interorganizational relations, interorganizational networks, and interorganizational collaboration (Provan, Fish & Sydow, 2007). Moreover, these may take the form of dyads, strategic alliances, cooptation, collaborations and consortia (Brass et al., 2004). Interorganizational relationships or collaborations are commonly entered into as a way to seek a new solution to a problem that requires complexity or specificity of input (Lawrence, Hardy & Phillips, 2002), and they are an important source of innovation often initiated with innovation as their purpose (Gray, 1989).

Regardless of the distinctions in types of interorganizational collaboration, key themes emerging from each of the bodies of literature include the social interactions and relationships

at work, the connectedness, collaboration and collective actions of those involved and trust and cooperation that is required to do so (Provan, Fish & Sydow, 2007).

Network research defines a network as “a set of actors connected by a set of ties” (Borgatti & Foster, 2003), the actors may also be called nodes and the connections have led to much research specifying the type of tie and strength of the connections (Borgatti & Halgin, 2011).

For the purposes of this research, interorganizational collaboration is defined according to Hardy, Phillips & Lawrence (2003; pp. 323):

“A cooperative, inter-organizational relationship that is negotiated in an ongoing communicative process and that relies on neither market nor hierarchical mechanisms of control”.

The reason that this definition is salient for this research is that it alludes to interpersonal and relational dynamics at the individual, team and organizational level. Moreover, there is the sense of an ongoing process, which is important in developing common practices and principles (Lawrence et al., 2002) and it reflects the essential components of effective interorganizational interaction: communication, cooperation and coordination (Walton, 1966; Stock & Tatikonda, 2008).

Resource Dependence Theory (Pfeffer & Salancik, 1978) describes an organisation as an open system that is impacted and dependent upon the external environment. This theory has been prominent throughout interorganizational (as well as organizational team) literature and has been used to explain the mutual dependence that the organizations involved in collaboration have between each other in order to survive in challenging circumstances and draw upon each other’s resources (Hillman, Withers & Collins, 2009; Knight, Pfeiffer & Scott, in Press; Casciaro & Piskorski, 2005).

With increased complexity in the environment, particularly in supply chains and markets, there are challenges associated with ensuring that requirements of the buyer are clear and discussed from the outset (Flowers, 2004; Ellram, Tate, & Billington, 2008). For this reason, suppliers, consultants and specialist third party agencies are actively involved from the outset of the project (Araujo & Spring, 2006) in order to assist in the definition and integration of these requirements from an early stage. Strong inter-personal relationships become essential in ensuring this involvement is successful (Terho, Haas, Eggert, & Ulaga, 2012).

Given that much of the research on interorganizational relations has capitalised on understanding what networks are, their structural and operational modes as well as their development (Provan, Fish & Sydow, 2007), this research seeks to expand on recent movements. In doing so, this thesis sets out to utilise concepts, findings and methods originating in the intra-organizational and social psychology literature and to consider the interpersonal dynamics contributing to effective interorganizational collaboration and innovation (Bergenholtz & Waldstrom, 2011).

1.1 Influences from psychology literature

Interorganizational network theorists have been working on a strand of literature relating to group processes (Borgatti & Foster, 2003) with their basis in social psychology, and have begun to examine affective factors that affect common beliefs, attitudes and interactions (Friedkin & Johnson, 1990, 1999; Carley, 1991). These researchers position the theory that homogeneity of beliefs are generated from the influence that individuals have on each other (Kiesler & Cummings, 2002).

Homophily theory has been positioned within this body of literature as an explanation for the structuring of interactions, where those with greater similarities in individual characteristics are more likely to work effectively as a group and on an individual basis (Mc-

Pherson, Smith-Lovin & Cook, 2001). This is true whether as a result of choice or environmental context, as efficiency in knowledge transfer, coordination and reduction in conflict boosts performance (Borgatti & Foster, 2003). However important consideration must be given to the benefits of diversity of knowledge and perception (Krackhardt & Stern, 1988). Group structure and development, and group stability and trust have also recently emerged in the literature having originated from social psychology theory (Burt, 2000). These studies tend to explore the way in which these factors develop over time and change, as the interorganizational interaction progresses (Borgatti & Foster, 2003).

In a review of interorganizational collaboration and the dynamics involved, the complexity of interpersonal dynamics have been found to significantly impact upon the success of the collaboration (Majchrzak, Jarvenpaa & Bagherz, 2014). Understanding how individuals and groups working in these interorganizational collaborations manage such complexities is still required (Majchrzak et al., 2014). Marion, Eddleston, Friar & Deeds (2015) suggest that cognitive and psychological considerations are useful in building on interorganizational relationships theory, following from Ring & Van de Ven's (1994) assertion that the relationships are entirely at the mercy of individual actions. The building of these relationships are viewed as iterative cycles rather than processual (Ring & Van de Ven, 1994), and it has been recommended that although many interorganizational relations commentators seek further understanding at the network level of analysis, factors at the individual level require examination in the literature in order to understand contributing psychological and affective factors individual, role and task level (Macneil, 1980; Ring & Van de Ven, 1994).

Interpersonal relationships have been a focus for some interorganizational collaboration researchers, and in particular the embeddedness of these relationships (Berends et al., 2011). Interorganizational relations allow mutual access to resources and knowledge therefore allowing for more innovation to occur and for that innovation to be more likely to be successful

(Aiken & Hage, 1968; Van de Ven, 1976; Powell et al., 1996). Embeddedness can also be seen as useful in future interorganizational relationships (Gulati, 2007; Powell et al., 2004).

Embeddedness shapes the relationship interactions and dynamics at the individual level within a single organization (Barden & Mitchell, 2007; Granovetter, 1985). The strength of individual, interpersonal ties shape the strength of relationship dynamics at play within an interorganizational project (Granovetter, 1985). At the organizational level, cross-boundary relationships between individuals also generate interorganizational level embeddedness (Hagedoorn, 2006). However research examining relationships and interaction at both the individual and interorganizational level within networks is sparse (Brass et al., 2004; Gulati, 2007; Marchington & Vincent, 2004) and where it has been carried out it has suffered from limitations with sampling and scope (Gulati & Sytch, 2008; Gulati & Westphal, 1999).

Interorganizational collaboration begins with an interorganizational agreement to collaborate which requires at the least, relationships between boundary-spanning employees (Van de Ven, 1976). However, it is possible that these relationships may not be formed through agreement and may solely exist for advice purposes (Liebeskind et al., 1996). Therefore, the idea of partial collaboration must be a significant consideration in interorganizational research (Rousseau, 1985) as the relationship may not be as structured as theorised in the literature. This is of particular relevance to the UK healthcare context.

There may be a balance to be established between factors such as mutuality of benefits, trust, commitment and room for understanding. It has been found that trust may be established between the individuals involved in collaborating or between the collaborating organizations themselves (Zaheer et al., 1998). However, more research at all of the multi-level perspectives available in the interorganizational research context has been called for (Brass et al., 2004), particularly interpersonal and interorganizational relationships (Gulati, 2007).

Marion, Eddleston, Friar & Deeds (2015) examined longitudinal case studies (n=14) in order to explore the development and maintenance of interorganizational relationships involved in new product development (NPD). The earlier relationships outside the origin organization were formed, the more likely the relationship emerged into successful ventures. The case studies also revealed strong social and emotional ties, which led to potential issues with the future of the venture and its success.

The importance of interorganizational collaboration has been noted in relation to supporting the innovation process which occur within organizations (Deeds and Rothaermel, 2003; Dodgson, 1993; Hagedoorn, 2002). It has been found that performance in firms that work collaboratively with a diverse assortment of partners improves, with higher proportion of turnover from new and developed products being realised as a consequence (Faems, et al., 2005). Integration of structures and processes supporting the innovation within the firm is a necessary success factor (Gann & Salter, 2000) as is the inclusion of end users and customers (Greer & Lei, 2012; Shah & Robinson, 2007).

The choice of running projects with interdependency inevitably brings with it challenges (Newell, Goussevskaia, Swan, Bresnen & Obembe, 2008). A recent feature in much of the interorganizational collaboration literature is interorganizational trust (Maurer, 2010) which has been found as a success factor and also a barrier to interorganizational innovation. This is an interesting addition to the interorganizational literature as traditionally organizational trust and trust in teams has formed a large part of the work psychology and organizational behaviour research, a discipline which has contributed towards the development of this research project and which is presented in the previous and following chapters.

1.2 Interorganizational Collaboration and Early Supplier Involvement

As previously outlined, there is a strong case for building strong interpersonal relationships between suppliers and purchasers from the outset of an innovation project in order

to ensure that requirements are clearly defined from the outset of the project (Flowers, 2004; Ellram, Tate, & Billington, 2008; Araujo & Spring, 2006; Terho, Haas, Eggert, & Ulaga, 2012; Selviaridis, Spring & Araujo, 2013). Selviaridis et al., (2013) suggest four role typologies of these interactions: translating, reengineering, developing and fine-tuning. These roles are dependent on the levels of uncertainty occurring within the relationship.

A translating role relies heavily on knowledge building in order to address a gap between the suppliers' limited knowledge and the buyers' level of uncertainty. Reengineering roles focus on modification in accordance with the purchasing organisational requirements, again in a situation where the supplier must build knowledge of the buyers' requirements. A developing role is very much collaborative and is associated with knowledge building on both the buyer and supplier sides. A fine-tuning role involves minor adjustments in a situation where the supplier has greater knowledge of the buyer context and the buyer has lower uncertainty (Selviaridis, Spring & Araujo, 2013).

This focus on early involvement, knowledge of the buyer and strength of the interpersonal relationships highlights the role of the buyer in shaping the project and the capability that they have in doing so (Selviaridis et al., 2013; Selviaridis et al., 2011; Gadde & Hulthén, 2009). Indeed it has been found that the suppliers and intermediaries must be adaptable and flexible to change in accordance with an evolving business context (Gadde, 2014). In allowing for this adaptability, it has been proposed that there are both permanent and temporary layers to a network (Dubois & Gadde, 2000), where the temporary network allows for flexibility and for joint solutions to be formulated according to the context and requirements. However, this shared learning has been found only to have a long-term benefit to those involved should the relationship only be confined to the duration of a singular project (Dubois & Gadde, 2000).

While it is difficult to capture the processes at work when researching networks (Aaboen, Dubois & Lind, 2012), interaction has become a focus of much of the

interorganizational networks, marketing and purchasing scholars. Interaction can help to integrate individual actors, dissolving boundaries both within and between organisations (Dubois & Araujo, 2007), and therefore there is significant importance on interaction quality and involvement both across the organizational hierarchy and between the organisations themselves, at the organisational and dyad levels. Hjelmgren & Dubois (2013) propose that those involved in network interaction must first understand their focal concerns, highlight their knowledge and then attempt to balance these insecurities in order that network interactions can be fostered, interdependencies promoted and uncertainties reduced (Hjelmgren & Dubois, 2013).

1.2 i Interorganizational Collaboration for Procurement and Supply Chain Management

Institutional theory can be drawn upon to understand how social constructs are generated at all levels, from individual to team and organizational levels, with the focus of this theory being on understanding the factors influencing behaviour and action (Meyer & Rowan, 1977; Powell & DiMaggio, 1991). This theory is particularly useful in unravelling the behaviours and procedures surrounding inclusivity in the procurement management process (Theodorakopoulos, Ram & Kakabadse, 2015). Neo-institutionalism requires organizations to conform to the fundamental environmental social constructs. In the case of procurement, institutional isomorphism is posited as earning the organization legitimacy with those it is engaging with (Powell & DiMaggio, 1991). Ram, Theodorakopoulos & Worthington (2007) found that in organizations that are collaborating, there are influences from the origin and collaborating organizations affecting the approach taken to procurement.

Some antecedents of information sharing and collaboration were put forward in a paper by Wu, Huang & Hsu (2014), whereby antecedents that were related to Social Exchange Theory (Emerson, 1976) including trust, commitment, power and reciprocity were examined for their effect on information sharing and collaboration. Social Exchange factors

were found not only to determine information sharing and collaboration in interorganizational supply chain settings but also to have a mediating effect on supply chain performance (Wu et al., 2014).

The early involvement of suppliers (ESI) has featured regularly in the literature on procurement and innovation (Johnsen, 2009). Primo & Admundson (2002) found that the involvement of new suppliers during phases of high innovation had a positive impact on the innovation process overall (Surtees, Knight & Shipton, 2014).

In a review of innovation and ESI, Johnsen, Calvi & Phillips' (2012) concluded that both continuous (i.e. more incremental) and discontinuous innovation relied upon ESI, and more critically with early involvement of the purchasing function. This involvement would enable conversation, debate and discussion throughout design and prototyping, meaning that clarity and understanding of the requirements and specification are at the forefront. This approach may not involve direct involvement during the development phase but would allow for procurement factors, such as costs and availability of materials, supply risk and intellectual property and contractual issues, to be considered earlier during product development and therefore agreements and modifications to be ongoing and regular (Surtees et al., 2014).

Better value for money has been linked with ESI (Loader, 2007) and while economies of scale are beneficial to larger organisations that can deal with the associated demands, small firms must demonstrate greater flexibility and efficiency than their larger counterparts to realise the same value for money. However the public sector procurement environment is in a state of constant change which adds a further challenge (Loader, 2007).

Public Procurement for Innovation (PPI) occurs when an organization recognises an internal, unmet need and requests that potential suppliers meet the need. This may involve a variety of requirements such as contractual commitment to subsequently acquire, or may relate to a product and/or service. However, PPI prompts innovation by one or more suppliers (Edquist

& Zabala-Iturriagoitia, 2012). Edquist et al. (2012) proposed two different types of PPI – direct or catalytic, which are differentiated by the origin of the innovation is from an end user or a procurement agency. Most public procurement is regular and planned, however certain sectors – including healthcare – involve innovation much earlier (PPI). Indeed, ward efficiency and successful ward management (Ancarani, Di Mauro & Giammanco, 2009) have been found to improve when PPI is used (Surtees et al., 2014).

Innovative procurement can be seen in pre-commercial procurement (PCP; Bos, 2008) which aligns research and development in suppliers with what buying partners are looking for. Martin et al. (2005) found that by focussing on the user during the design phase, the user remains interested. Furthermore, not involving the end user has been found to lead to negative outcomes.

The European Commission (Bos, 2008) has recommended that PCP promotes knowledge and idea generation, leading to innovation that has been carefully designed and is more liable to be invested in once design is complete (Rolfstam, 2012). PCP precipitates the traditional cycle of product innovation (Rolfstam, 2012); so that intention and requirements are fully scoped and act as a driver for the innovation.

Due to the nature of PCP, i.e. it is the procurement of a product that does not tangibly exist, there has been some debate over whether or not it can be considered alongside supply and demand (Edquist & Zabala-Iturriagoitia, 2012), however it is generally considered to belong to the demand group. Rigby (2012) outlined the advantages of PCP for public sector organisations: scalable pilots are possible, usage and setting requirements shape the design and users are involved from the beginning. In addition, Rigby (2012) suggests that the use of PCP opens up the market for SMEs.

1.3 Measuring Performance in IO Innovation

While much interorganizational research has involved the antecedent conditions contributing to successful innovation and what makes for more successful interorganizational collaborations, some investigation into how to measure interorganizational performance and success must be carried out. A review of some of the possible measures of interorganizational collaboration success has been conducted, to better understand what is required from a measure of interorganizational collaboration performance and which factors must be considered in measuring this performance.

Griffin & Page (1996) suggests that innovation success is extremely specific to the project and depends on the initial strategy of the project. Moreover, Griffin & Page (1996) suggest that innovation project success can be measured by three categories of outcomes:

1. Customer-based Success; including number of customers, satisfaction, acceptance, market-share and revenue goals and unit volumes.
2. Financial Success; profit and margin goals, break-even time.
3. Technical Performance Success; degree of innovation, competitive advantage, speed to market, development costs.

Griffin & Page (1996) found that these success factors will apply to different innovation projects depending on the newness to the market and newness to the firm. As such, they conclude that these outcome measures will be applicable to different firms hosting the innovation project.

Blindenbach-Driessen & Van den Ende (2006) have adapted a method of measuring innovation project success using the project performance, market performance and learning effects for future projects (Griffin & Page, 1996) which incorporates the learning occurring while the innovation project is underway. This is paired with a set of success factors from five meta-analyses on new product or service development; planning of work, senior management

involvement, team structure, involvement of outside parties and activities undertaken (Blindenbach-Driessen & Van den Ende, 2006). These success factors were tested on four firms (six development projects) and after testing Blindenbach-Driessen & Van den Ende (2006) concluded that innovation success factors are not universal for all contexts. This research suggests that more investigation on the effects of different project characteristics is required, particularly in projects where outside parties are involved.

Blindenbach-Driessen & Van den Ende (2006) suggest that the traditional measures of profit and market share as suggested by the research that they have adapted (Griffin & Page, 1996) are not applicable to all situations and respondents and suggest that these five success factors should be adapted to apply to each situation. This builds on the recommendations of Griffin & Page (1996) that the timing of measuring performance outcomes within the project lifecycle is an area which future research must both aware of and examine. Aggeri & Segrestin (2007) argue that product development progress is a salient contributor which requires both further research but also warrants inclusion in overall innovative performance measures. While these measures of innovation are robust and capture much of the important information required in measuring the performance of innovation projects, the key element of the project being interorganizational is missing.

Ramstad (2009) developed an evaluation framework, encompassing the idea that innovation can be a process or an end product. The model is based in Complementarity Theory (Milgrom & Roberts, 1995; Pettigrew & Whittington, 2003), which takes the view that there should be 'fit' and harmony between all key organizational functions, and their policies and practices. The model aims to create a framework for researchers to use in order to assess innovation network interactions and their effectiveness. Ramstad uses 17 long-term joint forums in learning networks to illustrate the conceptual framework. In doing so, three types of data are collected from the illustrative cases; project reports, self-assessment of outcomes from

project managers and an evaluation by the project team. The framework hinges on three criteria; the structure, openness and diversity of the learning process and the outcomes for each stakeholder in the network. While the framework succeeds in collecting extensive data and evaluating the network from many perspectives, it is primarily based on learning as a process within the innovation. While this is ideal for the context of Ramstad's research, for the particular research proposed in this report it is not ideal.

This research is investigating the effective innovation of an interorganizational team, and which behaviours and antecedents affect the innovation process. The Ramstad (2009) framework for outcomes could be useful in identifying the success of the innovation, but as a framework it cannot be wholly applied to the context of this research as it is too focussed on the learning occurring during the innovation itself.

Robson, Katsikeas and Bello (2008) examine the drivers and performance outcomes of trust in interorganizational alliances, utilising an alliance performance measure which targets the effectiveness (Fisher et al., 1997), the efficiency (Majumdar, 1998; Sarkar et al., 2001) and the responsiveness (Ayers et al., 1997) of the alliance. This measure not only explores how effective the alliance has been but also two other factors, which aren't directly related to project outcomes. This is an ideal measure for this research as it does not rely on the project being complete (and therefore, accommodates the extended NHS procurement process) but additionally it captures several dimensions which may indicate a successful management of an interorganizational collaboration.

1.4 Chapter Summary

Interorganizational collaboration has been a prominent feature in much of the interorganizational relations research, and the nature of this academic field is inherently multi-disciplinary. Much of the literature on interorganizational collaboration has focussed on the set up of the alliance or interorganizational network, the benefits and antecedent factors. The

success and performance of these interorganizational collaborations has also been explored both in relation to how the aforementioned factors impact on performance but also on performance as an outcome of working collaboratively. The literature has on the whole neglected the interpersonal relationships and collaborative practices and processes occurring within these interorganizational collaborations.

In a recent call for papers, Lauche, Berends & Carlile (2014) suggested that this “black box” of practices, processes and interpersonal relationships is an emerging but under-researched area of the interorganizational collaboration arena. While the literature review has presented some of the work on group processes and research that has leveraged findings from social psychology (i.e. Friedkin & Johnson, 1990, 1999; Carley, 1991), this move to adopt concepts and methods from interpersonal and intra-organizational psychology based disciplines is still occurring (Bergenholtz & Waldstrom, 2011).

Levina & Vaast (2005) explore how the emergence of practice in boundary-spanning activities occurs, and how these practices evolve from being designated to a manager to being employed in practice. However, there is more to unpack regarding the interpersonal interactions occurring as highlighted in the call for papers exploring the “black box” of practices, interpersonal relationships, processes, and behaviours involved in engaging on an interorganizational basis. It is clear that research has started to explore these areas using learning from social psychology, however team psychology and its application to the interorganizational setting requires further research. This will help to explore the factors emerging and implicating upon interorganizational innovation projects, as well as how these relationships are built, strengthened, and maintained in order that successful outcomes are a result (Bergenholtz & Waldstrom, 2011; Majchrzak et al., 2015; Marion et al., 2015).

This chapter has presented the interorganizational collaboration literature in the context of innovation, has demonstrated that much of the literature focuses on structures and processes

of innovation and collaboration as well as beginning to bring in findings from the social psychology literature. However, it has revealed that the literature is yet to fully address the factors, interpersonal processes, interactions, and practices associated with working and innovating successfully across organizational boundaries. In studying group processes involved in interorganizational collaboration, the team psychology literature can be used to further the understanding of which constructs affect interorganizational group collaboration effectiveness. It is inevitable that there will be organizational differences brought into the collaboration and as such it is important to understand how these differences are resolved through these interactions and relationships, as well as which factors support successful interactions and outcomes from interorganizational relations.

Chapter Four: Interorganizational Teams

This final chapter of the literature review presents an emerging academic discipline which marries together the team literature and interorganizational collaboration literature summarised in the preceding chapters, in the context of innovation. This chapter will explore the extant literature in the field of interorganizational teams. Ultimately, insights from these overlapping literatures can be extended and also used to inform the developing area of literature that is interorganizational teams. This chapter concludes with the research objectives, and leads into the following chapters which discuss the methodologies used to address the research questions.

1. Interorganizational Teams: A review of the existing literature

It is clear that innovation, particularly within the medical devices arena can encompass many types of innovation from incremental product development to rapid novel inventions, both types being necessary for organizational competition and survival (Roberts, 1988). Belonging to a network goes beyond improving innovation with external knowledge. It allows the two organizations to work together to achieve each of their goals more successfully than if working alone (Provan, Fish & Sydow, 2007).

Psychological research into teams has long demonstrated the benefits of working together in order to achieve more than could be possible individually. The diversity of teams and the perceived creativity that comes alongside this has often been seen as the key to effective cross-functional team work (Bolwijn & Kumpe, 1990). However, team literature has also elaborated on the issues and challenges that can arise with maintaining collaborative team work. A well-known example is illustrated in a tug-of-war analogy, where less effort is exerted individually when there are more people working together (Ringleman, 1913), also known as Social Loafing.

This phenomenon is found to increase when individuals do not have clear, defined roles or tasks and individual responsibilities within the team (Latane, Williams & Harkins, 1979), so that their reduced effort is hidden within the rest of the team.

Many established and widely cited phenomena provide examples of problems relating to team work, for example, conformity and obedience (Milgram, 1965), groupthink (Janis, 1982), risky shift or group polarization (Myers & Lamm, 1976). These examples must be considered when exploring the benefits of working collaboratively as working in close conjunction with other organisations within a team could potentially have a more profound effect, particularly when profit is not the main concern to a collaborative partner (Hackman, 1990; Hackman & Morris, 1975; Hoffman & Maier, 1961; Maier & Solem, 1952).

In order to address potential issues associated with working collaboratively, Grandori and Soda (1995) identify 10 organizational co-ordination mechanisms that are employed in interorganizational networks including: communication; decision and negotiation; social coordination; integration, linking-pin and unit; hierarchical and authority relationships; incentives; and selection mechanisms (cited by Newell & Swan, 2000). They suggest that these mechanisms depend on whether the network is social, bureaucratic or proprietary which can be aligned with the types of interactions and relationships between individuals and the level of formality and contract. With this, the mix of co-ordinating mechanisms of use to manage the boundaries of the collaboration will differ (Grandori & Soda, 1995).

It has been found that psychological safety in team members is linked to boundary spanning and innovative behaviour (Edmondson, 2004). Furthermore, trust has been found to help to improve the relationship within interorganizational projects (Wong, Cheung, Yiu, & Pang, 2008). These findings can be explained as trust making partner alignment easier (Atkinson, Crawford & Ward, 2006) or enhancing satisfaction reported by stakeholders (Bresnen &

Marshal, 2000). Ultimately, trust is well established in the interorganizational project literature as advantageous, particularly in interorganizational innovation project teams.

Blindenbach-Driessen & Van den Ende (2006) report that there is very little research on innovation within project-based organizations, despite the increased use of interorganizational relationships in practice (Ring & Van de Ven, 1994; Surtees, Knight & Shipton, 2014). This research aims to not only explore the success factors associated with interorganizational innovation teams but also explore the antecedent factors which define an interorganizational team and explore the factors associated with interorganizational team innovation success.

Boundary theory poses the concept that organizations are dependent upon their external environment for vital resources. This open-systems perspective suggests that the environment provides inputs and deals with outputs (Aldrich and Herker, 1977). Managing these boundaries to monitor inputs and outputs is key to maintaining optimum external interactions and boundary spanning activities are central to this boundary management. Boundary Spanning activities such as negotiation, contracting and building collaborative cooperation ensure that interactions have longevity and are not threatening to the survival of the organisation (Cross et al. 2000). Individuals play a vital role in these activities and the success of these boundary management techniques, as many involve interpersonal interaction and relationship building (Stock, 2006).

Stock (2006) explored interorganizational teams in terms of composition and ownership as well as reporting that the interorganizational nature of a team directly related to team effectiveness and team performance – which provides a great deal of support for the contribution of interorganizational teams. Additionally there is some indication of how these interorganizational teams might look – and that the project ownership should lie further from the organizations. Interorganizational team identification has been found to be increased even with individuals with low identification to their home organization through rich communication within the interorganizational team (Rockmann, Pratt & Northcraft, 2007). Team building

processes have been found as extremely important in the performance of the interorganizational project team (Albanese, 1994). Indeed Chan, Ho & Tam (2001) while discussing the effect interorganizational team work has on the overall job satisfaction of the individual, also suggest that the relationship between interorganizational team working and project outcomes requires further research, as does the way in which an interorganizational team is set up.

More recently, interorganizational teams have been featured in the research involving new product development and innovation. While a proportion of these studies are related to virtual interorganizational teams, many of the studies have begun to unpick the characteristics, practices and interactions by capitalising on literature from social psychology, interpersonal and intra-organizational areas (Bergenholtz & Waldstrom, 2011).

Interorganizational teams have been linked to organizational responsiveness (Drach-Zahavy & Pud, 2010), which given the benefits that interorganizational collaboration has been found to bestow upon an organization and coupled with the necessity of innovation in the changing global market place is unsurprising. However, three types of boundary spanning have been identified in relation to interorganizational team activities: scouting, ambassadorial and co-ordinating (Drach-Zahavy & Pud, 2010). Scouting activities refer to engaging with the other organization(s) in order to scope alternative or novel innovations and access knowledge. Ambassadorial interorganizational team activities refer to an alliance which is strategic, political or adds weight to a particular project. Finally, co-ordinating boundary spanning team activities refer to the act of pulling together the activities of organizations involved in the collaboration. Drach-Zahavy & Pud (2010) found that structure was an important consideration that managers of interorganizational teams must make as these different activities were found to mediate the relationship between three factors (boundedness, diversity and external links) and team effectiveness.

Beyond the structural factors, some authors have begun to examine the interactions occurring within interorganizational teams. The manner of the interactions occurring within the interorganizational team was found to impact directly upon innovation success (Mollaoglu-Korkmaz, Miller & Sun, 2014). Leadership was additionally investigated and successful interorganizational team leadership practices were found to be supported by a leader with detailed understanding and knowledge of the context; including the project, the population and team building processes (Kingsnorth, Lacombe-Duncan, Keilty, Bruce-Barrett & Cohen, 2013).

Marks et al., (2001) described the episodes that project teams involved in new product development pass through in order to move the project and make progress (Zaheer et al., 1998). These are categorised along a continuum of action phases and transition phases (Garcia, Mollaoglu-Korkmaz & Miller, 2014). The episodic process is aligned with the stages of progress, reaching and achieving the objectives and evaluating or reflexivity in order to learn and improve practice for the following project (Mathieu & Button, 1992). Action episodes are related to team members engaging in activities that directly lead to project progress, while transition phases are focussed on reflexivity, evaluation, strategizing and future planning (Marks et al., 2001; Garcia et al., 2014). This creates an episodic loop, where outputs (progress) from action phases lead to inputs into transition phases, and vice versa.

This cyclical episodic approach to describing team innovation has its' basis in the input-process-output model of team effectiveness (Chapter 2). While the input-process-output approach is widely cited in many areas of inquiry and academia as an approach to understanding relationships, particularly for the purposes of this research in the organizational team literature, it has recently been applied to the interorganizational project team context (Stock, 2014). Stock (2014) studied new product development teams which spanned organizational boundaries in order to ascertain the relationships between team characteristics, team co-operation practices and team effectiveness. A mediating effect of team co-operation practices was found, with a

positive effect from customer influence but a negative effect from customer involvement in the team.

As outlined in Chapter 2, the Input-process-output model of team effectiveness has come under some scrutiny as it does not allow for reflexivity and ongoing cycles of practices that inform each other. Moreover, it does not allow in its most basic format for factors that are not processes to be included in moving inputs to outputs of the team. The Input-Mediator-Output model of team effectiveness (Ilgen, 2005; Mathieu et al., 2009) allows not only for processes and emergent states to be included as mediating factors between inputs and outcomes. Furthermore the IMO model allows for antecedents and inputs from all levels to be considered. In the context of interorganizational innovation this is undoubtedly an advantage as there will be several levels of antecedents, from individual to interorganizational project.

Following on from the organizational team literature, some work has begun in the interorganizational team arena to understand the factors that lead to successful interorganizational teams. Interorganizational (project) teams have undoubtedly increased in both their presence in the business arena (Drach-Zahavy & Pud, 2010), but also in their presence within the academic literature, particularly in recent years (i.e. Stock, 2014). However, more work needs to be done on the antecedent conditions and inputs that are mediated by affect and psychological emergent states, and which have implications for interorganizational team effectiveness and innovation.

2. Literature Review Summary:

The literature review has presented the findings which form the academic foundation for this research and has led to the identification of a gap in the literature. With innovation as the context, two main bodies of literature are brought together to inform each other. The insights from the organizational team literature are used in order to explore and understand in more detail the antecedent inputs, mediating processes and emergent states that lead to successful

interorganizational team innovation, whilst the organizational team and interorganizational team literature will be aligned and extended to encapsulate interorganizational teams.

The literature review itself has identified gaps in the interorganizational collaboration and innovation literature surrounding understanding the interpersonal processes, practices and interactions that occur at the cross-boundary interface. In order to address these gaps, the *intraorganizational* team literature has been identified as an established body of literature which has previously explored team innovation and performance at great depth. In utilising these insights, the research seeks to examine the interpersonal interactions and seek to translate similar success factors associated with team innovation performance into the interorganizational relationship. Furthermore, this addresses the gap in the *intraorganizational* team literature which involves project teams set across the organizational boundary.

These literature gaps provide the background for the research context of interorganizational teams, which is an emerging body of research. By identifying and confirming that these two bodies of literature have findings that can lend themselves and be translated to the interorganizational setting, this opens the interorganizational team body for a wealth of future research.

Overall, the interorganizational team literature is an emerging research context which requires further research. Some of the measures traditionally associated with organizational teams have been applied to the context such as leadership (Mollaoglu-Korkmaz et al., 2014), communication (Rockmann et al., 2007) and boundedness (Drach-Zahavy & Pud, 2010). However, more needs to be done to identify how these interorganizational teams work together effectively.

3. Research Gap, Questions and Objectives

As presented in the preceding chapters, the literary context of this research is innovation in the interorganizational team setting. Firstly the *intraorganizational* team

literature was examined, to explore the findings that impact upon team effectiveness in the context of innovation. As in the literature, this research is reluctant to separate teams that operate across organizational boundaries as completely distinct, as team typologies historically dominated the literature and created a disparate approach to understanding teams (Mathieu et al., 2008). Instead, this research seeks to apply the findings of the *intraorganizational* team literature and extend its applicability to interorganizational teams.

In unpicking the factors that affect interorganizational innovation effectiveness, the interorganizational collaboration literature has been examined which has revealed that individual affect and psychological approaches have become more commonly applied to the field (Bergenholtz & Waldstrom, 2011; Marion, Eddleston, Friar & Deeds, 2015) in order to understand the interpersonal relationships at work.

This approach to utilising concepts and methods from other fields of literature, particularly the psychology literature, and applying it to the interorganizational setting can be furthered by applying team psychology literature findings to understand the dynamics and interactions which lead to the development and maintenance of strong, successful interorganizational teams. Therefore this research aims to examine the antecedents for effective interorganizational team innovation through extending the team literature to incorporate interorganizational teams, as well as building the interorganizational collaboration literature through applying concepts from the team psychology literature.

While some factors will be found through exploration of the context, there are other psychological factors which could be anticipated to have an impact on the team and their interpersonal relationships. These have been discussed in the literature review (Chapter Two), and some initial exploratory research is required in order to understand how to translate these measures to be more applicable to boundary-spanning activities.

This research takes the existing literature and applies it to the budding literature context of interorganizational teams, after a period of exploring to understand the contextual setting of the research. In considering this interorganizational team context, the ‘real team’ TDS defining characteristics must be tested. A clear understanding of the different forms these interorganizational teams may take will also be available from initial exploration of the context. The antecedents and team behaviours impacting on the overall successful performance of the interorganizational team can be proposed. In identifying these potentially important factors, contextually informed measurement of interorganizational innovation project success can be carried out. As a result the interorganizational team factors that contribute to effective or ineffective performance and ultimately affect the innovative outcome of the interorganizational team can be identified.

This leads to the development of a single research question:

What are the antecedent (input) and emerging factors (process and mediating) that impact upon interorganizational team effectiveness?

The singular research question invites exploration into the research setting, using the emic-etic approach (Harris, 1976; Lett, 1990; Buckley, Chapman, Clegg & Gajewska-De Mattos, 2014). By presenting the question as an exploration through both the emic and etic approaches in a complementary rather than dichotomous fashion (Buckley et al., 2014) there is an alignment with the same stance taken by the interpretivist approach. Furthermore, utilising both the emic and etic approach, the context can be examined from the inside out (emic) and the outside in (etic) ensuring breadth and depth.

In applying the theory to the novel context, the review of team literature identifies several key findings and concepts which could specifically translate to the research context of interorganizational teams.

Edmondson (1999) highlighted that while the characteristics of the team have long been researched, this has been predominantly within an organizational boundary. It has been recommended that the theories of team effectiveness must be reviewed in order to include factors such as interactions across team boundaries and how these are managed, as well as the impact that organizational context has (Gladstein, 1984). The performance of teams has been found to be influenced by organizational context and associated factors after research conducted upon Gladstein's (1984) recommendation confirmed these assumptions (Baninajarian & Abdullah, 2009).

There are also more specific areas that apply to the practical context of this research project, which will be verified following exploration of the context. The TDS (Richardson & West, 2010) has been developed to apply to all types of teams, and to distinguish between those teams demonstrating all or some of the accepted characteristics one expects a team to perform. When all characteristics are present, this is considered to be a "team", when not all of the characteristics are accounted for this is termed a "pseudo-team". By using this scale, which was originally developed as a definition tool, a definition for interorganizational teams can be developed. At present it seems certain criteria on the real-team scale (such as 'boundedness') may need adapting to suit the interorganizational team context. Using this scale can help with developing a clear definition of an interorganizational team as well as identifying the similarities and differences between teams within and teams spanning organizational boundaries.

Furthermore, as highlighted in the literature, team diversity requires delicate balance and indeed is a team condition which affects the team performance (Jackson, Joshi & Erhardt, 2003). Likewise the relationships between team members, team climate and the size of the team have all been found to affect team performance when the team is within the organizational

boundaries. Diversity will be increased in a team where members come from two organizations, which also differ with regard to the sector in which they sit.

The effects that these team factors and antecedents have on the innovation of an interorganizational team must be measured in order to not only establish the context of the interorganizational innovation project team but also to better understand the contributing factors to interorganizational innovation project success. By identifying the factors that impact on interorganizational team innovation project success, there can be a direct theoretical and methodological contribution to an emerging area of literature. In their literature review of team effectiveness, Mathieu, Maynard, Rapp & Gilson (2008) discuss a range of variables (including but not limited to vision, cohesion, support for innovation, communication) that have been found to directly implicate upon innovation. Their findings suggested that these factors were important under certain conditions, and that boundary conditions required closer examination in order to ascertain the effect of these factors in the interorganizational team setting (Mathieu et al., 2008).

3.1 A Framework for Exploring Team Effectiveness

Stock (2014) utilises an input-process-outcome approach (McGrath, 1964) to understand interorganizational team innovation effectiveness. This approach mirrors another model utilised by Edmondson (1999), who built on the input-mediator-outcome model (Ilgen et al., 2005). In the model of Team Learning, Edmondson (1999) presents a model whereby team learning is depicted as a process similar to team innovation. The antecedent conditions such as the context are seen to affect the beliefs that the team have about the interpersonal context found within the team. In turn team beliefs and antecedent conditions are seen to affect the team learning behaviours and finally affecting team performance. Team performance is affected by several factors; the antecedent conditions, the beliefs that team members have about their performance and the behaviours that occur in fulfilling the task (Edmondson, 1999). However, Edmondson (1999)'s model is solely a model of team learning and as such does not

either feature boundary-spanning or the sense that innovation can be an ongoing process, behaviour and outcome.

This input-process-outcome approach to team effectiveness (McGrath, 1964; Stock, 2014) allows emergent processes and many different types of factors being applied from the literature to be categorised together. The approach is also heavily embedded in Pettigrew's context-process-outcome perspective on strategy (1992), which indicates that context has a heavy influence in the process of strategy formulation. In so doing, the input in this model should be viewed as synonymous with context. Context can be viewed not only as the contextual setting of the empirical research but the individual context of each of the projects within the sample. This allowance is vital for the qualitative stages of the research design, as much of the findings will be heavily context specific.

Pettigrew's context-process-outcome (CPO) perspective on strategy (1992) is equally useful as a potential theoretical model to base this research. However, for the purposes of this research, the strengths of the IPO and IMO models are both present as the models are amalgamated. In the diagram below, these two frameworks have been summarised in order to better articulate where these similarities lie. In Pettigrew's model there is the opportunity to examine all antecedent factors both from the internal interorganizational team perspective but also including external context. Certainly the IPO model (McGrath, 1964) allows the inputs and antecedent factors to be explored from the individual, team, organisational, interorganizational, and contextual environment levels. However, by only allowing processes to be measured, this significantly reduces the factors that play a part in the transfer between input and outcome.

The Input-Mediator-Output model of team effectiveness (Ilgen, 2005) combines all process and affect factors that emerge between the inputs and outcomes and allows for loops of feedback from mediators to inputs, to demonstrate the evolving nature of mediators. There are also interactions between different layers of antecedent inputs between the individual, team,

organizational and interorganizational levels which furthermore demonstrates the intricacies of environmental contexts and the impact that they have on each other at different levels. Finally, the mediator replaces the process aspect of the IPO, CPO models, as it includes process factors alongside factors of affect, cognition, beliefs, attitudes and behaviours which ultimately lead to effective team outputs.

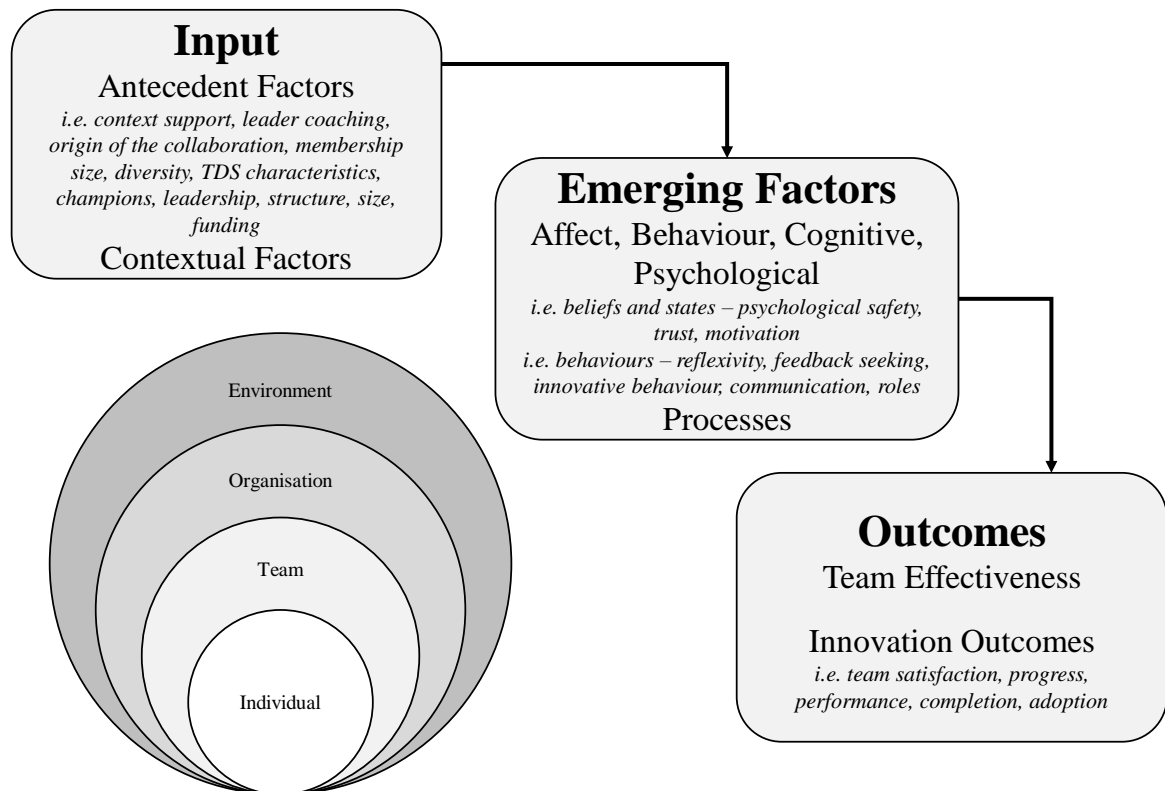


Figure 1: The Input-Process-Output Framework of Team Effectiveness (McGrath, 1964; Stock, 2014) and Input-Mediator-Outcome framework of Team Effectiveness (Ilgen et al., 2005; Edmondson, 1999), combined with The Context-Process-Output Framework (Pettigrew, 1992). (Italic font depicts example factors).

For the purposes of this research the IMO model of team effectiveness is favoured, but is overlaid with the IPO/CPO model as well as Edmondson's (1999) model of team learning which has its basis in team psychology. There are merits of each of the approaches and each of the frameworks allows for external context to be included within the inputs. The context-process-outcome combines internal and external contexts. There is an emphasis on context in this research project and it is for this reason that Pettigrew's context-process-outcome (1992) framework has been overlaid as well as the IPO model with the IMO model of team

effectiveness. The application of existing insights from the team literature can be applicable within this framework. By utilising an existing framework, this research can be deployed in the future in order to compare across samples and even contexts. Moreover, there is the opportunity to align the interpretivist approach by exploring the factors that emerge and categorising them easily within this framework. This model will be used as a framework for the purposes of this exploratory research, but relationships may be tested in future research.

4. Chapter Summary

This chapter has presented the final body of contributory literature, the emerging body of interorganizational teams. The organizational team literature has been more recently introduced into the interorganizational collaboration literature (Bergenholtz & Waldstrom, 2011) and this approach is also evidenced in the growing findings of interorganizational team academics (i.e. Stock, 2014). In doing so, an amalgamated model of team effectiveness originating in the organizational psychology and team psychology literature (Ilgen, 2005; McGrath, 1964; Stock, 2014; Edmondson, 1999; Pettigrew, 1992) has been put forward as a framework to use to explore the context of innovation within interorganizational teams.

The aim of the research is to extend the extant *intraorganizational* teams literature into the interorganizational team setting. By utilising this framework, the context can be explored and antecedent and mediating factors can be identified and their impact upon interorganizational team outputs and overall effectiveness can be evaluated.

Chapter Five: Research Paradigm, Strategy, Design and Methodology

The research aims to explore and understand the antecedent conditions and factors that contribute to interorganizational team effectiveness and successful innovation outcomes. This section of the thesis provides justification for the research paradigm, research strategy and high level design. By clearly understanding the original philosophical perspectives that are involved in the field and the perspective being taken in the research, one can ensure that informed, suitable and clear research designs can be developed (Easterby-Smith, Thorpe & Lowe, 2002).

The practical setting will be presented and justification given for the selection of the setting. Additionally an in-depth description of the methods, sampling, and data collection techniques that have been used will follow. Finally a discussion of the ethical issue and how ethical principles have been upheld concludes the chapter. This will then lead onto the findings section of the thesis.

1. Interpretivist Approach

As figure 2 depicts, there are several layers that the researcher must address in order to successfully design a research strategy which will lead to quality research (Beech, 2005; Ates, 2008). The ontological perspective can be either objective or subjective and refers to the perception of the nature of truths within the world. Social sciences tend to sit across these two perspectives due to its differences from more traditional and pure science. This research takes primarily the subjective ontology where emergent perceptions and interpretations are allowed for rather than focusing on the objective ontology, with its measurement of objective facts and causality. This may be an important influence, particularly when dealing with attitude and interpersonal interaction or in this case a novel practical setting. Therefore, while this research

is concerned with robust fact and statistical findings, the novel and complex contextual setting requires some consideration too. In acknowledging this, published measures and insights originating from different areas of literature may be usefully applied and tested in the novel setting while other themes may also emerge as the context is explored from within.

Interpretivist approaches would be more likely to adapt their responses according to the context both of the research and the environment surrounding the research, as well as their understanding of the context. In addition, it is important to consider that the bottom two stages of the diagram require careful criteria in order to evaluate the strength of evidence and contribution. Examining predecessors reported research is vital in answering the “what counts as evidence/contribution?” question.

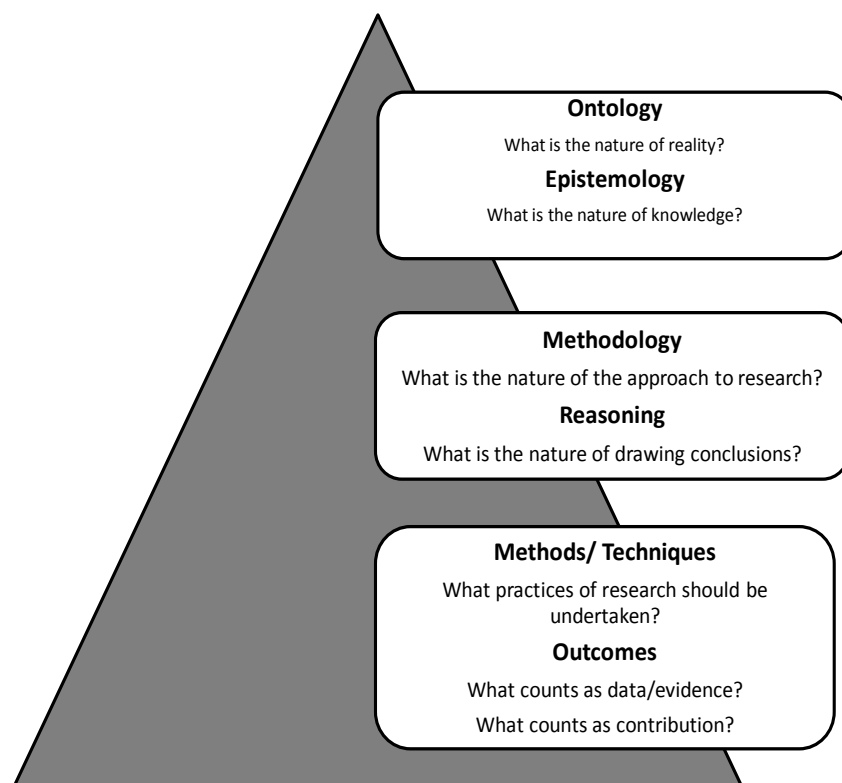


Figure 2: Research Methods Design (Beech, 2005; Cited in Aytes, 2008, adapted from pp. 29)

Generally the realist or positivist perspective is positioned as opposite to the interpretivist or constructivist perspective (Easterby-Smith et al., 2002). Beech (2005) explained that an epistemological paradigm forms the framework around which the research is designed and performed. These underpinnings have a direct effect on the quality of the research: the validity and reliability of the work and the types of assumptions that can be made from the findings. As such there is wide and historical debate over the strength of different approaches.

An interpretivist approach begins with exploratory data and pursues profound understanding of the organization through deep data analysis. Interpretivist ontological assumptions are that what is valid or true can be open to interpretation and negotiation, and that there is more than one way of interpreting data. Angen (2000) also suggests that interpretivist research follows the criteria outlined in Figure 3. For Angen (2000) the validity of the research is more of a question of ethics that should be posed to peers, particularly including the value of the research to the contextual population.

| Criteria for “Good” Interpretivist Research |
|--|
| <ul style="list-style-type: none"> • Evidence of reflection on and clear articulation of the research question • Knowledge of the approach taken, and persuasive discussion of the implications of that selection • Evolving persuasive and convincing accounts of the research • Thought for how widely applicable results will be and have been • Ethical Validity – has it been useful for the subjects? • Substantive Validity – Were the choices made correct? What were the associated biases and issues and how were they overcome? • Self-Evaluation – how has the research impacted on the researcher? |

Figure 3: Interpretivist Research Criteria (Angen, 2000)

Many facets of data collection add to the generalisability within the interpretivist paradigm and the intention is to thoroughly examine different contexts. This approach is typical of collaboration and network research in the interorganizational relations literature. A facet of

interpretivism is social constructionism, where the aim is to increase the basic understanding of the particular context and to generalise and explain (Easterby-Smith et al., 2002; Lee & Lings, 2008). Qualitative data collection is typically associated with data collected from methods such as case studies, interviewing and direct observation. These methods of data collection allow for much more detail to be collected which overcomes a significant criticism of realist, quantitative methods; that striving to achieve generalisable results from observation compromises detail (Saunders, Lewis & Thornhill, 2007).

The philosophical stance of interpretivism sits as a polar opposite to positivism (Easterby-Smith et al., 2002). It emphasises the importance of observations being specific to each individual participant (object, individual, or organization), with a view to identifying the individual differences between them. Interpretivists propose that each observation is open to different empathetic interpretations (Easterby-Smith et al., 2002). However, this is a common criticism of this data as it inherently holds the bias of the perceptions that the observer makes. This is avoided in positivist research by using techniques such as obtaining independent ratings on the data or observations. The key difference between positivism and interpretivism is that the priority is not to generalise or create laws or rules. Some generalisation must be possible (Lee & Lings, 2008), as seen in Knight & Pye (2005), in order for research to be ongoing, provide conclusions and contribute to the field (Saunders et al., 2007).

Johnson & Onwuegbuzie (2004) present the idea that, given the increased interest and use in mixed methods research, researchers using mixed methods should no longer view their position “qualitative versus quantitative” but rather as “qualitative and quantitative” (pp. 14). The interpretivist paradigm offers the researcher the opportunity to utilise a “practical and outcome-oriented” (pp.17) approach to answering their research questions based and allowing them to select the best methods with which to do so.

2. Research Strategy and Design

This section provides justification for the research strategy that has been designed in carrying out this research. Influences from the interorganizational relations literature which focuses on interorganizational collaboration as well as the work psychology literature examining teams, both in the context of innovation, have informed this design.

In terms of this research project, the practical setting and motivation for the research is novel and therefore the approach in dealing with a new context has been further developed by discovering more about the setting first. The idea of choice of methods is advocated by Bechara & Van de Ven (2007), who suggest that engaged scholarship and critical realism requires acknowledging the “complex reality” and selecting the most logical and useful methodologies to understand this reality; an approach which also supports the use of multiple perspectives and approaches to understanding. This school therefore accepts the flexibility that a researcher must practice when ensuring that context is taken into account.

The context has been explored and understood from within, which has informed and allowed for appropriate methodological approaches and measures to be honed and applied at a later stage. By adopting some of the opportunities presented by the interpretivist stance (such as being sensitive to the unknown context, and adapting measures to suit this context) has resulted in an exploratory set of studies, which complement the use of mixed methods and perhaps some of its concepts dovetail into the emic-etic approach of ethnography.

This research is strongly influenced by the interpretivist paradigm due to the nature of the context which required some clear understanding and exploration before the research questions and objectives could truly be developed and the research design could be made concrete. The methods can be selected and chosen according to which is most appropriate to the specific design of a piece of research (See Table 1), however the philosophical stance is

inherent to the researchers' initial approach to research as a whole (Lee & Lings, 2008). The approach allows for contextually sensitive methods as well as theoretical underpinnings over iterative cycles of observation and data collection. This enables theoretical underpinning and contextual sensitivity when drawing conclusions from the data (Easterby-Smith, Thorpe & Jackson, 2012; Biesta & Burbules, 2003).

With this in mind the research strategy employed in this research is to utilise a contextually influenced mixed methods approach (Bryman & Bell, 2007; Yin, 2014). The use of mixed methodological approaches has risen in popularity since the late 1980's (Bryman, 1988a) as the use of qualitative and quantitative methods in tandem (Johnson & Onwuegbuzie, 2004) were proposed to play to the strengths and away from the weaknesses of the two approaches. In order for this to be borne out, researchers must ensure that they still engage in the same high level of planning and evaluation of their own practice. In addition Bryman & Bell (2007) recommend that the separate parts of the methods should be explicitly related to each other rather than completely distinct sets of data.

In anthropology (Lett, 1990), contexts are understood by both understanding context from within (emic) and also by applying existing theories to the novel context (etic). In both mixed methods and emic-etic research, advocates suggest that the two should be used to complement each other rather than being viewed as dichotomous options (Buckley et al., 2014; Bryman & Bell, 2007).

Table 1: Understanding the Major Paradigms (Adapted from Milman, 2010)

| Descriptive | Positivism | Post - positivism | Pragmatism | Critical Theory | Interpretivism |
|---|---|---|---|--|--|
| Synonym | Verify | Predict | Dialectic | Emancipate | Understand/Interpret |
| Ontology – What is real? | Objectivist: findings = truth, realism | Modified objectivist: findings are probably true, transcendental realism | Constructed, based on world we live in and explanation that produce the best desired outcomes | Historical/virtual realism shaped by outside forces, material subjectivity | Local, relative, co-constructed realities, subjective objectivity, relativism |
| Epistemology – What is true? | The only knowledge is scientific knowledge – which is truth, reality is apprehensible | Findings approximate truth, reality is never fully apprehended | Objective and subjective points of view | Findings are based on values, local examples of truth | Co-created multiple realities and truths |
| Methodology – How do I examine what is real? | Quantitative – primarily experimental , quasi-experimental | Usually quantitative – experimental with threats to validity, Qualitative (e.g. case study) | Quantitative and qualitative | Usually qualitative but also quantitative | Often qualitative and/or quantitative |

The advantages of using mixed methods for this research are clear: it will provide a better and more detailed understanding of the complexities of the interorganizational innovation context, allows confidence in the rigour through triangulation of the results and also allows the most appropriate method to be selected according to context from the generated understanding of the practical contextual environment (Bryman & Bell, 2007; Milkman, 1997). It is also subject to similar constraints as the two separate methods and as such every effort must be made to ensure a robust research strategy is set out and that a clear procedure is articulated.

Further to this, the research question for this thesis related to exploring and understanding the team conditions under which innovation takes place within the context of interorganizational team innovation. Much of the network innovation research uses in-depth case-study or report information, and is based in qualitative methods. Qualitative methods

typifies network research; case studies (i.e. Shaw, 1998), observation, interviewing (i.e. Provan & Milward, 1995) and documentation have all been used in network and network innovation research. Evidently this method can deliver benefits in the form of an extraordinarily detailed data source.

Key characteristics of qualitative research are that it is emergent, has an opportunity to be less structured should that be required and there may be a close relationship between the researcher and the participant (insider) (Bryman, 1999). Direct deductive causality can only be established by quantitative research and statistical analysis, however quantitative research cannot give insights into the environmental context as easily as qualitative. Additionally, qualitative research may uncover hidden practices as it does not rely on self-report information (Bryman, 1999).

Mixed methods is defined as “the collection or analysis of both quantitative and qualitative data in a single study in which the data are collected concurrently or sequentially, are given a priority, and involve the integration of the data at one or more stages in the process of research” (Creswell, Plano Clark, Gutmann, & Hanson, 2003, pp. 212). When both quantitative and qualitative data are included in a study, researchers may enrich their results in ways that one form of data does not allow (Brewer & Hunter, 1989; Tashakkori & Teddlie, 1998). Using both forms of data, for example, allows researchers to simultaneously generalize results from a sample to a population and to gain a deeper understanding of the phenomenon of interest. It also allows researchers to test theoretical models and to modify them based on participant feedback. Results of precise, instrument-based measurements may, likewise, be augmented by contextual, field-based information (Greene & Caracelli, 1997).

The methodological approach taken in this research is mixed methods, which aligns with the ontological and epistemological stance taken of interpretivism. It will use qualitative techniques in an initial exploratory phase and to uncover hidden practices (Bryman, 1999),

which will also incorporate in-depth interviews to build on the contextual understanding. The findings from the exploratory phase will then be used to inform an exploratory quantitative survey.

An observation approach has been employed as an exploratory methodology to the context, through many varied sources of information including documentation, direct observation, informal interviewing, and secondary sources of data and actively participating in the project (Yin, 2014). A key strength of exploratory research strategy is that it allows the researcher to collect, collate, analyse and present from a wide range of different sources of evidence. This combined with the quantitative survey instruments aimed at collecting specific measurements will allow for a mixed method research strategy and robust data and conclusions to be drawn.

It is proposed that a mixed method approach to data collection and a longitudinal design will be used in order to both explore and understand the factors that lead to interorganizational team effectiveness and innovation outcomes. There are several advantages of using a mixture of qualitative and quantitative methods (Bryman, 2006). A typical advantage widely advocated and used, is triangulation of data whereby data from one method can be confirmed by using another method. The data can be used to develop results from another method or to inform the other method as will be done in both phases of this research. Bryman (2006) indicates that the detail from qualitative methods and the explicit results from quantitative will lead to a much broader range of results, which work together and complement each other.

The proposal is that mixed methods can align well with prior research and help to bring together two fields of literature whilst also examining the unfamiliar context. Table 2 summarises the interpretivist approach and research question of the project and how these map onto the data collection techniques, type of data collected and the benefits of selecting these techniques.

Table 2: Summary of Data Collection Techniques, Data Phases and Research Questions Answered

| Phase | Data Collection | Method/Approach | Benefits |
|--------------|---|---|--|
| 1 | <ul style="list-style-type: none"> • Ethnography • Observation • Events, Meetings • Documents • Emphasis on exploring the context and understanding the contextual factors at all levels. | Qualitative Emic Pilot/Exploratory | Information about the context can be collected in order to inform the researcher – this is important as the NHS and contextual setting is extremely complex. Additionally this time allows for sample to be more accurately identified and access negotiated. |
| 1i | <ul style="list-style-type: none"> • In-depth Interviews – Semi-flexible interviews • Emphasis on detailed discussion on the intricacies of the context, identifying other factors that had not been included in the questionnaire, confirming and explaining questionnaire findings and triangulation. | Qualitative Emic In-depth exploratory | Opportunity for identification of variables and factors that had not yet been considered from literature and pre-published measures More in depth collection about a range of projects, aimed at understanding and categorising according to the IMO framework |
| 2 | <ul style="list-style-type: none"> • Questionnaire adapted using Phase One information. • Emphasis on confirming measure suitability and effects of these constructs on IO team performance | Quantitative Etic Survey | Opportunity to confirm that established team literature insights have a place in the IO team literature, utilising the slightly adapted existing/ previously published measures. This allowed the research to engage academics in the field of team research into the IO team arena. Understanding the team level factors affecting project performance. |

Research Question:

What are the antecedent (input) and emerging factors (process and mediating) that impact upon interorganizational team effectiveness?

3. Contextual or Practical Setting

The practical setting which motivates this research was proposed by the funding body (ESRC) as an area of interest for the industrial partner (The Department of Health). This order of events has had some effect on the way in which the literature approach has been developed and ultimately on the philosophical and methodological underpinnings of the research. In addition the practical setting of the research has had a large impact on the available sample and the selection of techniques for data collection.

The medical device sector itself is not a novel setting for research, however the conduits between SMEs designing and innovating medical devices alongside NHS and healthcare practitioners – that is the interorganizational innovation team within this setting – are a unique research context. As a result the multi-disciplinary nature of the overlapping areas of academic knowledge which apply to the context has allowed for the strengths of different approaches to be leant upon and influence the overall methodological perspective. This is of particular importance when dealing with a novel practical setting as the contribution to knowledge which is based on sound research must not only be aligned with strong research techniques to ensure academic rigour but also in order to accurately study the novel context for the research.

When applied to the contextual setting of the practical environment in which this research sits, the research question seeks to explore and understand how the interorganizational working groups, made up of NHS staff and SME employees, work together to develop and bring products to market and into clinical use. It seeks to understand how these groups innovate in order to meet the needs of health-care providers, clinicians and patient groups and the commercial needs of the SMEs; what the contributory factors that lead to this success are and also to understand the different forms that “innovation” takes in the medical device sector. The interorganizational innovation team is an emerging research context and the practical challenge

faced by the NHS and SMEs when attempting to engage productively and innovatively during the development of a medical device is the motivation behind the selection of this context.

Ultimately this research project aims to understand how the relationships between NHS and SME collaboration projects can be facilitated, and also to uncover which interorganizational team factors affect interorganizational innovation project performance, and the ultimate effect these working groups have on innovation outcomes. The setting is particularly interesting as the imperative of innovation is even more keenly felt by the NHS, where innovation is essential as well as being controversial. The interorganizational team formed between the NHS and SMEs in the medical device sector provides an environment rife with many levels of environmental antecedent conditions, both external and internal in their origin, and across these distinctions there are some that cannot be changed.

The setting of the NHS/SME medical device innovation provides not only an environment of high need, and therefore interest in taking part in the research. This interorganizational setting provides an extremely high level of diversity at the project, team and individual level. This allows the researcher to explore as many different types of projects and associated factors as possible to try and uncover a larger range of antecedent conditions and mediating factors that lead to effective interorganizational innovation in the NHS/SME medical device innovation setting.

The following chapter will examine and present findings from this contextual setting in the practical environment, and add more detail to this section. Key reasons for selecting interorganizational teams formed between the NHS and SMEs for the purpose of medical device innovation were that it offered an environment where there was innovation need, where innovation was a key strategic priority and understanding how to improve it was salient. This allowed willing participants to be accessed through existing contacts. Furthermore inherent in the setting was a high diversity of projects allowing for a heterogeneous sample.

4. Procedure Overview

The procedure for this research is split into two exploratory phases: qualitative and quantitative. Within each phase was an exploratory study, the details of which can be found in Chapters Seven and Eight. Table Two summarises the data collection phases and which research questions are addressed.

Phase 1. Exploratory Qualitative.

An initial exploratory period began the research, and included detailed ethnographic study of the contextual setting for the research. This ethnographic study saw the researcher engage in a range of activities and gave rise to rich and detailed exploratory data. Informal telephone interviews and meetings were set up, following an extensive networking period. This allowed the researcher to gain an understanding of the salient issues occurring at the time, as well as the way in which projects and working parties operated. This exploratory phase involved informal face-to-face interviews or telephone interviews (in order of preference) depending on the commitments of those taking part. Additionally a secondment with an NHS body representing innovation and adoption of medical devices was taken over a 4 month period. This offered unique insights and opportunities not only to network and identify suitable candidates to approach for data collection, but also to obtain rich, detailed understanding of the context.

This research context of interorganizational teams is under-researched, and by ensuring that the concepts that have been identified are indeed relevant, not only does it prevent respondents from answering unnecessary questions but it also helps to ensure the collection of relevant data. This exploratory phase is also useful in questionnaire development as particular items on team measurement scales need slight adaptation in order to fit with the context. This phase also helped with the exploratory survey construct identification as it gave rise to a much clearer idea of the context in which the interorganizational team is operating.

Phase 1i. Exploratory Interviews.

During the course of the exploratory phase, several in-depth data collection projects were identified. The researcher was requested to attend project meetings regularly for several of these projects.

An interview schedule was set so that the same themes were always probed in the interview, although the interviews were semi-structured allowing for the interviewee to elaborate and discuss along the themes they felt were salient. The interviews were recorded, transcribed and the interviewee was given the transcript to sign off consent. Transcription was carried out by the researcher in order to ensure data familiarity, however this was then checked for accuracy by two independent individuals. The transcripts were then analysed for themes and quotes were coded accordingly (See Chapter Seven). This was carried out on an individual interview basis and then through cross-case comparison.

Phase 2. Exploratory Survey.

Following the detailed ethnographic study and the exploratory interview study, the questionnaire was refined and completed. The interviews and ethnography helped to identify any items which did not apply to the situation and also ensured that the measures being collected to judge team effectiveness with regards to the innovation (Ramstad, 2008) were as applicable as possible. Having developed an appropriate and relevant questionnaire, the questionnaire was administered to 15 interorganizational working groups. This was preferably done in person during attendance at a meeting, but was available electronically. The opportunity to attend a meeting and ask the team to fill in a questionnaire was excellent for collecting detail rich data for use in the third phase and for triangulation of the data. If not possible, the questionnaire was distributed by the contact within the organizations, and respondents were asked to put the

questionnaire in a sealed envelope and either return it by post or place it into a collection box, or to complete online. Having collected the completed questionnaires, the data was input and coded using SPSS.

5. Detailed Methodology of Studies

In this sub-section, more detail is presented relating to the two studies that are presented in Chapters Seven and Eight.

5.1 Exploratory Study Ii: Exploratory in-depth Interviews

The justifications and reasoning for the in-depth interview Phase 1i and how each of the projects featured in Chapter Seven was selected to act as an illustrative, detailed case will be presented. The exploratory qualitative interviews were designed in order to understand from a team perspective more about the antecedents and factors that lead to interorganizational team effectiveness and NHS-SME innovation outcomes. The selection strategy for these qualitative interviews is presented, as well as a discussion of a suitable sample size. A schedule for the interview themes is presented in Appendix 3.

5.1.i Project Selection Prior to Qualitative Interviews:

It is important to present both a logical grounding of the reasons for selecting case projects for qualitative interviewing and also to create sound frameworks to support these interviews (Miles and Huberman, 1994). Qualitative data can provide a “source of well-grounded, rich descriptions and explanations of processes in identifiable local contexts” and this qualitative stage of data collection provides the opportunity to further explain the findings in the literature and during the initial exploratory observation period. In-depth qualitative interviews with case projects have been selected as they provide the opportunity to refine the survey used in Phase Two as well as to explain further some of the findings from the survey data, by exploring the projects in more depth (Ragin & Becker, 1992).

The exploratory nature of the research has involved collating a range of data from exploratory discussion and informal meetings, websites, policy documents, observations,

survey data as well as some post survey interviews (Yin, 2014). Interviews were a suitable qualitative data collection method as the previous discussions with the project leads and contacts have been extremely fruitful, but this will be collated with information collected during the Phase 1 exploratory stages. The researcher has taken time to develop strong networks and the respondents have been keen to have the opportunity to raise their opinion of the current situation of NHS innovation and adoption.

In order to harness this wealth of information available to the researcher, as well as ensuring that the respondent is getting the most out of participating in the research; interviews have been selected as the most appropriate technique to use. This highly detailed technique relies on a strong rapport and the interviewee feeling comfortable enough to offer detailed information.

5.1.ii How many projects should be explored in depth?

The question of how many case projects should be explored during interview should be answered prior to exploring how to select them. By performing any sort of selection on the cases, we are limiting the scope of the detail that can be obtained. However, due to time constraints as well as possible attrition rates during longitudinal studies, a subset of the 15 cases will be selected to be explored further. A single project would only represent a single exemplar of interorganizational innovation on-going between the NHS and SMEs.

It is evident from the exploratory ethnographic data, that a single interview in one project would not give sufficiently clear insights and detail for an individual to gain a good understanding of the context or the many ways in which medical device projects and interaction between the SMEs and NHS can take place. A single project would not provide insight into the various mechanisms and incentives used in promoting these alliances or in the structure of them. This is also rare in academic research, particularly if the project is not being examined in

much more depth, or being used to test theory. For example, Baldwin, Hienert & Von Hippel (2006) utilise a single case study only, however it is used in order to test practice against the model formulated in the survey.

This choice to use multiple in-depth interviews which demonstrate diversity between themselves (Miles & Huberman, 1994) mirrors much of the interorganizational innovation project research (i.e. 4 cases: Lettl, Herstatt & Gemuenden, 2006).

5.2.iii Individual Interview Techniques and Analysis Strategy

The interviews were semi-structured, with a set of key questions and probes into specific themes that had been identified in the ethnography data and from the literature review. The advantage of only having a semi-structured interview meant that there was no order, and the interviewee was able to take the conversation to where they wanted. This also meant that while specific probes on themes were present in each interview, other emerging themes could naturally be found in the conversation. The interview schedule can be found in Appendix 3.

Becker (1998) presents four different analysis techniques for case studies, which can also be applied to in-depth interviewing analysis. The most appropriate of these is that of analytic induction (Angell, 1936) which explores the data in a case by case approach in order to build theory and answer an “important problem”. When analysing the interviews, attention must be paid to the previous exploratory qualitative phase in order that the observation based work may be built upon. Becker (1998) explains that ethnography data aims to develop interconnecting, wide and generalizable evidence. Moreover, narrative analysis seeks to widely explain a large proportion of the context and these sections will be presented in Chapter 6, the first of the findings section.

In analysing the interviews, a case by case approach is useful, however abductive reasoning (Miles & Huberman, 1994) will also play a part. The confirmation of presence or absence of particular variables can be carried out whilst observing combinations (Becker,

1998). A cross-interview comparison will also add depth to the understanding and explanations presented while the initial case by case approach will provide awareness of case specific conditions. Thereby the interview by interview analysis will first provide the “particular” while the cross-interview analysis will provide evidence for the “universal” (Silverstein, 1988; cited in Miles & Huberman, 1994).

When coding, the transcript themes were coded over several iterations in order to ensure the same theme was consistently pulled out from the data, and that any emergent themes were clearly understood (Kotlarsky, van Fenema & Willcocks, 2008). Each interview was coded separately, so that codes were not searched for between each interview at first. This was important to ensure that the themes were being viewed as unique to the project and therefore with different connotations for each project. The codes have been structured into categories for presentation in Chapter Seven. These categories have been selected as they sit commonly across each of the case study projects, although within the categories there are differences between the projects evident in the themes encompassed within them. Following these individual project case summaries, the data is then pulled together in broader themes across the four projects involved in the interviews in order to understand the data in a between case-study discussion.

5.2. Exploratory Study 2 – Quantitative Survey

Following the exploratory qualitative phase, where ethnography and observation were first used to explore the contextual setting, and in-depth interviews with some of the projects gave rise to an understanding of the context and factors affecting performance and innovation progress. Resulting data was able to inform the adaptation of existing organizational team measures to suit the context of interorganizational teams. Particular measures were prioritised and the contextual knowledge informed the development of a survey (Appendix 1). Below is a short explanation of each original scale used and some examples of items which needed to be

adapted. The questionnaire itself and a breakdown of adaptation to scales that were made can be found in the Appendix 1.

5.2.i Measures

Part I: Project Plans and Structure

This part of the questionnaire was designed to obtain information about how the team is organized, set up and run. The team 'lead' was liaised with in order to obtain an objective or short goal related statement for the project. The individual was then required to indicate their agreement and invited to add to this if they felt that more information was left out of the statement. The individual was then presented with questions about how many core team members there were and the allegiance of these members. The length of time that the individual has been involved in the project, and the length of time the individual believed the project had been running was collected. Information about the regularity of meetings, how many attend these meetings and the methods of communication were also collected from the individual respondent. By collecting this information from each member, it would allow some measures of agreement to be calculated and also to compare between those involved in the project and belonging to different organizations.

Part II: About the Project Working Group

- a) Team Diagnostic Survey (TDS) (Wageman, Hackman & Lehman, 2005). This measures the extent that a team is 'real' and traditionally has measures assessing whether the team has a compelling direction, has a facilitating structure, has a supportive organizational context and whether there is opportunity for support and coaching as well as measures for boundedness, stability and interdependence. This forms the basis of antecedent condition measurement. Following the preliminary exploration stage of the research it emerged that the 'real' team measures would provide interesting insight into the interorganizational team context, and while space was tight on the questionnaire; boundedness, stability and interdependence would be most important in identifying this

interorganizational 'team' as a team or as an entirely different structure. The wording of the items was adapted slightly (see Appendix 1 for details) in order to apply to the context with appropriate and neutral wording. The boundedness and interdependence scales had three items each, while the stability scale had two items. Each statement item was required to be assessed in terms of accuracy in relation to the project working group. There was a 5 point Likert scale provided in order to indicate individual feelings of the accuracy of the statement items with 1= "highly inaccurate" and 5 = "highly accurate".

- b) Leadership Clarity (West, Borrill et al., 2002) allowed the individual to select from five options which statement about the clarity of the team leadership was most relevant to their project working team. This was a key factor in identifying intraorganizational teams and is often considered to be a control variable (Richardson, 2012) in team research.
- c) Team Psychological Safety is measured using Edmondson's Psychological Safety Scale (1999). This scale has a published Cronbach's Alpha of 0.82 which indicates that it is reliable and the correlations between each item indicate that it is valid. This scale needed limited adaptation as it applies to beliefs about the team that respondents are participating in, rather than about the task. There are seven items relating to psychological safety and the statement items required a response to be selected in terms of accuracy along a seven point Likert scale where 1= "very inaccurate", 4 = "neutral" and 7 = "Very accurate".
- d) Intrinsic Motivation (adapted from Amabile, 1985; Tierney, Farmer & Graen, 1999; Zhang & Bartol, 2010) was measured using three items (previously published Cronbach's Alpha was 0.82). A 5-point Likert scale was used in order to obtain the participant's agreement with the statement items.

- e) Creativity (Zhang & Bartol, 2010; adapted from Zhou & George, 2001) was measured with respondents answering the extent to which the statement items were characteristic of the project team using a 5-point Likert Scale where 1 = “Not at all characteristic”, 3= “neutral” and 5 = “Very characteristic”.

- f) Individual Team Satisfaction (Van der Vegt, Emans & Van de Vliert, 2000) was measured using two items which were regarding their satisfaction with their colleagues and with working in the team. Items were rated along a 5-point Likert Scale where 1 = “Strongly disagree” and 5 = “Strongly Agree”. The previously published Cronbach’s Alpha was 0.75.

Part III: Current Progress

Innovation & Performance was measured using some initial items intended to gauge the progress on the team and the project specifically. These were influenced by the preliminary exploration phase and some measures which were available and published but not wholly appropriate for the particular context of this research.

The alliance performance data was obtained using the measure of alliance performance published by Robson, Katsikeas & Bello (2008). This explores the alliance performance using three previously published subscales: effectiveness of the alliance (3items; Fisher et al., 1997) the efficiency (3items; Majumdar, 1998; Sarkar et al., 2001) and the responsiveness (4 items; Ayers et al., 1997) using a seven-point Likert scale with anchors requiring a response of agreement where 1= “strongly disagree” and 7 = “strongly agree”.

An estimated date of completion was requested and an indication of the current state of the project was also requested. This included four options relating to the completion state and also in relation to expectations and understanding of the overall outcomes.

Part IV: Demographic Questions

Respondents were all asked to indicate their gender, the type of organization that they belong to, the length of time they have worked for that organization, their incumbent role at the organization and their ethnic origin. This information was collected in order to not only give some idea of the diversity of the organization but also to see if understanding of the sector and/or experience had an effect on team performance.

4.2.ii Construct Validity

A Cronbach's Alpha was performed on each of the scales that have been developed or adapted to this research. This was important in order to ascertain whether the scales have proven fit for purpose.

Table 3: Cronbach's Alpha Scores for each scale (Validity considered >0.75)

| Scale | Cronbach's α | Notes |
|-------------------------------------|---------------------------------------|--------------|
| Team Diagnostic Survey | 0.893 | Acceptable |
| Psychological Safety | 0.937 | Acceptable |
| Intrinsic Motivation | 0.876 | Acceptable |
| Creativity | 0.966 | Acceptable |
| Individual Team Satisfaction | 0.789 | Acceptable |
| Progress | 0.962 | Acceptable |
| Alliance Performance | 0.966 | Acceptable |

The table indicates that all scales had acceptable construct validity, indicating they were measuring the intended construct. This indicates that both the method of adaptation of the scale to suit the context has been appropriate, but also that the construct is being measured appropriately within the context it has been translated to.

4.2.iii Correlation Analysis

Generally statisticians recommend using as many ways to explore the data as possible. In deciding which test to use, several opinions were sought. While it is important to explore the data with as many tools as possible, it is also important that these tools are applied within their recommended parameters.

Given that the scales feature small numbers of items it is important to ensure that nothing has been missed by utilising only the Pearson's correlation analysis. Moreover it is advised that Spearman's rank correlation coefficients can be over-interpreted. Hauke & Kossowski (2011) warn that researchers using Spearman's rank should be careful not to over exaggerate the significance and strength of a relationship between the two variables. There has been some argument as to whether psychological construct scales utilising the Likert-style scale can, when items are collated, be considered to provide interval data (Stevens, 1946). However, it is an accepted practice to use the Pearson's correlation analysis in quantitative survey based research (Stevens, 1946).

The Pearson's correlation is a test on interval data which measures the association between two continuous variables. Whereas the Spearman's Rank Correlation Analysis acts in a similar manner to Pearson's, it is however, considered to be a ranked based version that can be used on interval and ordinal data (Chok, 2010). Generally guidelines suggest that selection should be made based on the type of data being analysed and for this reason when dealing with interval data Pearson's is considered to be the most powerful test of association (Chok, 2010).

However, the test parameters require that Pearson's correlation be applied to normally distributed data, and Spearman's rank analysis to data that isn't normally distributed (Norman, 2010; Bishara & Hittner, 2012). A test of the distribution of the data was carried out and this output revealed that only the creativity scale data was normally distributed. Given the strength of support for Pearson's correlation, both Pearson's and Spearman's correlation were performed and the correlation matrices can be found in Appendix 4. Where significant correlations are shared, the Spearman's rank provides a stronger coefficient, however it is important not to over-interpret these results as signifying a relationship between the two variables (Hauke & Kossowski, 2011).

The two correlation tests were carried out and do share many similar patterns in the data upon comparison. The Pearson's Correlation is presented in Chapter Eight and is used for all references to correlation relationships throughout unless expressly specified, due to the adequate sample size, the power of the Pearson's Correlation and the generally accepted practice to use this correlation in this type of data analysis.

6. Sample

Phase 1 Exploratory Qualitative: In the exploratory phase of the research, most individuals that the researcher met through networking with spoke in an informal discussion with the researcher, providing general opinion and experiences of innovation in the medical device sector. Additionally several of the project teams and the NTAC team involved the researcher in actively participating – therefore ethnography style of data collection. The sampling technique was most similar to snowballing (Goodman, 1961; Biernacki & Waldorf, 1981) which allows the researcher to access targeted and hard to locate populations, through networking. However, there are several biases associated with this technique which will be discussed in the limitations section of the discussion.

During this process the researcher was able to identify projects that could potentially take part in the research. Having understood more about the context and also having read the literature on traditional intraorganizational innovation teams, some simple initial criteria were put together. In order to ascertain whether these criteria had been met it was necessary for the researcher to engage over a period of time with a project. Often the researcher was invited to attend meetings and to actively participate in these meetings by virtue of the experience and network contacts she had gained. In return the project would be pleased to be involved in the research whilst the researcher obtained detailed information about the projects.

The in-depth interview data was collected in semi-structured face-to-face or telephone interviews, while the quantitative survey was distributed and collected. For the interviews, there

was a sample of four projects selected. Of the four projects, lead contacts were interviewed. The total number of interviews carried out was six, with two projects providing two interviewees and two providing single interviews. This view is balanced with the detail from Phases One and Three, however it is indicative of the difficulty of access to busy and dispersed project teams. Furthermore, those interviewed were of a similar position or role within the separate case projects.

Phase 2 Exploratory Survey: The sample for the second phase survey administration consisted of 15 interorganizational teams and the majority of their members responded (See Table 6), giving 75 responses. After an initial sort of the data, 4 responses were found to be incomplete or not filled out correctly and as such these were removed leaving a total of 71 responses from a possible total of 91. These teams consisted of employees of both the SMEs supplying the NHS and employees of the NHS involved in innovative procurement with the SMEs. There were also University based academic members, consultancy members and other key stakeholders found to be involved in the working groups.

The sample included teams which meet more than once for the duration of an innovation project and were required to have several members belonging to different organizations present. This was to ensure that the team is truly interorganizational and that they are truly a team, as opposed to meeting once only. The sample is not a randomized or stratified sample but was selected based on whether the team satisfied some criteria (Winship and Mare, 1992). This is by virtue of the context and the availability of a suitable number of contacts and projects to engage with. Some further discussion on the detail is found in Chapters Six, Seven and Eight.

7. Ethical Considerations

Every effort has been made when writing up the research to preserve individual, team and organizational anonymity. The research does not gather particularly delicate personal measures (such as beliefs, agenda and/or financial information which could jeopardise the individual, their role, team, product or organization) and following interviews all voice recordings and transcriptions are held securely. Employee details will not be revealed to managers or colleagues and participants have been made aware of their right to withdraw at any point. Furthermore participants have been debriefed and organizations received an anonymized report. Any personal data that has been included in the report was treated with complete confidentiality and will not be made public at any point especially if the identity of the individual is obvious.

When attracting projects and individuals to participate in the research, they were given time and information to ensure that informed consent had been given upon completion of the survey (Aguinis & Henle, 2002). Individuals that were involved in ethnography were aware that discussions were being noted and that the researcher's attendance was part of research. However, this should not be a cause for concern due to the effort of concealing identifiable data during the presentation of results. Where required, non-disclosure agreements were signed in order to ensure that participants felt that their Intellectual Property (IP) would be dealt with using integrity and their rights protected (Mulvey, 2015).

One key consideration was to ensure that the data was collected and reported in a way that did not exacerbate or create mistrust of researchers (Mulvey, 2015; Baumrind, 1964) so that the environment and context can always be approached by future researchers.

8. Summary

This chapter has outlined the philosophical underpinnings and approached taken in designing the high level research strategy. The interpretivist approach has been reasoned and the inherent biases and issues have been discussed. The implications of using mixed method research means that each phase of the data collection builds on the last phase, building up a detailed understanding of innovation within interorganizational teams formed between the NHS and SMEs.

Triangulation and qualitative enquiry is vital in order to ensure a strong mixed methods approach is upheld throughout the research project. Triangulation allows findings to be explored again, strengthening the robustness and validity of any claims that can be made (Myers, 2013).

This chapter has also provided the details of the sample, the procedure and the measures utilised within the questionnaire. It provides a basis for explaining how the data was obtained and how the biases and issues have been taken into consideration when analysing the data. These details have important implications for the mixed methods approach, the following section of the thesis (encompassing Chapters Six, Seven and Eight) present the data collected in each of the phases. The implications will be mentioned within these three analysis chapters (Six, Seven and Eight) but will also be drawn together during the discussion chapters in the final section of the thesis (Chapters Nine and Ten).

Chapter Six: Exploring and Understanding the Context

This section of the thesis and the following two chapters present the findings from data collection and the results of the analyses. This particular chapter presents exploratory, contextual data garnered utilising the best practice principles of ethnography and sets the scene for the following two chapters; the exploratory qualitative study featuring analysis of in-depth project lead interviews and the exploratory survey featuring quantitative exploration of survey data.

This chapter will first explore the literature and background behind this research context. The following section will then explain the detail of the data collected and more about the analytic techniques utilised. Following this a narrative analysis of data collected will be discussed along the macro and meso levels. The micro level data will be presented in the immediately adjacent chapter.

1. Context from the Literature

The context for this project specifically relates to innovation of medical devices, which when involving the NHS could lead to adoption and procurement of the device by the NHS. As presented in the literature review, the potential contribution that new suppliers can make may impact on the innovation process success (Primo & Admundson, 2002), and this can lead to more clinically applicable devices being developed with regulatory guidelines involved from an early part of the process.

Procurement professionals in the public sector face a number of difficulties when engaging with SME suppliers (Wert, 2012). The wrong incentives are in place; there is a lack of knowledge and capabilities regarding the technology, innovations and world-wide market developments; there is a deficiency in strategy aligning public procurement with public policy

objectives and R&D; demand is fragmented; and it is very difficult for innovative SMEs to be involved in public procurement as a supplier (Surtees, Knight & Shipton, 2014).

Following the efforts of previous governments, the incumbent UK Coalition Government has attempted to address these problems by stimulating public bodies to assist SMEs in competing for public contracts by removing unnecessary obstacles, committing to making the market more competitive and creating new business opportunities for SMEs (Her Majesty's Government, 2010; Surtees et al., 2014). However, this sits in direct opposition with targets to reduce spending (Public Spending Review, 2010) and focusing on delivering Return on Investment (Loader, 2007). It is advantageous that small firms can achieve better value for money through greater flexibility and efficiency. Their ability to do so is, however, limited by the constantly evolving landscape of public procurement (Loader, 2007) and can't compete with the economies of scale that larger companies are able to offer.

The mechanisms of funding procurement and innovation within the NHS have featured in academic research (Grimshaw, Vincent & Wilmott, 2002), potentially due to its complexity and challenges. The Department of Health funds the National Health Service using taxes collected from the UK taxpayer. Previously, there were several possible routes to access financial resources from the NHS (Phillips, Knight, Caldwell & Warrington, 2007). Primary Care Trusts (PCTs) were responsible for regional care provision, one budgets from the DH had been allocated (Talbot-Smith & Pollock, 2006). PCTs and Strategic Health Authorities (SHAs) were later abolished, resulting in a more divided NHS with local and national structures. Clinical Commissioning Groups (CCGs) now possess control over budgets and also have the authority to implement strategy and policy at local and regional levels. CCGs are also responsible for the quality of health and social care that they deliver. Services are most often commissioned from NHS hospital trusts, but increasingly private companies are also being contracted in to respond to particular care needs (Grimshaw, et al., 2002).

The improvement of NHS budget efficiency (Department of Health, 2013) has resulted in challenging targets, putting the spotlight on procurement effectiveness. As well as the general drive for cost reduction, there are some recognised barriers to innovation (Surtees et al., 2014). Previously trust funding was based on historical budget use which created difficulties for procuring slightly more expensive but incrementally improved devices (Phillips, Knight, Caldwell & Warrington, 2007).

More recently, payment by results has been implemented (Department of Health, 2013) in the NHS. The intention is to create a transparent, equitable and objective system based on the value provided to the NHS. Instead of allocating budget based on historical use and executive support, this approach has promoted patient choice, and the results and impact on quality of healthcare provided is used to make budgetary decisions. All medical device (MD) firms could encounter difficulties from this approach, however for smaller firms, there are likely to be greater consequences in the outgoings required whilst collecting sufficient evidence to demonstrate the value of their device and to build the business case for their products (Surtees et al., 2014). Furthermore, smaller companies will have smaller production operations and therefore a higher cost for top of the line innovation. The retail costs of their products costs are likely to be respectively higher especially early in the product life cycle. There appears to be opposition between all of these strategies (Sorenson, Drummond & Wilkinson, 2013).

NHS Hospitals in England are able to apply for innovation payments towards medical devices, new drugs or other technologies (Sorenson et al., 2013; Surtees et al., 2014). The purpose of this scheme is to help hospital trusts to deliver strategic policies of increased innovation and innovative procurement. Clinical evidence of therapeutic benefits of the device are used to assess whether the funding will be granted and so are aimed not at enhancing innovation as a process but at the introduction of specific novel devices. When applying the concepts of this scheme to SME medical device projects, the nature of the SME, its' size and

limited resources put SMEs at a fundamental disadvantage as alluded to previously. The cost of small scale production for a product that may subsequently require further adjustment and/or may not be purchased following trials and evidence collection can be particularly difficult for an SME to withstand and therefore may not be appealing at the outset (Surtees et al., 2014).

The interorganizational relationship between an SME and the NHS is not just a useful vehicle for the exchange of external information but is also mutually beneficial, allowing the two organizations to work together and achieve their goals more successfully than if working alone (Provan, Fish & Sydow, 2007). For the SME it is a chance to ensure innovations cater for the needs of their consumers, increase their sales and ultimately boost their profits. Conversely for the NHS, the SME acts as a supplier who can listen to their needs and requirements, helping to meet and hopefully exceed the needs of employees and patients, as well as ensuring that their budget is spent effectively. In addition the NHS currently views relationships with industry, and especially SMEs, at high priority in its recent strategies and restructuring.

This mutually beneficial relationship ensures that each of the organizations helps the other, while the overall objective is to ensure that the innovations are successful, well carried out and are applicable to their clinical applications (National Innovation Centre, 2012). The ultimate success of an innovation is the primary concern for the interorganizational project team and its effectiveness as a team has a key impact.

The interorganizational innovation project team between the NHS and medical device SMEs is an emerging context for research which requires more detailed attention. In doing so not only will the academic knowledge gap be addressed, but in the practical setting management of interorganizational teams can be informed and developed into more successful innovation outcomes. This research is not intended to be a comparison between teams within organizational boundaries and those spanning organizational boundaries. Nor is it intended to examine causality between the investigated variables. This is a relatively unknown contextual territory

for research and to some extent for practice, despite the prevalence of interorganizational team activity. As such there must be some exploratory work done in order to make informed decisions about which factors are likely to be suitable to apply to the boundary-spanning context and measure.

2. Exploratory Data

This data collection phase has been a continuous and ongoing phase throughout the PhD research project, utilising snowballing techniques (Goodman, 1961) as well as collection of documentary evidence, observations, ethnography and field-configuring events (Meyer, Gaba & Coldwell, 2005; Van de Ven & Poole, 1990). This exploratory phase in data collection is rooted in the interpretivist paradigm, and is aimed at exploring the context at a detailed level in order to better understand its intricacies prior to further data collection and further theory building (Bryman & Bell, 2007).

The philosophical underpinnings have been outlined within the methods and strategy sections, therefore the methods employed in order to collect data are “mixed”. Phase 1 has incorporated several forms of data collection in order to utilise best practice principles of ethnography. Ethnography often involves the researcher actively participating in daily work activities (for the purposes of business research) (Hammersley & Atkinson, 2007). This not only pulls in the emic perspective of understanding the context from the inside-out but also ties in the engaged scholarship approach. Information has been collected from a range of sources, including policy and official documents, event attendances, networking, discussions and informal interviewing, as well as a secondment placement (Meyer et al., 2005). This constant information gathering has very much mirrored the intensity of the literature collection in terms of its contribution to understanding the contextual setting of the research.

The narrative analysis has resulted in three levels of context being identified along the common analytical framework used in organizational research as well as in healthcare research

(e.g. Kapiriri, Norheim & Martin, 2007); Macro-, Meso- and Micro-Levels. This provides a suitable hierarchy to apply to the different levels of contextual data collected, and more saliently within the NHS impact is commonly discussed along these three levels. These are classified again along another spectrum specifically referring to context which has been previously discussed alongside the theoretical framework (Chapter Four); that of inner and outer context (Pettigrew, 1987).

| | | |
|---|-----------------------------|-------------------------------------|
| <p style="text-align: center;">Macro-Level</p> <ul style="list-style-type: none"> • Department of Health • Strategy • Policy • Organizational Change | <p>Outer Context</p> | <p>Literature and Theory</p> |
| <p style="text-align: center;">Meso-Level</p> <ul style="list-style-type: none"> • NHS Bodies • Other Organizations • NHS • SMEs | | |
| <p style="text-align: center;">Micro-Level</p> <ul style="list-style-type: none"> • Interorganizational Projects | <p>Inner Context</p> | |

Figure 4: Presentation of Qualitative Results using two frameworks - The Macro-, Meso-, and Micro- Level approach and Pettigrew's (1987) framework for Outer and Inner Context

Reference is made to the data throughout, which is presented anonymously in summary within the text or can be found in more detail within Appendix 2. Attendances and meetings have been annotated and placed in a ‘diary’, to summarise the journey of knowledge collection and understanding of the context that the researcher has taken. Some key themes emerge when the data is considered as a whole, some of which will be presented here.

3. Macro-Level

The Department of Health (DH) is the Government Department with duties overseeing the NHS and it’s funding, as well as implementing policy and change. Previously NHS England featured 10 Strategic Healthcare Authorities (SHAs) with regional jurisdiction devolved from

the DH, this includes local control of budgets and procurement and responsibility for ensuring DH policy and change is delivered within that locale.

These SHAs were set up in order to implement strategy and ensure delivery of the commitment to quality of care in hospital trusts (i.e. Royal Liverpool Hospital NHS Trust Website, 2009). In April 2013 the Department of Health announced the introduction of a new policy and structure within the NHS (see Figure 5). This primarily saw SHAs and the Primary Care Trusts (PCTs) within their umbrellas being replaced. Instead a whole new structure for the NHS was announced, with regional Clinical Commissioning Groups taking responsibility for local budget, strategy implementation and also quality of care provision and Trusts taking responsibility for regional hospital and longer-term care provision. A National body was also set up to take care of complaints and patient care procedures, analysing the national healthcare patterns and issues and holding legal power to ensure that once a problem has been reported to CCGs it is tackled; this is called Healthwatch England.



Other nationwide organizations have been set up under this flatter, more devolved structure of the healthcare system. These bodies have also been given budgetary control to deliver particular policy agenda. Recent policy initiatives include building industrial relationships particularly with SMEs to support regional economic development, and the promotion of innovative procurement (Department of Health, 2012; NHS, 2009). These new bodies have also seen the closing and shuffling of existing organizations to ensure divisions between responsibilities over deliverables are as clear as possible. NICE (National Institute for Health and Care Excellence) has been restructured and has absorbed some other organizations. Overall NICE delivers clear practice guidance and regulation on an array of healthcare provision. AHSNs (Academic Health Science Networks) have been set up to enable academics and the NHS to work collaboratively with industry on innovation and research projects.

Lord Darzi's "High Quality Care for All: NHS Next Stage Final Review" Report (2008) was highly influential, and positioned innovation as vital in order for healthcare to remain as a publicly funded provision. Darzi recommended that the NHS needed to work hard to change its reputation of being a late adopter, and that through NHS procurement "seek to foster a pioneering NHS" [pp. 13]. The report highlights the part innovation plays in an economically sustainable health service, and the responsibility that procurement practices have on facilitating innovation. The National Innovation and Procurement Plan (NHS, 2009) was a response to the warning that the NHS will hit an extreme budget shortfall by 2014 if procurement practices stagnate. The Chief Executive of the NHS announced that more innovative procurement would help to improve service quality and productivity, whilst averting the budgetary crisis (Surtees et al., 2014).

Throughout adoption and procurement processes, it is vital that suppliers demonstrate how cost-effective their medical device (MD) is and how it meets a direct clinical need (NIC Website, 2013). The National Institute for Health and Care Excellence (NICE) is an

independent body providing guidance in four key areas: technology assessment, clinical, interventional procedure and public health. NICE is involved in establishing the clinical suitability of new devices and technologies. To ensure MDs are cost-effective, regulated and economical, there is a systematic review process for MDs in the UK often involving rigorous testing. MDs must go through this process in order to be considered for adoption even on a trial basis within a healthcare authority, prior to larger-scale NHS adoption. This process can be lengthy and difficult for all organizations particularly given that conforming to the regulations does not automatically lead to adoption and procurement (Secondment Diary, Appendix Two).

Healthcare purchasing strategies can unintentionally suppress innovation (Phillips, Knight, Caldwell & Warrington, 2007). For example, guidance issued to improve healthcare can create a standard product specification is widely adopted, competition becomes based on cost, and innovation is stifled as potential new entrants are deterred from the market. Buying decisions may result in a consolidated market where a monopoly emerges. Monopoly suppliers have little reason to innovate. Furthermore, 'good' purchasing practices have the potential to create SME exclusion from the market, notably the consolidation of demand into fewer, larger contracts which can be too big for SMEs to cope with. With its publicly funded National Health Service that has highly distributed decision making and high costs of market entry for device manufacturers, these are likely risks in the UK medical device sector.

The Coalition Government SME agenda was a cross-government plan to engage SMEs in at least 25% of all public procurement by 2015. In making public procurement contracts and tenders visible to all, removing any unnecessary obstacles to SMEs and commitment to making more opportunities for SMEs (Her Majesty's Government, 2010; Booth, 2013), the plan attempted to open up the market to SMEs. The DH has set out an SME Agenda Action Plan (2012) for the NHS which aims to achieve a level of 18% SME procurement.

The high economic pressures on the NHS have continued to increase. The Public Spending Review (Her Majesty's Government, 2010) set a target for the DH to cut procurement costs by £1.2 billion to be achieved by 2015. This, along with the recognition that the NHS is perceived to be extremely difficult to start selling to, and the lack of clarity over the remits of many DH/NHS organizations that contribute to innovation and procurement of medical devices and technologies, resulted in a conclusion – that procurement and adoption processes required extensive review and restructuring.

The findings of the Innovation, Health and Wealth Review (Department of Health, 2012) have led to extensive changes in how procurement and innovation practices are facilitated in the DH and NHS. “NHS England will lead further work on efficiency savings from 2015-16 to meet rising demand from an ageing population. As a first step, the Department of Health will publish plans in the summer for an overhaul of NHS procurement that could save up to £1 billion” (HM Treasury, 2013; pp. 28). The Innovation, Health and Wealth document (Department of Health, 2012) also presents 6 barriers to innovation within the NHS. The diagram below presents these barriers, and depicts the NHS level challenges facing interorganizational innovation projects between the NHS and SMEs. The changes made to the NHS, have been clearly targeted to combat some of these barriers, in particular two and six have been addressed through restructuring however the culture, financial and best practice elements require time to develop and change.

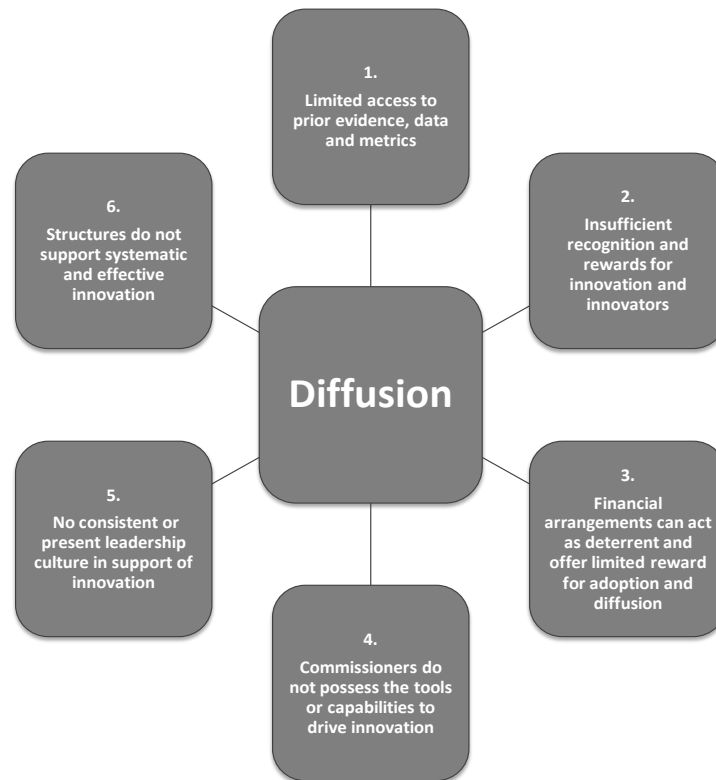


Figure 6: Barriers to Innovation in the NHS Adapted from Innovation, Health and Wealth Report (Department of Health, 2012)

At the NHS Innovation Exposition 2013, many keynote speeches highlighted and increased appetite and need for the NHS to create more relationships with industry in order to achieve the innovation priorities in emerging strategies. Mike Farrar, Chief Executive of the NHS confederation presented a workshop in which he discussed the correlation between understanding need within the NHS and actively engaging with those (i.e. industry) who would be able to provide the answers to these problems. He also discussed the difficulties that this would present for the NHS: NHS employees needing to be convinced why change is necessary; implementing mechanisms to support and underpin change; and ensuring that leaders approach change with the right mind-set and are less suspicious of the agenda of industry as a whole. In addition he posited that the NHS needed to become more flexible financially in order to create relationships with industry but also for intellectual property rights to be made clear at the outset of any such projects.

Lord Darzi suggested that in order to better facilitate the NHS engaging with industry, focus needed to be on comparing other countries' innovation activities with those of the NHS. Darzi called for innovation to be accelerated in order to tackle the healthcare problems of the future and in doing so the NHS must look outwards to do so. He also presented the idea that the industry relationships with the NHS needed to be much more close, and that those that are the most adaptive to change are the most likely to survive.

The NHS is facing increasing demands: an ageing population; the cost of advances in science and technology; and rising public expectations. It must meet these demands with its current budget while at the same time improving quality of healthcare provision and increasing innovation. The Quality, Innovation, Productivity and Prevention (QIPP) challenge, which requires the NHS to make up to £20 billion of savings by 2014/15 to invest in meeting demand and improving quality, means that all parts of the health service will need to take bold, long-term steps to generate viable changes.

On top of the QIPP savings, outgoing NHS chief executive Sir David Nicholson called on Clinical Commissioning Groups (CCGs) to formulate 3-5 year plans to help address a further funding gap of £30 billion by 2020/21. Announcing the "Call to Action" in the summer of 2013, Nicholson said: "Our analysis shows that if we continue with the current model of care and expected funding levels, we could have a funding gap of £30bn between 2013/14 and 2020/21, which will continue to grow and grow quickly if action isn't taken. This is on top of the £20bn of efficiency savings already being met. This gap cannot be solved from the public purse but by freeing up NHS services and staff from old style practices and buildings" (NHS England News, 2013). Commissioning and procurement will play a critical role in closing this gap, making the health service sustainable for the future.

3.1 Macro-Level Summary

A number of NHS calls and reports have highlighted the requirement for the NHS to focus on productivity and efficiency as well as reaching budget saving targets. This has now

been implemented through the restructuring of the NHS and consequently strategic aims are beginning to be realized. In achieving these strategic aims it has been recommended that innovation and relationships with industry through innovation provide the answer, and recent restructuring reflects this. However, this change has only just been implemented and it remains to be seen whether this new structuring and positioning will have the desired effect. There is still a requirement for NHS leaders to understand better how to initiate, develop and maintain relationships with industry, and in particular SMEs. This imminent change has an impact for the study, particularly given that this is due to be introduced from 2012 during the aimed data collection period. These strategies will also have an impact on how important the findings could be to the NHS due to wanted to learn how to collaborate with industry more successfully and to ensure that all resources (time, financial, talent) can be deployed and a return on investment realised.

4. Meso-Level

The NHS Innovation Centre (NIC), and the NHS Technology Adoption Centre (NTAC) were established in 2008 and 2007 respectively in order to support industry with financial and/or clinical resources and guidance through the stages required by the NHS prior to product adoption and procurement. NTAC (disbanded in 2013) provided guidance and resources, for the range of individuals involved in MD innovation such as MD organizations, NHS professionals with responsibility for innovation and NHS procurement personnel. NTAC complemented their involvement with NICE providing the appropriate driving support towards innovation once NICE had checked that devices adhered to clinical guidelines and provided suitable service improvements for the NHS. NTAC dealt with ‘push’ projects, where a device was developed and NHS involvement was being sought in order encourage faster adoptions. NTAC did not have sufficient resources to recruit smaller companies at product development

stages, focussing on larger companies or those with devices that had already been engaged in testing.

Conversely to NTAC, the NIC (also disbanded in early 2013) provided funding opportunities, access, advice, support and resources to organizations with 'pull' projects, for which funding was made available to support calls for solving identified clinical problems/needs. A diverse range of calls were issued, encouraging all sizes of organization to vie for these funding opportunities by submitting a proposal or prototype solution. Several bid winners were SMEs, the winner receiving support through contacts, knowledge and expertise, and possible access to adoption on a trial basis. This process necessarily encouraged firms to pay closer attention to clinical needs at the beginning of the design process and facilitated awareness and pre-design awareness of the requirements of NICE guidelines and regulations. The intention was to reduce the changes required in the prototypes at each stage, so increasing speed of the design process and decreasing the cost of lengthy redesign processes.

The NHS Supply Chain is a partially outsourced enterprise which solely provides a supply chain service to NHS hospital trusts. Many of the medical items required in healthcare can be purchased through the NHS Supply chain, and DHL provide the logistics for delivery. The NHS Supply Chain (2013) announced itself as a champion of SME suppliers of MDs, harnessing the knowledge and unique ideas that can come from entrepreneurial, smaller organizations (Audretsch, 2004). Links with SME industry are being sought out and an understanding of how to nurture these links is being explored by the DH.

In early 2011, there was some indication [E1]¹ that structural change within the NHS was on the horizon, and that leadership of the proposed Academic Health Science Networks

¹ All sources have been given codes, in order that anonymity can be retained in this document but also to ensure the researcher and the reader can understand and differentiate between the different sources. In this chapter these codes respond to data within the tables presented, which will give more insight and detail into the source context and provide a point of reference.

was being discussed. In addition [S] it was clear that many of the bodies involved in the sunset review were keen to demonstrate their relationships with industry and the extent of “push” technologies that they were actively engaged in. During one conversation [E1] it was indicated that this change was in order to connect to local need, and that a priority was collaboration and partnerships between buyers and suppliers and encouraging collaboration between trusts with a desire to create more “pull” through the AHSNs.

Table 4: Data sources from exploratory data collection phase included in macro- and meso-level analysis, coded and anonymized where required

| Date | Code | Location | Description | Person | Notes |
|------------|------|---|--------------------|--|--|
| 13/03/2013 | C1 | NHS Innovation Expo, 2013, EXCEL London | Speech Masterclass | Mike Farrar, Chief Executive NHS Confederation | <p>"Spreading innovation: from rhetoric to reality & why the NHS has to have skin in the game".</p> <ul style="list-style-type: none"> • Challenges and Improvements are linked but changing NHS patterns difficult. • Pulling innovation to bring value not addressed at all in any material way due to difficulty engaging with the organizations with answers to key NHS problems. This cannot continue. • Must examine: 1. Story of why change is necessary? Many people remain unconvinced, need public and staff support. More transparency in how we provide services. Call to be more honest, visible and transparent. 2. Do mechanisms underpin and support? Must make it the right thing to do. Rapid innovation and spread of innovation. Must incentivise and support spread from within. Problems with commercialisation of partnerships. Problems with intellectual property – return on IP. 3. The mind-set and opinions of leaders. Why are CE and boards not pulling technology through? Uncomfortable about public-private partnerships. Mistrust and fear of the commercial agenda. • Correlation of you understanding need and engaging with those that have the answers to the problems. • Opposition to innovation – the psychology and mind-set of those needed to engage in adoption. Flexibility of financial portion of the NHS difficult • Call for present evidence of real world examples that can then be showcased. |
| 13/03/2013 | C2 | NHS Innovation Expo, 2013, EXCEL London | App Presentation | Vitri-care Application | <p>How do we manage long-term care conditions?</p> <ul style="list-style-type: none"> • Aimed at GPs – patient centred • Demonstration of need, but also ease of adoption of this technology |

| | | | | | |
|-------------------|----|---|-------------------|--|--|
| 13/03/2013 | C3 | NHS Innovation Expo, 2013, EXCEL London | Speech Main Stage | Lord Darzi, Head of Surgery, Imperial College London | <p>“Innovation Goes Global”</p> <ul style="list-style-type: none"> • Southern and Eastern hemisphere include the workforce in the innovation process • The key challenge is dissemination • Labour as driving innovations, and associated shortages damage this. • Need to accelerate innovation to meet health care challenges of the future. • Needs to be the right kinds of innovation. • Must look outwards (to industry) for inspiration. • Need to learn to work more closely with private partners. • Darwin once said It’s not the strongest or most intelligent that survive but the most adaptive to change. |
| 13/03/2013 | C5 | NHS Innovation Expo, 2013, EXCEL London | Presentation | Dr Paul Stoffels, Johnson & Johnson | <ul style="list-style-type: none"> • “ Creating value through innovation and collaboration” • Larger organisation perspective of innovation and procurement within the NHS • More innovative collaboration required between NHS and external organisations • Suggestion of creating incubators for seed investments, in order to provide resources. • Share the learning between those that are engaging in innovative collaborations. • Public – private partnerships as the solution to driving innovation in the NHS and delivering the NHS Innovation Challenges. • Innovation is found where people, ideas and technologies can intersect. |
| 13/03/2013 | C8 | NHS Innovation Expo, 2013, EXCEL London | Presentation | Sir Andrew Witty, CEO, Glaxo-Smith Klein | <ul style="list-style-type: none"> • “Innovation through collaboration: Leveraging the expertise of industry” • How to use partnerships and how to bring products to market. • As a potential industrial partner with the NHS and be part of the dialogue must be trustworthy, reliable and transparent. • Proposes need an increase in appetite for innovation in the NHS • Key decision makers are not involved early enough |

| | | | | | |
|---------------------|----|-----------|---------|--|--|
| | | | | | <ul style="list-style-type: none"> • Need a different relationship with suppliers – procurement flexibility • Need to create degrees of negotiation and flexibility, get engaged in discovery and create a more open innovation environment |
| October 2011 | E1 | Telephone | Meeting | Senior Level at UK Department of Health | <ul style="list-style-type: none"> • Structural change on horizon – changing landscape • Now considering leadership of the networks and the transparency of information, Implications for practice, Connecting in local need, Pay offs for behaviours, Governance • A priority is collaboration and partnerships between buyers and encouraging collaboration between trusts • Large hubs have large overheads • Developing Academic Health Arm – want to create more “pull” |
| 05/03/2012 | E2 | Telephone | Meeting | Senior Level at Procurement, Investment and Communication Division, Department of Health | <ul style="list-style-type: none"> • There is a protocol for sharing. Imperial college commissioned by PICD to look at the benefit of sharing and scope • Small Business Research Initiative – leading project £20m, set out challenges and present calls for ideas, give funding and work together on clinical problems. • Innovation Health and Wealth big agenda and will raise lots of questions – some new initiatives being promised • NHS confederation is a pipeline project, companies to share with the trusts |
| 06/06/2012 | E3 | Telephone | Meeting | Senior Level at Showcase Hospitals, HCAI Department of Health | <ul style="list-style-type: none"> • Identifying the technologies (push and pull) • Showcase set up in 2008 through Technology Innovation Programme, motivation and interest a factor as well as geographic and demographic – performance important too in selecting. • Test in hospital setting, reduce barriers • Design Bugs Out Programme: put out a competition from the design council to focus on bedside equipment SME manufacturers created prototypes and fitted in 2 wards in 8 hospitals. Ran evaluation. • Worked with SMEs which lead to some implementation challenges |

Chapter Six: Exploring and Understanding the Context

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|-------------------|-----|---------------|--------------|---|---|
| 07/02/2012 | E4a | Telephone | Meeting | Senior Level at NHS Innovation Centre (part of NHS Institute) | <ul style="list-style-type: none"> • 70% a business arm of NHS. Set up a Health Industry Task Force – development support, proactive and reactive, identifying issues and demonstrating benefits. • Support across 5 stages ID1-ID5 (this mirrors NTACs 5 stages to adoption?) ID1 Define the Need ID2 Design the Solution ID3 Develop the Opportunity ID4 Demonstrate the Benefits ID5 Distribute the Product • Resources and practical support, Financial support and royalty agreements • Half of their projects originate from the front line of NHS |
| 10/01/2013 | E4b | NHS Institute | Meeting | Senior Level at NHS Innovation Centre (part of NHS Institute) | <ul style="list-style-type: none"> • Understanding the differences of NHS Staff and the “challenges of entering the NHS market”. • To what extent do the needs and values drive criteria by clinicians and managers for healthcare innovation technologies? • Pace and scale of adoption needs to be better. • Several current projects with SMEs. |
| 05/09/2012 | E4c | NHS Institute | Team Meeting | NHS Innovation Centre (part of NHS Institute) | <ul style="list-style-type: none"> • Institute is 1/8 closing down under the NHS restructure, although NIC may be hosted by the commissioning board according to Miles Aisling, closure timeline to be released, must give notice to customers. |
| 22/08/2012 | E4d | NHS Institute | Meeting | Senior Level at NHS Innovation Centre | <ul style="list-style-type: none"> • Barriers to development – very keen to know what these are |
| 14/02/2012 | N2 | Birmingham | Meeting | Medical Device Industry Expert and Consultant | <ul style="list-style-type: none"> • MDTI (Medical Device Technology International) • Strategic Partners – NHS Supply Chain, Medtrak, Centre for Healthcare Innovations and Developments, Maxwell, NHS Innovations • QUANTAFS – “good practice – range of devices • Team development varies – can come from clinicians, NHS driven or on own • Medlink – working together to create medical devices – regulations, clinical requirements and speed to market • There can be various people involved including those with medical knowledge, designers, manufacturers etc. • No protocol at present, can be through a company but depends on the remit of the company |

Chapter Six: Exploring and Understanding the Context

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|-------------------|----|-----------|-----------------------------------|--|--|
| 2012 | N3 | Telephone | Meeting | Senior Level, Manufacturing Advisory Service | <ul style="list-style-type: none"> • Speed to market extremely impeded by the NHS |
| 15/11/2011 | S | NTAC | Team Meeting during secondment | NTAC offices | <ul style="list-style-type: none"> • Innovation review, key item in meeting. Raising profile of activities of concern, producing adoption packs of pull projects. |

Discussions with high level NHS staff in 2012 demonstrated that many people were aware of projects involving industry and the NHS, but that in reality there were very few occurring and many did not involve SMEs or micro-companies. Some examples (suggested by [E2] and [E3]) included the Showcase hospitals, the Design Bugs Out programme, Mtech, SBRI and NIC. Once source [E3] worked directly in an industry-NHS project and reported that there were fewer barriers in place as the NHS had commissioned a new design and funded the prototype development. However [E3] working with an SME had led to implementation challenges due to size of expenditure and volume of production capacity. [E2] suggested that there was a protocol for sharing success stories in these types of projects, but only a few were found by the researcher.

Indeed it was clear that there were several strategic partners available for SMEs to approach within the NHS and even some outside the NHS. Medilink is an independent SME providing networking opportunities and resources for SMEs and other organizations within the medical device and healthcare technology sector. Medilink's remit is to work together to help in the creation of medical devices through providing support and resources about governance and clinical requirements in order to speed products to market. Medtrak was set up as the NHS's version of Medilink, however Medtrak focuses on bringing forward innovations from within the NHS. In addition Trustech was formed in order to serve as a point of contact to build these relationships, and so it serves as another mechanism through which the NHS was attempting to mirror the work of Medilink.

It is evident that there were bodies and organisations both within the NHS and in the private sector set up to fulfil these advice and support roles required by medical device companies hoping to work alongside the NHS with a particular innovation: concept, idea, prototype or development. NTAC provided this type of service from within the NHS, in particular working on a complementary basis with the old form of NICE. Given that one source [N3] described 'speed to market' as being extremely impeded by the NHS, it is clear that the

NHS had identified these barriers and was working towards providing help with them. NTAC was one such body working towards breaking down these barriers to adoption [E4b,d] and communication was often a key feature in much of the team meetings. Raising the profile of NTAC became more of a priority as the sunset review results came closer in December 2011. Focus came on providing briefing packs and reports on “push” projects, demonstrating their successes to the decision makers creating the new NHS structure. NTAC were unsure as to where they would fit, but were assured that they would not be closed but absorbed by NICE. Nevertheless there was an immense amount of uncertainty at this time and for over a year this impacted upon the work that NTAC were able to deliver to the projects they were representing [S].

The NIC was set up in order to support innovation of medical technologies from the beginning of projects and in order to prevent the development of devices which did not meet a clinical need and provide value to the NHS. This sits alongside their belief [E4a,b,c,d] that NHS pace and scale of adoption needs to be improved, and as such their objective was to attempt to engage with development projects in order that adoption in the future of the product when developed may be smoother. From discussions with many of the projects working alongside the NIC, it was clear that the NIC had a clear understanding of the differences between the NHS and SMEs in the medical device industry and also the “challenges of entering the NHS market”.

The NIC acted in many different ways on a wide variety of types and structures of projects, including partnerships, commissioning designers to answer a particular clinical need based design brief, providing seed funding as well as paying for and owning patents. Many of the projects featured NHS champions instated by the NIC, were spin-outs from Universities, or approached the NIC seeking NHS involvement which they were lacking at that time. This was further highlighted by an industry expert [N2], who stated that all projects would be shaped in entirely different ways and involve many different organizations.

The NIC used a 5 stage model to develop medical devices [E4a]: Define the need, design the solution, develop the opportunity, demonstrate the benefits and distribute the product. This demonstrates that the clear clinical need must be the first and most important factor (demonstrated with [C2]) to consider throughout medical device innovation, so that these benefits may be easily demonstrated at a later stage¹. At the initial involvement with the NIC 12 active projects were being managed by the team of 6, with half of the projects originating from the front line of the NHS and the other half coming from industry or academic origins.

In early 2013, NIC and NTAC (amongst others) were closed as part of restructuring the innovation and medical device/technology side of the NHS. At the Healthcare Innovation Exposition (2013), new Academic Health Science Networks (AHSN) were formally presented. These networks sit regionally, have funding available and are designed to be an easily accessible resource for all types of projects. It seems that instead of either championing early involvement (thus directing the innovation to directly apply ‘correctly’ to the context) or later involvement (thus redirecting once the true innovation has taken place) AHSNs have been designed to encourage both approaches. Moreover, at the Healthcare Innovation Exposition (2013) many of the key note speakers emphasised the importance and salience of the NHS learning to work and innovate better with industry [C1] [C3] [C8].

The NIC was aware of closure, but even during the NHS Innovation Exposition, in September 2013, NIC had a large stand and showcased the technologies that they had been partnering and aiding. In addition, they set in place meetings and introductions for the projects and in a meeting made a significant action point to notify and meet with each project prior to the Innovation Exposition (2013). However, despite being well aware of this closure, they were still just as conscious to raise awareness of key successes and to continue seeking new projects.

¹ In parallel, NTAC had 5 stages to the generic adoption process into the NHS: The minimum requirements, understanding clinical outcomes, delivering clinical outcomes, overcoming barriers to adoption, and how to raise awareness. This mirrors the approach taken by the NIC, despite being at a different stage of the innovation cycle.

The NIC was particularly keen to seek feedback and use this PhD research for more information about barriers and success factors in order to further the understanding of partnerships between the NHS and industry [E4d].

At the NHS Innovation Exposition 2013, many keynote speeches from industry highlighted the increased appetite and need for the NHS to create more relationships with industry which aligns with the NHS' emerging strategies [C1] [C3] [C8]. There was a clear agenda throughout the NHS Innovation Expo that featured industry linkages [C1] [C3] [C8]. Many stands were held by large organizations in the healthcare field such as Johnson & Johnson, and Glaxo Smith-Klein. Technology was also heavily featured with a specific section of the village dedicated to Mobile Apps, such as the Vitri-care App which was designed as a patient interface to aide in long-term treatments [C2]. However, this is an example of a technology developed in industry requiring relatively little input and change from the NHS and in the healthcare pathway in order to be implemented.

Dr Paul Stoeffels, CEO of Johnson & Johnson, [C5] implored the NHS to involve themselves in more collaborative innovation with external organizations, suggesting that incubators for seed investors to provide the much required resources would aid in developing these ties. Moreover, Stoeffels suggested that those engaged in these activities within the NHS needed to share learning and frameworks with others in order to ensure that more is known about the success factors and barriers to these types of relationships.

Dr Andrew Witty, CEO of Glaxo-Smith Klein, [C8] suggested that recently research had been redesigned and that partnerships with the NHS were key, but the questions of how to use partnerships and how to bring products to market needed to be answered first. As a potential industry partner Dr Witty said that Glaxo-Smith Klein needed to be trustworthy, reliable and transparent in order to be part of the dialogue within the NHS. In these partnerships it was presented that the NHS would get better value for money. Using an example of drug development, Witty stated that the "fail rate" of new drug developments, which inevitably costs

GSK money and in turn increased prices, could be reduced with more NHS involvement at the development stages. In order to create these partnerships Witty suggests that the NHS appetite for innovation must be increased and key decision makers needed to be involved at an earlier stage. Witty also suggested that the current procurement model within the NHS needed to change and that relationships with suppliers needed to be more flexible and involve more negotiation. Witty proposed prize programmes in order to encourage and create a more diverse approach to industry partnerships.

It was at the NHS Innovation Exposition (2013) that the NHS presented the new Academic Health Science Networks, thus clearly demonstrating the move towards a more local structure and a move towards engaging nationally with industry on innovation projects. In reality, very few of the AHSNs had anyone appointed and in role at the time of closure of the other bodies such as NIC, the Institute and NTAC and such closures occurred without any points of contact for many existing projects to be passed on to. This rapid and poorly joined-up structural change was also marred by miscommunication and little dissemination of the remits and strategies of newly formed and re-formed bodies. This was therefore an important issue for the projects in this research, and one which was evident throughout the qualitative interviews (Chapter Seven).

4.1 Meso-Level Summary

There were major strategic and organizational changes occurred during the time of this research and data collection which were important contextual factors to consider for the basis of the data and findings.

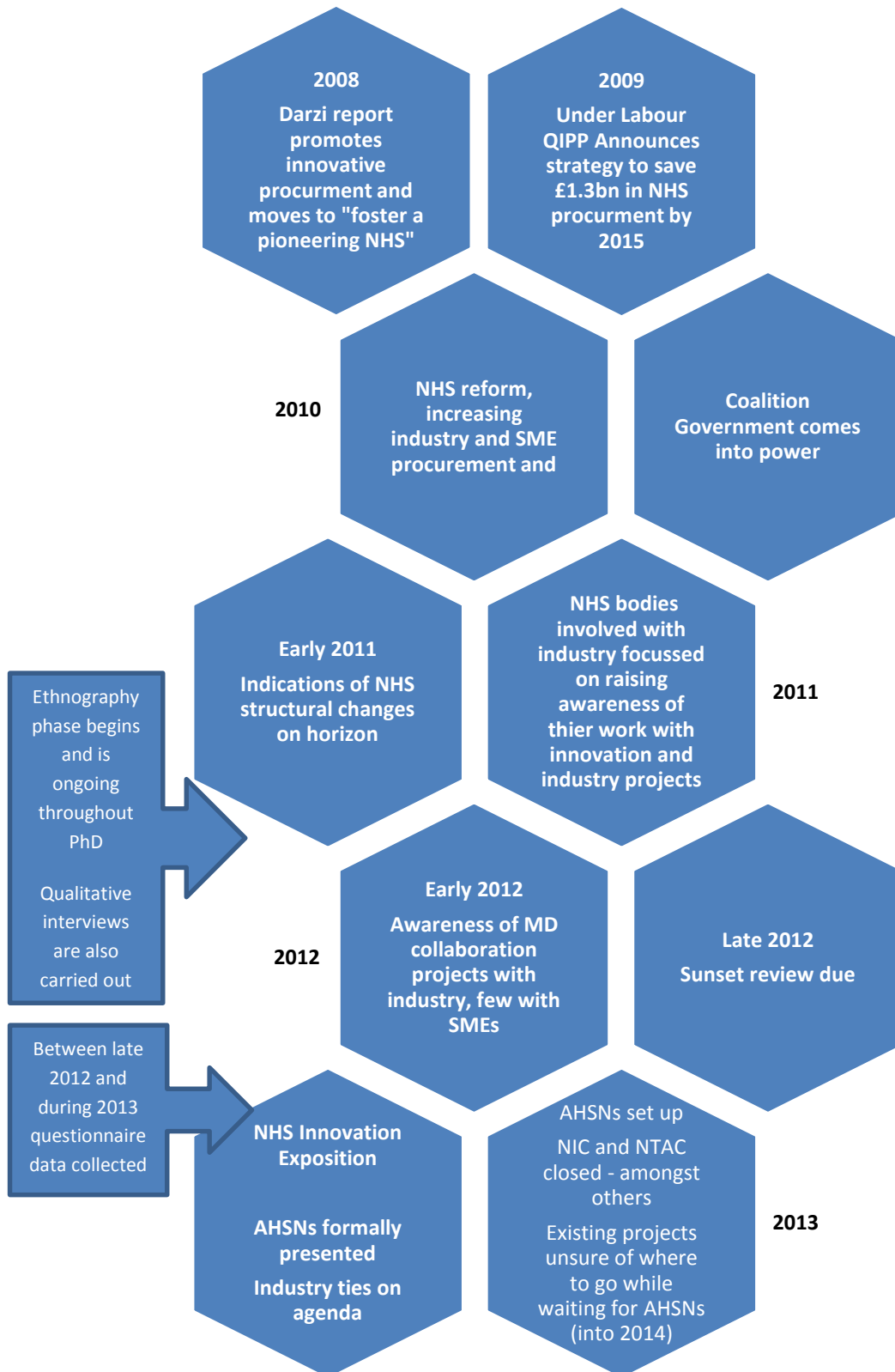


Figure 7: Timeline of Data Collection against major policy change and activity

The restructuring of the NHS was rumoured for a long time, raising uncertainty amongst those bodies that were under threat. These bodies were involved with industry in development, adoption and governance remits, all with innovation within the NHS as a central strategy. The MD industry has called out for the NHS to develop stronger ties with them, and have highlighted that there is mutuality in the benefits available to them. This is coming from the perceived barriers and slow paced adoption historically faced in medical device innovation with the NHS.

The new strategic direction from the NHS to engage with industry and to become more innovative, demonstrated in the introduction of the Academic Health Science Networks has acknowledged these shortfalls. Change and implementation of AHSNs has been slow and there does not appear to be a common understanding of best practice across the regional AHSN. However it is undeniable that the NHS is attempting to rectify and strengthen ties with industry, having understood how important the focus on maintaining the position of the NHS as “world class” in integrating leading innovations is for improving care and service available to patients. In acknowledging that engaging more closely with industry, the challenge lies in understanding how best to go about promoting innovation via industry collaborations, and how to ensure that resources put into pursuing this strategy can give rise to successful projects. For industry and particularly for SMEs, the challenge is how to work successfully on NHS collaborations in order to ensure that the resources and effort are seen in ROI in the future.

5. Summary of Ethnography Findings

Key insights from the exploratory phase of data collection include the priorities of NHS strategy to not only save £1.3 billion through procurement by 2015, but also to engage with SMEs and industry in a much closer manner and as a priority. The anticipated NHS restructure in 2013 saw many NHS employees left in a state of limbo, not quite being sure how the restructure would affect them or the bodies they were working for. The looming strategic change prevented the projects that were thriving under NTAC and NIC from receiving their full

attention and they have now been left in a difficult position of uncertainty. The speed of announcements of change has not only prevented best practice evidence being collected, but the speed of implementation may have put these projects into difficulty too. The lack of communication and decision making from the top left many existing projects and partnerships with SMEs in a state of frustration and disarray as information was not able to be disseminated to them in good time. Moreover, the building of the AHSNs took much longer than expected also leaving these projects without clarity over what to do and where to go next.

There are many calls for the NHS to engage more closely in industry relationships both from a development and procurement point of view. In addition, many have expressed the view that systems in these fields need to be less complex, more consistent and need to foster these relationships. An issue arising from the exploratory data is that the NHS is not clear on how best to engage with industry. They have taken care to ensure AHSNs are positioned regionally, however the barrier articulated in the Innovation, Health and Wealth review (2012) that there is a lack of evidence and data to provide guidance for those involved in innovation and with industry.

So the question remains – how can the NHS engage closely and successfully with industry? It is clear that this is the strategic direction desired from both the NHS and industry perspectives, however how to implement and deliver this strategy effectively and successfully must be explored and best practice needs to be established. Whilst attempting to successfully engage in these relationships the NHS needs to be more transparent and share its learning within the organization. In addition, at a time of uncertainty the NHS needs to encourage positive attitudes towards change and working alongside industry to enable relationships with industry to occur – whether they are to be successful or not. The findings in this chapter provide the contextual backdrop for the following two chapters and their associated study analyses.

Chapter Seven: Exploratory Qualitative Study Findings and Analysis

Following the Exploratory Phase of data collection, where the context was explored using ethnography techniques (findings presented in the previous chapter) and provides a backdrop of contextual information, this chapter presents the exploratory qualitative study involving qualitative observation and in-depth project interview analyses. First, an exploration of the fifteen projects identified during this initial ethnography will be presented in a narrative analysis mirroring that of the previous chapter. This is a qualitative exploration of the context from the micro level of interorganizational teams. Then the analyses of individual interviews will be presented. Selected quotations from the individual interviews are within the tables, to provide an in-depth narrative and illustrative description and analysis for each selected project. Finally a cross-project comparison where all interview data has been assimilated is presented, summarising all themes.

The value of these interviews is the richness of the data. Emergent themes can develop from the data allowing factors that have not been accessed in the quantitative survey. There is also the opportunity to strengthen understanding of factors already measured and explaining previous findings. Furthermore, these insights inform the practice oriented outputs of the study in terms of understanding best and worst practice moving forward with similar projects.

A detailed table of observational and exploratory data collected throughout the PhD project from each of the project interactions is located within Chapter Six, this chapter and Appendix 2.

1. Qualitative exploration of identified interorganizational projects

Having attended events, carried out the secondment and made presentations, the researcher followed up with all contacts. Each contact was either able to help or direct the researcher to another party that may be able to help thus a snowballing technique was employed to ensuring that people directly able to participate were contacted (Heckathorn, 1997). There were a number of criteria required before pursuing data collection as laid out in Chapter Five and this section of the current chapter. However, generally personal recommendations and face to face meetings provided sufficient information for the researcher to decide whether a project was possible to pursue.

From the secondment at NTAC, it is clear that all companies find seeking adoption of their medical device and technology into the NHS is extremely difficult, regardless of the size and equity available to fund the project. However, often for start-ups and SMEs, there is even greater hardship to endure. Many of the projects revealed a trend across all organizations but in particular in SMEs, that funding and budgets were extremely tight. With finite resources available to them, or some even using their own personal savings to fund the organization, this caused an incredible amount of pressure. This pressure was expressed as intense frustration about the length of time it took to penetrate the NHS and be seen by the ‘right’ person.

This difficulty often led to the expression of confusion and frustration from many sides, with several even suggesting that they may look overseas – to Europe and the USA – in order to advance some sales and fund the tooling and manufacture that would be required should the NHS decide to put in a large order. With tight resources and funds, some SMEs had no choice but to sell some units to Europe in order to be able to fund the waiting stages of the project where they were seeking input from the ‘right’ person within the NHS, in order to progress the project further.

Table 5: Data sources from exploratory data collection phase included in micro-level analysis, coded and anonymized where required

| Date | Code | Description | Person | Notes |
|-------------|-------------|--------------------|-------------------------------|---|
| 13/03/2013 | II1 | Meeting | Designer and consultant at II | <ul style="list-style-type: none"> • Approached by NHS for product innovation, but has developed into process, system and pathway innovation too. • Feel that the NHS do not engage well in partnerships • NHS have no understanding of industry perspective and the fact that SMEs have limited financial resources. |
| 04/04/2013 | II2 | Meeting | Designer and consultant at II | <ul style="list-style-type: none"> • Keen to get on with the project but are now in the driving seat since NIC closure – confusion over AHSN – funding • Concern over communication – what is replacing the NIC? • Challenges over how to secure consistent sponsorship. • NHS procurement strategy creates difficulties and the efficiency in procurement is not across the board. • Identification of the requirements has been better from the NHS however it has been a challenge and has required tenacity and understanding of the NHS (knowledge of business as well as development, innovation and NHS processes) • Want continuity and visibility • Bound up by bureaucracy and protection. • Too much NHS structure which is not good for creativity. |
| 13/03/2013 | KK1 | Meeting | MD at KK | <ul style="list-style-type: none"> • NIC as a trailblazer of the NHS working with industry. • Very disappointed that it will be closing down - invaluable support • Now questioning if they should continue to aim in an NHS direction or is it too regionally based. • There is no real clarity over which body will be taking them on. • Funding and support from the NHS has weakened offers and bids from or to other investors. • Very unhappy with the NHS regional change decision. • “Now who do I talk to?” |
| 27/03/2013 | KK2 | Meeting | MD at KK | <ul style="list-style-type: none"> • “team” and “objectives” • Expo was an opportunity to network with Oxford AHSNs • Last minute feeling to the NHS change decision – Colin described a different event when inviting them to the Expo – with a clear direction. • How does this new model suit companies with no academic or NHS associations? UK NHS not really considered their market now. • “Memorandum of understanding” but no insights or handover discussed properly. • Bad start to the AHSN relationship, the remit was promising but requires proper dialogue. Still setting themselves up. |

This difficulty often led to the expression of confusion and frustration from many sides, with several even suggesting that they may look overseas – to Europe and the USA – in order to advance some sales and fund the tooling and manufacture that would be required should the NHS decide to put in a large order. With tight resources and funds, some SMEs had no choice but to sell some units to Europe in order to be able to fund the waiting stages of the project where they were seeking input from the ‘right’ person within the NHS, in order to progress the project further.

Some projects were found to have been started through an NHS initiative for example they were approached by the NHS to design a solution for a particular clinical issue which the NHS had identified i.e. [AA] [BB] [CC] [GG] [II] [JJ]. However, even a simple design project had been found to lead to a lengthy adoption and trial process, requiring system and pathway change and so the project which had been initially fast paced had become stagnant as they awaited change in the NHS and their proposals to reach the correct level of decision makers [II]. During a discussion [III] one project stated that they felt “the NHS do not engage well in partnerships” and that the NHS “have no understanding of the industry perspective and the fact that SMEs have limited financial resources”.

One project that had approached an NHS body for support felt that it was not the involvement of the NHS body that had opened doors as they had hoped for, but the fact that one of the managing directors was in fact a consultant [MM]. Despite an NHS employee having a vested interest in this project and company, they revealed that in the time they had been awaiting procurement and adoption processes to occur within the NHS they had managed to sell their product in the USA and across Europe.

After the closure of the NHS bodies and restructuring around the AHSNs had begun, more meetings were arranged between the projects and the researcher. Discussions [II2] [KK3] revealed that even three months after this had occurred there was still confusion over what was happening to them in terms of their previously agreed partnership and funding from the NHS.

They were keen to get on with moving the project forward but felt they were having to get in the “driving seat” themselves, although they had not been leading the project previously. They expressed concern over the lack of communication they had received and had been expecting to be contacted by an AHSN member, which also presented them with challenges over how to fund the future of the project.

The implementation of the NHS change was not driven forcefully and therefore many projects that were already struggling to move forward were put into a state of stasis whilst the NHS was reorganised. Much of the information and visibility was lost with reorganisation of staff previously involved in these innovation projects and therefore many projects were made to contact the NHS themselves again, despite receiving funding from the NHS. This almost made many previously NHS –led “pull” projects change to being “push” projects reflecting effects on motivation behind the project as well as being affected by the gap in knowledge, resources and contacts previously provided by the NHS.

Appendix 2 holds a table which summarises these insights. In particular the frustrations felt by SMEs and projects that were or are trying to engage with the NHS are prevalent in these discussions. Some key points to draw from the data are: frustrations over how the structural change has been carried out; accessing the appropriate individuals within the NHS; and that the NHS has been extremely difficult to engage with. In addition there was clear support for the NIC and disappointment and anxiety about what to do following its closure.

1.1 Case Project Detail:

The sample involved 15 projects /project teams, some further detail about the projects engaged with for further data collection is provided here. There are categories describing the project, size of the immediate project team as identified upon meeting the team, the type of organisations involved in collaboration and whether the project was a “push” or a “pull” innovation. Push innovations are typically those whereby an organisation approaches the customer with an innovation, whereas a pull innovation is requested by the customer.

The cases include three Department of Health “pull” innovations which announced an aim and objective for redesign under a strategic programme, the winning designers were funded and trials were run in showcase hospitals, with a range of NHS and designers involved on each project team. Four other “pull “ innovations involved an NHS body announcing a call for innovation prototypes for a particular NHS challenge and funding as well as support from the body awarded to the winning design. This same body was also contacted and provided support for several “push” innovations. All of these involved NHS team members from both the funding body but also practitioners and experts from the field. Some projects were stand alone “push” projects, without NHS members directly considered as on the project team. Academics and Universities were involved with at least three of the projects and these were mainly “push” projects although only half had sought NHS involvement alongside University involvement.

The table (Table 6) on the following pages gives more detail about each of the cases and whether the innovation was a “push” or “pull” innovation, how many identifiable members were on the project and whether NHS, department of Health or another organisation was collaborating with the team. This demonstrates the quality and variety of the sample, which although smaller than preferred (as outlined in Chapter Five) supports the excellent breadth of the sample of cases.

Table 6: Anonymized Case Project Sample Descriptions (Including short outline of device or project, number of members observed and discussed, collaborative organisation and whether innovation was "push/pull")

| Name of Project and Description of Innovation | Number of Identifiable Members | Pull/Push Innovation⁴ | Organization(s) Collaborating with SME |
|--|---------------------------------------|---|---|
| <p>AA. Bedside Table/Cabinet Involved in the Design Bugs Out Programme alongside clinicians within the Showcase Hospitals, the emphasis of this project was reinventing four key items of furniture that hadn't been redesigned for over 20 years in order to make them easier to clean and less of an infection risk. This design innovation saw some different approaches to the materials, design and construction of the bedside cabinet and has been installed in the showcase hospital programme as a result.</p> | 9 | Pull | Department of Health |
| <p>BB. Bedside Seat Design Bugs Out programme, similar as the AA product but redesign and innovation of the bedside seat/armchair that had followed the same design. An emphasis was on how to make the appliance easier to clean between patients for the ward staff.</p> | 8 | Pull | Department of Health |
| <p>CC. Over bed Table Design Bugs Out programme, similar to the two above. Redesign and innovation of the over the bed tray table. Emphasis on ensuring the piece of furniture is ideal for all patients, and easy to clean for the ward staff. The key challenge was to keep the number of component parts low whilst also allowing better functionality and ensuring that cleaning was easy.</p> | 7 | Pull | Department of Health |
| <p>DD. Hand Wash Unit This hand wash unit was being redesigned and innovated to incorporate a minimal contact dispensing point and some new coatings that destroyed bacteria or viruses upon contact. This was in an effort to reduce transfer of bugs. The coating was being developed alongside a material being proposed for all door handles which destroyed bacteria and viruses. Inevitably these are the surfaces touched by the most hands in the hospital. Problems in attachment to the wall were being ironed out, as the coating had a limited duration of effectiveness and the attachment needed to be removable.</p> | 7 | Push | Other (industry) |

⁴ "Push" innovation is related to a company approaching the NHS with an already developed innovation seeking adoption, whereas "pull" innovation is associated with the NHS (in this case) seeking companies out to aid in the development of particular and required devices and technologies.

| | | | |
|---|---|------|--|
| <p>EE. Muscle Stimulator A muscle stimulator which had been developed from a previously existing (20 years plus) weight management device. The company is a family run business and following liaisons with a clinician and physiotherapist has been attempting to get their muscle stimulator to be adopted by the NHS. They have had some trials and proven that there is a reduction in the length of stay and speed of recovery when physiotherapists have used the machine.</p> | 8 | Push | Other (Family members that were practitioners) |
| <p>FF. 3D Cornea Imaging Project A technology and software allowing for the traditional photos taken of the cornea during an eye examination to be sewn together into a 3D model. This technology was developed by a PhD researcher and a clinician was working with the academic team in order to use the models in briefing prior to operating.</p> | 6 | Pull | NHS |
| <p>GG. Intelligent Mattress A mattress developed in partnership with the Ambulance service and a University Hospital, with joining power of National Innovation Centre and funding resources. The mattress measures respiration rate, blood pressure, weight and vital signs and would be used in particular for paediatric emergencies in order that children have less invasive monitoring in stressful times. This is also useful in a number of vulnerable adult patient groups too.</p> | 6 | Pull | NHS |
| <p>HH. RFID Tracking Technology An RFID (Radio Frequency Identification) System, allowing for particular instruments to be tracked in and out of theatre and data to be collected about their usage and how recently they had been sterilised. The overarching aim of the use of this technology is lean systems and management. This is developed in partnership with PhD student and academics at H University, as well as the Business Spin Out operation of H University and has had some involvement with a hospital trust.</p> | 3 | Push | Other (University) |
| <p>II. Fracture Neck of Femur Splint A splint designed to reduce pain and improve hospital stay length in the elderly in particular. The most common reason for OAPs to be admitted to hospital via ambulance is fracture to the neck of femur (hip). It has a huge impact on the person, particularly if the pain requires long term administration of opioids (this can double length of stay in hospital). This splint is put on at the house, stabilising the whole leg preventing further damage to muscle and vessels and able to be taken with the patient through x-rays and theatre. Ambulance trust and Professor at a University Hospital Trust involved. Originated from a “Wouldn’t it be good if?” event – where a brief was given by the NIC and II won the design quote.</p> | 6 | Pull | NHS |

| | | | |
|---|---|------|------------------------------------|
| <p>JJ. Paediatric Wheelchair A wheelchair designed to be with a child from a young age into early adulthood. The concept behind the chair is that the chair can grow with the child, instead of needing to be fitted and waiting for an appropriate chair to become available. This chair is able to not only adjust with growth but allows a huge range of movements for the child including raising the height of the chair. NIC funded and involvement.</p> | 8 | Pull | NHS & Other (charity and industry) |
| <p>KK. Ultrasound Software and Device Ultrasound is the most used medical imaging system in diagnosis due to its broad application. Intelligent Ultrasound have developed a software based addition to existing ultrasound units which not only produces higher quality images but also gives a better field of view (3D) and is just a small attachment to a regular ultrasound machine. This eliminates the need for costly replacements of existing hardware and also allows for strong initial diagnosis to be made without sending patients for more invasive or costly procedures or scans. Some low level funding from NIC at a time of crisis, a roll out from K University (Technikos) and involvement of hospitals, a University and several other champions from the field of medicine.</p> | 3 | Push | NHS |
| <p>LL. Psychological Support Site Service delivered in a joint venture partnership between LL and an NHS Foundation Trust. The LL LiveTherapy allows online mental wellbeing pathways to be available to those suffering with mental health issues and allowing them to be in control of their own care and access appropriately monitored peer support. This has been in small part funded by the NIC and the support for trials in particular areas as well as licensing has been aided within the collaboration, now moving away from partnership.</p> | 5 | Push | NHS |
| <p>MM. Orthopaedic Table Extension A compact, lightweight and portable extension attaching to the end of standard operating tables and facilitating easy control of leg positioning during a hip operation. Average hospital stay is reduced as the position the leg may be held in allows for minimally invasive surgery approach procedure (Direct Anterior Approach) to be used, which has been shown to reduce the post-operative pain experiences as well as reducing blood loss and recovery time before being discharged. A pair of brothers have invented and implemented the product. Involvement with the NIC although difference in opinion about how useful this collaboration has been. Difficulty in approaching the NHS, and getting orders.</p> | 4 | Push | NHS |

| | | | |
|---|---|------|-----|
| <p>NN. Clinical Decision Support System Innovative clinical decision support system providing outputs and user interfaces for all stakeholders in the care of a patient – clinicians, management and the patient themselves. The system allows transparency of information in order that well informed decisions can be made based on patient preference and clinical guidelines. All clinical decisions are recorded for auditing purposes. This allows patients and management to know whether treatment has been in line with clinical guidelines, ultimately reducing complaints from distressed patients or relatives as well as ensuring that decision making is monitored by the hospital.</p> | 4 | Push | NHS |
| <p>OO. Automated Suture A small company mainly creating inventions of all kinds. Liaised with clinicians and those often suturing. This small hand held device sutures wounds automatically, at speed and with precision ensuring that the wound is both stitched neatly and also in a uniform manner, at an appropriate tension.</p> | 7 | Push | NHS |

1.2 Micro-Level Ethnography Summary

The projects have praised NIC initiatives, and dismay and frustration has been commonly expressed regarding the AHSN introduction. This is an important factor to consider from a contextual perspective as this could have implications for project progress, success and performance. The uncertainty and change will certainly be important to be aware of as data collection is longitudinal.

The exploratory phase of data collection was of high importance in confirming whether the proposed questionnaire scales and items required adaptation and indeed whether they would even be suitable in such a diverse sample, with so many “unknowns” regarding the size of the team, who was involved and what the collaboration looked like. Before creating a questionnaire that some of the sample would find irrelevant, this phase helped to get a general feel for what these collaborations looked like and whether the team was based in the middle of the collaborative boundaries or not.

Some themes for further investigation arise at the micro level analysis, including leadership, teamwork, the role of champions, involvement of academics, involvement of NHS bodies and Universities, origins of the projects and objective setting. The key findings is that several discussions have seen the phrase “team” or “teamwork”⁵ used, or indeed “the sum is greater than the individual parts” all of which can be mapped onto the appropriateness of using the term interorganizational team and of applying organizational team literature to the interorganizational project setting. However this terminology was by no means used by all of the cases and as such care was taken in adapting “team” scales into this context. There are 15 interorganizational teams identified, all with very different structures, origins and working practices provided a diverse sample.

2. Individual Interview Analysis

Each case will be presented with a mixture of description and analysis, both looking for certain themes previously measured in the quantitative data analysis and also examining the data for emerging themes. Each case interview discussion contains a summary table of quotations and codes, as well as an overall summary of the themes at the end.

2.1 Project KK ~ Ultrasound Software and Device (Interview with CEO Ltd. Company)

The project began through a contact within the University, who invited KA to attend an event and meet several individuals working on different research projects. The University was actively involved in creating start-up companies with these research projects and KA was told to “choose a project and you can be CEO of it”.

⁵ Great care has been taken to ensure that the word team was not used, so as not to lead the respondents.

Table 7: KK Interview Quotations and Thematic Coding

| Quotations | Themes |
|---|---|
| The Beginning and Origins of the Project | |
| <ul style="list-style-type: none"> • “choose a project and you can be CEO of it” • “I was introduced in December 2010 to ProfessorK” • “So I invested....maybe £20,000 plus the opportunity cost of not having a job, to get the project up and running....we thought in August of 2011 that we would be able to spin the company out, but the then lead investor changed the basis on which they were willing to make an investment and consequently it fell apart....I have no income, I do have a mortgage, so I thought ok, what am I going to do? So I cast around and stumbled on the National Innovation Centre website.... he said I think we can invest £200,000as a grant” • “with £900,000 got our heads down and started developing the product” • “we took software out of the University and completely recoded it and reduced the time it took to process a standard set of images from about an hour and forty minutes to about 38 seconds” • “then did some other work to check whether it would work in different clinical settings” • “through the manufacturers” however, “some of the assumptions we had about the market were incorrect” • “we finally figured out how to structure the thing and because the National Health Service through the National Innovation Centre were investing all of the people that we’d been talking to before who were sitting on the fence came off the fence and said yes we’ll invest too!” • “single investment. And it took him 24 hours to make the decision” | <p>Origins/Drivers Funding NHS Relationship Collaborating Partners Clear Clinical Need Expertise</p> |
| The Current Situation | |
| <ul style="list-style-type: none"> • “KK is the opportunity, KK now is a much bigger market opportunity than <previous iteration of product>, probably double maybe even three times the size. We thought that we would have a market of about half a billion for <previous>. Well we know it’s much less than that now. The market for KK is well in excess of a billion dollars probably globally it’s nearer to three billion dollars. So it’s a big opportunity.” • “I mentioned to NIC we’ve got this concept KK concept, and he said in his view that that was in terms of value to the NHS massively more valuable than <previous> which just reinforced what we thought.” • “70% of the images were of substandard quality. Which kind of scared them. If you can save one just one you would pretty much pay for intelligent quality analytics for the whole of the NHS.impact nationally...reduce the risk of wrong and misdiagnoses” • “got about £150,000 sitting in the bank” • “first funding round in January 2013”, raising “a total of £900,000”. • “through to profitability”, • “about to go out and attempt to raise another £1million” • “going to see any money for at least another year” | <p>Clear Clinical Need External Environment Market Research Champions Funding Knowledge Expertise Implications Collaborating Partners Flexibility</p> |
| Barriers and Challenges, Successes and Progress | |

| | |
|--|---|
| <ul style="list-style-type: none"> • <i>“dynamics in the market for KK”</i> • <i>companies used to pay developers up front to develop the software and then also pay them to engineer it to suit their operating system and they won’t do that either anymore”</i> • <i>“we made a bad hire and our original Head of Engineering turned out to be a disaster so that was a problem”</i> • <i>were “fully expecting them to say get out of here”</i> • <i>“just getting the company going itself”</i> • <i>“We will be forever in debt to him for pushing this through the NIC”</i> • <i>“I remember very clearly the day that we broke through our record our goal for the processing speed of the images.”</i> • <i>“we always believed KK as it was originally conceived was big.....ProfessorK particularly was very sceptical. And I remember the day when she flipped from being incredibly sceptical to suddenly realising it was huge. Because it would provide the hospital with the information it needs to actively, actively manage the service they provide, which they can’t do right now.”</i> | <p>External and business dynamics NHS Relationship Collaborating Partners Challenges Successes Motivation/Motivators</p> |
| <p>Set Up and Structure of the Project Working Group</p> | |
| <ul style="list-style-type: none"> • <i>“remarkable incredibly intelligent”</i> • <i>World leaders in ultrasound image quality control” “probably in the top few in the world”.</i> • <i>“And that’s pretty much the core team. You’ve then got the Board.....So that’s the kind of advisory bit, then you step outside of the company.....we want to keep them you know at arm’s length to a degree....”</i> • <i>“key opinion champions”,</i> • <i>NIC as “proactive, it was creative, strategic”.</i> • <i>“this was a mistake. I still stand by that. I think the concept behind the NIC made a huge amount of sense. I still think it makes a huge amount of sense and I think it was an inadvertent error on the part of the Government to cull it, they shouldn’t have done that”</i> • <i>“it was mooted at the time that we would be it would be suggested that we affiliate with one of the AHSNs”</i> • <i>“they’ve got about £20,000 sort of a bequest in our name from NIC into the AHSN”</i> • <i>“I have communicated with them repeatedly”</i> • <i>“so far the communication has been poor. I think you know you’ve got to give them some leeway with the fact they’re trying to set themselves up and figure out what they are doing. I don’t think they know what they are yet”</i> • <i>“turning this company into a strategic reality”</i> | <p>Political Change Collaborating Partners Expertise Champions NIC Change in the NHS Barriers Team Members Team Roles Role Definition</p> |
| <p>Team Practices and Processes</p> | |
| <ul style="list-style-type: none"> • <i>“there’s a lot of discussion and we have frequent telephone calls and meetings, we’re in the same room most of the time”</i> • <i>“So it’s quite exciting”</i> • <i>“we’re in the middle of our first audit with the KK product and that’s looking great and everybody’s kind of buzzed about it”</i> • <i>“they are literally making a difference to what’s happening”.</i> • <i>“I would be very disappointed if somebody said I don’t feel like I’ve got any kind of autonomy here”</i> • <i>“I think KK is the product of a group of people it’s no one person’s vision”</i> • <i>“I think we all of us want to have that kind of culture in the company.....that positive we can make this happen, when all sorts of stuff is hailing down from on high upon us we’re going to get through it.....we’ve got it now, we want to keep it....there’s no autocracy....you should be able to help shape that culture....would be great to have a reputation of people saying we want to be here, you know this is a good company to work for.”</i> | <p>Boundedness Communication Leadership Team Shared Objectives and Vision Motivation/Motivators Role Definition Culture Team Work Role Definition</p> |

Chapter Seven: Exploratory Qualitative Study Findings and Analysis

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|---|----------------------------------|
| <ul style="list-style-type: none"> • <i>“democratic, there’s a lot of discussion”</i> • <i>“final say so depending on what subject it is down to me”</i> • <i>“to continue as best we can with that kind of philosophy as we grow and that’s going to be hard....how as we build the company we can ensure that everybody feels like they’re part of it”</i> | <p>Psychological Safety</p> |
| <p>The Future of the Project</p> | |
| <ul style="list-style-type: none"> • <i>“an immediately obvious and recognised need”</i> • <i>“I would have approached NIC earlier”</i> • <i>“I would definitely have gone after TSB funding and grant funding much much more aggressively”</i> • <i>spin-out company process with the University which he believes is not “structured in a way that makes it easy”</i> • <i>“nice piece of independent validation”.</i> • <i>“It ought to be. Yea, we’re looking more internationally. The reason is because the way the funding stream works the way the benefit of the service accrues to the system it’s going to be difficult to get it paid for I suspect.”</i> • <i>“NHS to a large extent leads the world in clinical audit it doesn’t do a very good job of it but it does a better job than a lot of other places....our expectation is that in a market driven environment where insurance plays a part....will probably confer a significant competitive advantage.”</i> | <p>Hindsight Reflexivity</p> |

After managing to gain investments from a range of sources, they began to develop the product and initially presented it as an add-on for existing ultrasound machines. This was designed to provide support and advice, as well as auditing for ultrasound scans and it was decided that obstetrics was the best clinical situation to target initially due to the uniform nature of measurements and scan positions. However, after a while the funding became difficult and by chance KA came across the National Innovation Centre who offered some seed funding to the company.

2.1.1 Summary

KK has more recently changed the product that it is focussing on, having further developed the product in line with both market demands and also bearing in mind the external environments. In the face of emergent market research this demonstrates that their business plan is flexible and adaptable, and the product has been developed in order that it can be implemented in many and various useful applications within the healthcare environment internationally. Whilst not only working on this capability, the company has been extremely proactive in approaching investors and applying for funding, amassing in excess of £900,000 to see them through the first round of development.

KA, CEO of KK has previous experience of project management, working with the NHS and running small companies but has no knowledge of the technologies. However in the interview he is convincing as a non-specialist and this has clearly been borne out during presentations to potential investors as well as fully engaging with the activities of all of his team members. Following the initial phase where the project was held within the University, the pace of the project was slow, but with dynamic changes to the project and the company being rolled out of the University, there is now a greater emphasis on seeking funding and making required developments such as increasing processing speed.

The commercial environment has played a large role in the need for change in direction, with potential manufacturers no longer providing seed-funding software developers to deliver on projects, a change coinciding with economic changes. In addition KA mentions political change as having a heavy influence on the funding available and the NIC's closure as having a detrimental impact on the NHS's collaboration with SMEs. The NIC had saved KK at a time of crisis, where the business was on the verge of folding.

There is a very strong sense that KA wants KK to be a good place to work and also wants individuals working in the team to be active, engaged and involved indeed he says that he would be "disappointed if people didn't feel like that". There is a clear culture of creativity and psychological safety within the team, indicating that all contributions are valued and that communications and discussions are always occurring both informally and formally – the majority of the team work on the same site.

With regards to leadership, KA is pleased with the environment and culture that is within KK at the moment and shares concern for maintaining it as it is when the inevitable growth of the business occurs. His expression of disappointment if individuals felt they had no autonomy mirrors his preference to run a democracy. He is infectiously enthusiastic and although he doesn't necessarily understand the technology and software is keen to absorb as much information as possible. He is an enthusiastic leader and is driven by the outcome and potential of the product. The motivation and drivers of the team and KA is demonstrated in the speed of more recent developments.

There is a clear sense of a common and shared vision of where the product and team is aiming for which is regularly reviewed. This is articulated by KA but also evident in the rapid change approach to the external environmental barriers that have been encountered. One internal barrier has also been identified – the hiring of the wrong person. Although the team

culture is highly valued within KK, KA is not afraid of making final decisions and identifying when individuals are not performing their part in the team according to KK expectations.

The team is extremely clearly defined, but overlapping roles and areas of expertise enable the team to work interdependently on the project. There is a huge amount of respect expressed for the Professors involved, whose knowledge and gravitas both add weight to the organization but also to the foresight of the product development. In addition the idea of having product champions on the periphery allows the company to spread the word in the many healthcare environments internationally and garner support and interest without a conflict of interest.

Lack of clarity over the introduction of the Academic Health Science Network has left the organization unclear of its position with the NHS and consequently seeking out markets abroad. However, KA is able to articulate a holistic view of the potential implications and impacts that the technology could have on the NHS thus demonstrating a clear clinical need. Indeed he suggests that when the issue that the device could tackle was presented to the NHS Trust “it kind of scared them” indicated that the requirement for the technology is accepted by the NHS.

2.2 Case II ~ Fracture Neck of Femur Splint (Interview 1 with Managing Director of II Design Engineering Company)

In 2005, II were invited along to the NHS Innovation Exposition by the NHS Innovation Centre (NIC). The invitation was to attend a workshop running during the exposition: the Wouldn't It Be Good If? (WIBGI) workshops where they were presented with a current issue from a Local Ambulance Trust and some basic information to design a Fractured neck of Femur splint (an extremely common and traumatic injury for the elderly).

Table 8: IS Interview Quotations and Thematic Coding

| Quotations | Themes |
|---|---|
| <p>The Beginning and Origins of the Project</p> <ul style="list-style-type: none"> • <i>“not really knowing quite what to expect”</i> • <i>“they wanted something that was intuitive to use and simple to put together so that you know you didn’t have to spend 5 minutes assembling it before you could actually put it on the patient”</i> • <i>found no “direct competitor really”</i> • <i>“allowing for all those bits of information that he gave”</i> • <i>“it started off pretty quickly but during the course since then it’s been the likes of the 18month ethics and waiting for that that’s really held things up.”</i> • <i>“those first meetings he gave us lots of good feedback”</i> • <i>“early on as we’ve said it was pretty well organized, I think NIC knew where they wanted to go which kind of direction and working with three or four design consultants they had the right structure in place”</i> • <i>“clearly you can’t be everywhere at once”</i> • <i>“In each instance it was great to have somebody actually controlling the project but there have been these instances where there hasn’t been anybody at the tiller within the NHS or steering the project. And in lots of ways we even when NIC CE came in, we were doing a certain amount of steering yes he was asking the questions how’s it going, but we’d have to say you know we’d like to show you this.”</i> | <ul style="list-style-type: none"> Origins/Drivers Market Research Collaborating Partners NIC NHS Relationship Flexibility Contacts NHS Change Clear Clinical Need |
| <p>The Current Situation</p> <ul style="list-style-type: none"> • <i>“We...made improvements in ... parts that were needed, parts that weren’t needed...so there’s been general improvements overall”</i> • <i>“go into a trial up in <an> ambulance service”</i> • <i>“a contract just to say this is what we’re responsible for this is what they’re responsible for”</i> • <i>“as a small company then we’ve got to make sure our insurance is right. I’m going to be the one putting my name on the CE marking certificate so I feel that’s a responsibility that we need to make sure that everything’s right with.....they’re <NHS and ambulance trust> obviously responsible for running the trialethical approval ...being on the right side of that and ticking all the right boxes is clearly very important....we’re not really the manufacturers we’re the designers and we will be assembling the first 150 units”.</i> • <i>“Professor I has put in a bid for continuing some of the requirements for the splint into the regional innovation fund” and some work between the paramedic and the mechanical engineer on linkages is desired but “has stalled”</i> • <i>“should have been a smooth transition”</i> • <i>“it could be seen as a bit of a postcode lottery”</i> • <i>“they should be able to put us in touch with whoever”</i> • <i>“the AHSN would be happy to organize help organize trials but not really necessarily pay for them”</i> | <ul style="list-style-type: none"> Politics Funding NHS Change Motivation./Motivators External environment Barriers Implications AHSN |

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|---|--|
| <ul style="list-style-type: none"> • <i>“In some ways after the show we could have said after the show right that’s it not doing anymore but because there’s nobody to drive it forward but the fact that we’ve got Prof. I on board, at least we’ve got good contact with and the Research and Innovation Department up at I Hospital are pretty good as well. But it still feels like we’re driving it forward yet it is an NHS project product. And that’s been the kind of frustration.”</i> • <i>“I think once 150 units are made then we can give them a bit more publicity and a bit more feedback on where we’re going”</i> • <i>“interest from people who’ve seen the video on our website from America and New Zealand”</i> | |
| <p>Barriers and Challenges, Successes and Progress</p> | |
| <ul style="list-style-type: none"> • <i>the ethics process for the trials approval took “the likes of the 18 month ethics and waiting for that that’s really held things up.”</i> • <i>“We hit a bit of a barrier when it came to the ethics really. We had ten splint prototypes ready to go into the pilot made for about getting on for two years before things could actually go into the trial. That was definitely the main one. I don’t think there’s been since apart from the NIC shutting which is kind of pretty final, then we’ve moved things on as best we can while that’s there’s been no driving force.”</i> • <i>“it still feels like we’re driving it forward yet it is an NHS project product. And that’s been the kind of frustration”</i> • <i>“Unfortunately it was more about what they couldn’t do for us rather than what they could do for us. It felt a bit negative....I did get an email just recently to say you should approach this person”</i> • <i>“you need that continuity and it’s not there”</i> • <i>“very keen that small businesses are paid interest on their late payments”</i> • <i>“I mean yea it’s only £2,500 but for a small company £2,500 could be a big indent on them.”</i> • <i>“they preferred our concepts for the splint over the others which we’re pretty pleased about given our size but not just the its only a few of us but it’s our novel way of thinking”</i> • <i>“getting the two projects the go ahead to take them both to the next stage of prototype over competitors that was a good feeling and knowing that actually that the thinking of 5 of us at the time was seen to be better than the thinking of a large company who employ 500.....good proposals...maybe some of our thinking was a little more creative”</i> | <p>NIC NHS Change Politics Motivation/Motivators Origins/Drivers Challenges Barriers Funding</p> |
| <p>Set Up and Structure of the Project Working Group</p> | |
| <ul style="list-style-type: none"> • <i>“<Interviewee 2 – consultant> in terms of the business side of things has certainly helped and how we you know the process of getting us potentially to production has definitely been aided by <Interviewee 2 – consultant>”</i> • <i>“Prof I he’s certainly put his helped us by putting his name to it and giving us lots of advice... he’s pretty responsive he’ll tell you what he wants”</i> • <i>“That’s the kind of feedback”</i> • <i>they “all work together...all presented them and all had our say”</i> | <p>Culture Team Work Team Boundedness Role Definition</p> |
| <p>Team Practices and Processes</p> | |
| <ul style="list-style-type: none"> • <i>“kind of a process but it’s not may be quite as regulated or procedural”</i> • <i>“have sufficient freedom”</i> • <i>“all had our say”</i> • <i>“a little bit more experience than the other guys”</i> • <i>“I don’t think I’m particularly dictatorial in what is done I know I maybe with a little bit more experience than the other guys and I can see the strengths and weaknesses of things maybe where they can’t. But it’s all about working together and I feel that</i> | <p>Creativity Culture Team Work Leadership Role Definition</p> |

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|---|--|
| <p><i>in a creative team you know you put people under pressure or dictate to them certain things they become less creative.... they know the parameters that we work within in, they know when our deadlines are for projects, and certainly along the way then the deadlines for the splint prototypes or whatever that was all met. I don't need to tell them that those deadlines need to be met. They know that.... I think I lead them but I don't think I necessarily lead them with an iron fist...I think they need that freedom."</i></p> <ul style="list-style-type: none"> • <i>"allowing that freedom allows bits of thinking that might be a little bit different"</i> • <i>"I suppose because we're fairly close knit we all get on pretty well"</i> • <i>"it's down to taking the brief looking back at the original requirements set up at that WIBGI event ...almost checking occasionally going back to that and saying is where we are actually fulfilling all of those requirements?"</i> • <i>brief was "pretty open"</i> • <i>"wanted to see it through and hopefully he still can"</i> • <i>"is thinking that it will benefit the NHS"</i> • <i>"learning curve"</i> | <p>Shared Objectives and Vision</p> |
| <p>The Future of the Project</p> | |
| <ul style="list-style-type: none"> • <i>"I'd probably keep the same Government....a change in Government has meant so many legislative changes and changes within the NHS that it's been a poor time to develop a product like that... how it can impact on something that a small company like ours working on something for a large establishment....If there could just be consistency that would be good"</i> • <i>"keeping the same team in place would have been much better as well....but I don't think that's had major impact on the project itself but the fact that those leading it, well Prof I has always been there it is rather disjointed because he is rather busy better things to do in many respects"</i> • <i>"Prof I and the feedback he's given and when in the early days we had that structure that was going in the right direction...I think if there'd been some continuity they could have continued to improve things that's been the frustrating thing really, The lack of continuity."</i> • <i>"look at a model for setting up another separate company to actually be responsible"</i> | <p>Politics Hindsight NHS Change AHSN</p> |

2.2.1 Commentary

IS is CEO of II, a design engineering company with 5 employees. II was approached by the NIC to become involved in the design of a splint and in his description of events, in particular recent changes that were required, some important information about the NHS led project emerges. The market research was guided previously by those that the NIC put II in touch with and as such they based the first design on second hand market research rather than observing how a patient with FNOF is dealt with first hand.

In terms of progress, IS suggests that there has been “general improvements overall” but there has been significant difficulties in driving the project through any faster. Although as an organization they are well informed and understand the political environment, and the NHS context itself. IS expresses that there has been extensive ethics processes to go through, that the NHS has demanded proper agreements to be put in place such as IS holding the CE marking certificate, and the insurance has had to be intricately managed. The legal and contractual responsibilities weigh heavily on IS, but he is aware that they need to be “ticking all the right boxes” in order to work with the NHS effectively. There was a clear distinction in the speed of progress made on the project between the 18 month long design process and the slower, feedback rich period of time occurring now.

This change in pace is mainly marked by the change in NIC management. The original NIC contact left and there was “no handover” to the new CEO. Having been funded by the NIC to further develop the winning design, IS expresses that it was “great to have somebody controlling the project” but there have been certain instances where “there hasn’t been anybody at the tiller...steering the project”. IS expresses that they have been the driving force to demonstrate changes and improvements, contacting the NIC first, and also suggests that due to the increased number of projects involved with the NIC when the new CEO was introduced time was stretched too much (“you can’t be everywhere at once”). As a legacy of the previous

NIC incumbents, II may therefore have had less introduction to the new team and not have felt as much of a priority as previously.

The recent closure of the NIC, has further sparked frustration regarding the involvement of the NIC and NHS. IS emphasised that this was an NHS led project originally, but that with the closure of the NIC there has been no one asking them to account for the funding previously given and no real help was set up. The AHSN was supposed to pick up from the NIC but there has not been a “smooth transition”, and IS believes the AHSN should be approaching them not the other way round. There is a feeling of trying to drive forward others when they have other roles and responsibilities themselves. IS believes there had been preparation from the NIC prior to the closure, but the AHSN has not been clear in their strategies, responsibilities or remits. Therefore this contradiction regarding even funding (“they tell us they’re not responsible for funding”), and the idea that the interest area the AHSN has, is a “postcode lottery” has caused apathy and discontent within II when considering working with the AHSNs. Instead they have doubled their efforts with Prof I, who has been part of the project since the design won the funding and is a part of a University Hospital Trust. They were expecting the AHSN to be able to put them in touch with anyone they needed to speak to.

Undoubtedly there is the feeling that II are driving all communication and interaction with the NHS, which is causing some conflict in the organization as it was originally an NHS led project. There have been many external challenges and the NIC change and eventual closure has provided the main barriers for the project. IS suggests that the creative thinking of the team was behind the biggest achievement and successes to date. It is clear that the team communicate between each other a lot, and IS articulates that it is a team effort.

There is a core team membership which is clear, and a periphery that is sought out for advice and support. There is ongoing feedback and communication between the core members, informing development through feedback and contextual research as Prof I “advises along the

way”. However, later on IS suggests that Prof I “he’ll tell you what he wants”, which doesn’t map onto true team membership and is perhaps due to his schedule and priorities as well as not being involved at the beginning of the project. He was brought into the project for his advice and gravitas, as an NHS “champion”. Those providing advice from the periphery are very much intrinsically motivated as they want to see an improvement in the current care pathway and are not being compensated for their involvement in the project. There is “sufficient freedom” for creativity and a team culture of psychological safety which helps with this. IS is conscious not to lead in a dictatorial style and chooses to manage in a way that maintains creativity and is not restrictive. There is a suggestion of reflexivity – the revisiting of the brief and original vision not only ensures that they stay on the original path but also that the shared vision is always in sight.

Overall IS states that the same incumbent Government and consistency in the way they were dealt with by the NHS would have improved the progress of the project. However, it can be inferred that the lack of true primary market research at the beginning of the project could have prevented the redesign being needed and engaging with all the potential users of the splint along a patient pathway (i.e. doing a ‘walk-through’) would have enabled the team to identify all issues that needed addressing early in the design phase. There appears to be many team processes and practices occurring and clear team identity, which IS is happy with.

2.3 Case II ~ Fracture Neck of Femur Splint (Interview 2 with SME Business Consultant working with II)

As in the previous interview analysis, this is the same product and project but this interview is with an external business consultant (IG) employed by II for their work with the NHS.

Table 9: IG Interview Quotations and Thematic Coding

| Quotations | Themes |
|--|---|
| The Beginning and Origins of the Project | |
| <ul style="list-style-type: none"> • <i>“other design houses and other people involved in supplying the NHS both internally and externally”</i> • <i>it was a really well- organized thing”</i> • <i>“they said this is what we want, I took those ideas and developed them..... we won that particular quote”.</i> • <i>“We looked at what was in the market at the moment...we tried to say well that looks good, let’s use that idea....being very sensitive to technology because of course if you’ve got MRI scanners.. X-Rays....So it’s an intuitive process”.</i> • <i>“who are the customers...who is the end user because it’s not always one person...the focus with the NHS is the patient ...and it’s not just the patient...you’ve also got to care about the people who work in the NHS and care for the patient because if you make their job easier the patient by default will have better care.”</i> • <i>“continuing clinical issue”</i> • <i>“weren’t involved in a say as to who should be involved on the clinical side but the interesting thing was that the clinical side omitted the nurses. So we were given the brief from the surgeons’ perspective, what was totally excluded was with the concept of keeping a splint on a patient right up to the operating theatre it was obvious that A&E needed to be involved in the nursing care but also the nurses on the wards needed to be involved with how would the product work within their regime.”</i> | <p>Market Research Origins/Drivers NHS Relationship Hindsight Clear Clinical Need Knowledge</p> |
| The Current Situation | |
| <ul style="list-style-type: none"> • <i>“Funding is the next challenge and also trying to get a project manager installed in the programme to make sure that all the facets of the project work together and that the clinical results are valid”</i> • <i>“process of how do you herd cats”</i> • <i>“We don’t have a project manager defined within the NHS who (a) has enough seniority and (b) enough time to take this on so that the various components to this project can try and work successfully.”</i> • <i>“how do we get people focussed?”</i> • <i>“The historic funding from the NIC is still in place ... both at the hospital trust and here so for this particular trial I think we have just about enough funds to be able to complete the trial...funding for the ambulance trust is problematic and he may not have enough funds for that I know he’s seeking funds at the moment”.</i> | <p>Funding Challenges NIC NHS Relationship Leadership Champions</p> |
| Barriers and Challenges, Successes and Progress | |
| <ul style="list-style-type: none"> • <i>“to try and get focus into the NHS for this project but because everybody is so either very very busy on the clinical side and also the amount of bureaucracy is within that they just because they don’t see things moving forward they lose their interest.”</i> • <i>“the collapse of the NIC with no real strategy from the Department of Health of how is that wish to exploit innovation from the NHS how is that going to continue...by not having the health science networks streamed in at the time that the NIC was collapsed then there’s been a massive void ...they’re allowing the 15 health</i> | <p>NIC NHS Relationship NHS Change Funding Progress</p> |

| | |
|---|--|
| <p><i>science networks to have their own strategy instead of a common strategy.... great intention but it's going to become another talking shop... the problem is the NHS bureaucracy and the structure of the NHS is so change resistant that actually people give up hope...I know I'm going to lose my market ...lack of common good will within the NHS".</i></p> <ul style="list-style-type: none"> • <i>"NIC the great thing was there was a central body with a central funding and now its disparate funding and it's a mess because there's no focus".</i> • <i>"void" that the NIC has left</i> • <i>"getting it on a patient" and "the senior consultants at hospital trust saying yes they felt that this was worth taking to a trial"</i> • <i>"despite the NHS, getting it on a patient".</i> | <p>External Environment Barriers Political and Business Dynamics Change Successes AHSN</p> |
| <p>Set Up and Structure of the Project Working Group</p> | |
| <ul style="list-style-type: none"> • <i>"champion" or expert</i> • <i>"Professor I has been the person who's continued the project and without him and without his seniority and his ability to be able to cut through the NHS wall"</i> • <i>"<NHS ethics> is brilliant. He's pragmatic, he's aware, he's brilliant with ethics but he understands all the issues within and cares about the issues within a hospital environment for all the clinicians not just the consultants. So he cares about the pathway how it affects A&E, how it affects nursing, he, so great guy"</i> • <i>"Professor I holds a great deal of respect...commands respect and uses fear extremely professionally."</i> • <i>"IS and IA in the way they design and worked with and thought through the process of what do we do and how we design because they're not clinicians so the way they've been how intuitive they've become by working with consultants who have very limited amount of time."</i> • <i>"Ambulance Trust was a major issue because they had major problems themselves, very political, very defensive, so very poor member of the team"</i> • <i>"added value"</i> • <i>"one project manager assigned"</i> • <i>"was an ex-nurse and she was very good"</i> • <i>"they understood the process... they could undercut the bureaucracy they could go and talk directly to a consultant because they knew the system"</i> • <i>the second trial will be "very difficult"</i> • <i>"arms length now" or displaying "no real interest"</i> | <p>Champions Expertise Knowledge Creativity Team Roles Boundedness NHS Relationship Collaborating Partners</p> |
| <p>Team Practices and Processes</p> | |
| <ul style="list-style-type: none"> • <i>"IA came up with the design and IS critiqued it and then we improve it and then we do it again and we refine it and refine it and refine it."</i> • <i>"listened" and the result is "simple and easy to use"</i> • <i>"II as a group of people, we've really driven it in so much that we just keep on. We keep on trying to get hold of Professor I to get a decision... when he's got time he makes decisions because he knows that there's somebody motivating him to do that. It's not that he's not interested he's just so busy".</i> • <i>"everybody's got the same focus"</i> | <p>Creativity Team Shared objectives and vision Psychological Safety</p> |

| | |
|---|---|
| <ul style="list-style-type: none"> • <i>“interactive, intuitive and always positive”</i> • <i>“take them out of their comfort design home”</i> • <i>“Confidence to know that any criticism is not personal but it’s actually meant to improve the product and therefore improve what the customer is trying to do”</i> | |
| <p>The Future of the Project</p> | |
| <ul style="list-style-type: none"> • <i>from “day one” after an “analysis of who needs to be involved”.</i> • <i>“find a project manager who’d take over the whole project and run it holistically but somebody who was as commercial as they were NHS”</i> • <i>“put a time on things so that this project will be at this timeline within a period and for that holistic team to know that they are responsible for doing that”</i> • <i>had “excellent processes” and that WIBGI events were excellent “because they were engaging people from all over the country”</i> • <i>“how to exploit the work done into other areas...this works absolutely into the government strategy of doing more care with the same budget”.</i> • <i>can’t really exploit other markets because that’s not our role”</i> • <i>“there is a worldwide market for this”.</i> • <i>“If we could get the NHS tick that this works then obviously we would want to exploit that...they would get an automatic lifetime royalty on everything we sold...there’s no doubt that we can produce that product and supply that product at a competitive price. But then if we have permission to sell that abroad I’ve got nothing to say at the moment that I have got to pay a royalty out.”</i> • <i>“developed a cleaning process using ultrasonics and a particular chemical which means that the product would be returned cleaner than if it would be cleaned in a hospital”</i> • <i>“win, win”</i> • <i>“continuing clinical issue with<in> the NHS which has not been solved”</i> | <p>Origins/Drivers Clear Clinical Need NHS Relationship</p> |

2.3.1 Commentary

IG works as a consultant on behalf of II in order to provide advice on the business side of operations, freeing II to focus on the design service they provide. IG has a more holistic perspective on the situation and has also previously worked alongside the NHS on several projects. During the interview it is clear that IG has a very clear understanding of the NHS and political environment, but it is peppered with extreme frustration associated with several experiences with projects with the NHS. He describes the project as a “process of how do you herd cats”. There are clear difficulties articulated regarding the primary roles of the NHS champions, with a quite self-centred viewpoint that they don’t “focus” on II’s project due to agenda and time. There are clear issues with the amount of time and resources available to the NHS champion Prof. I and IG articulates the need for a project manager from the NHS to manage the whole project.

There is mention of the creativity of II, although initially this reference occurred around the briefing only. However when a problem was identified on the splint, the redesign meant that they needed to be dynamic, flexible and creative in order to produce a more suitable prototype. However, again there is the inferred idea that there was restricted contextual and market research done on a primary basis at the outset of the project. IG attributes blame for this externally to the project (“we weren’t involved in a say as to who should be involved on the clinical side”). This expression of having no control, reinforces that the NHS were the driving force behind the project at the outset. There is also the expression of reluctance to use PRINCEII which is a standard operational tool within the public sector and in many project management programmes, this unwillingness suggests some rigidity and could be borne out of the origin concept not coming from II themselves.

Despite the extensive lead time, there remains a clinical need for the splint although IG is concerned he might lose his market. IG feels there has been a loss of interest from the NIC

and AHSNs due to the progress speed of the project more recently. The speed change he attributes to bureaucracy and how busy the individuals from the NHS who are involved are.

IG considers all of the barriers and challenges that the project has encountered as external, all lying outside of the remit of II and steeped in politics and change. He criticises the AHSNs as not being “streamed” at the same time as the NIC closure and also suggests that each have their “own strategy instead of a common strategy”. This is closely bound with frustration over lack of continuity, clarity and time lags. The key achievement IG identifies to be the first time that the splint was put on a patient – very much a practical goal. This difference from IS reflects IG’s position as a consultant as this is a tangible goal, while for IS the creativity and design process is a reflection of the thinking and the way he manages his employees. They are both proud of the external and practical validation that the design and prototype has received.

In terms of team processes, IG articulates a clear team boundary but does not include himself within the team. The shared vision of the team is concerned with the original brief. The communication and project is now completely driven and guided by II, which is an interesting twist given the origin of the concept itself. However, IG’s view of the II project focus could be seen to be drifting as other markets and a service based application are brought up in both interviews. The leadership and decision-making is clearly now in II’s hands, however the NHS champion is respected and the gravitas that his involvement brings is comprehended.

Again many external forces are discussed, regarding speed of change, politics, NHS change and influence of champions within the NHS. There is the idea raised of driver vs. decision-maker – i.e. who is driving the project and who has the final say. It seems that Professor I has the final say but that II are responsible for all the other aspects of running the project itself.

When questioned further about the team itself, IG views them as confident but that they must be open to criticism. There is some discrepancy between this and his earlier statements that lead to a sense of psychological safety within the team. IG reports the feeling that everyone is working together and that they work positively, interactively and intuitively. He sees his outside role as challenging them. He articulates that they all have the same focus and that they have courage to pursue creative ideas (indicating some level of psychological safety). IG suggests that prior experiences with the NHS has aided the team, however he expresses the feeling of being “stuck” in and “abandoned” by the NHS in a project they started in the first place.

2.4 Project HH ~ RFID Tracking Technology (Interview with Managing Director Ltd. Company)

Previously HH had engaged in projects with the aerospace industry and a leading soft drink manufacturer, and following a personal experience in a hospital the Managing Director [HD] realised that there were further applications for the approach. This was confirmed after consulting with the surgeons and sterilisation managers within two particular hospitals, these contacts had been developed through Medilink and through HD’s extensive network. Medilink also provided an introduction to academics at a local University working on a novel form of 3D printing which could harness a charged “identity” and hold related data – essentially a novel form of RFID (Radio Frequency Identification).

Effort was made to understand the NHS and clinically based issues better, and the technology has been positioned towards providing a solution for the associated requirements such as generating traceability for instruments used on patients with New Variant CJD for example, as well as ensuring that all instruments are accounted for before and after operations. However, it became apparent that due to the outsourcing of these sterilisation services, it was in fact another non-NHS company that would be purchasing the technology and integrating it into the service they provide for the NHS.

The decision was made to approach this company once more research and detail had been acquired. During the first meeting in 2013, the sterilisation company presented the issues that have affected all other RFID products they had seen and asked HH if they were able to solve these issues. HD's discussion of the meeting does not match up to the observations made, as many of the issues associated with other competitors were either not resolved or not considered at that point by HH. Instead HD puts a positive position forward which does not reflect the true state of the device and how it fulfils requirements, based on observations collected by the researcher. This is reflected in lack of prioritisation, and HD's lack of technical knowledge.

Table 10: HH Interview Quotations and Thematic Coding

| Quotations | Themes |
|--|---|
| The Beginning and Origins of the Project | |
| <ul style="list-style-type: none"> • “project started from a personal experience” • “it became apparent that although the sterilisation process was well controlled, in that instance run by a company called by <sterilisation company>, there were gaps very much so in that service”. • carried out a “Lean Survey” of the instrument and sterilisation procedure at the hospital • “eight areas in total, whereby we could, by introducing a system of monitoring the flow of instruments, we could actually in real time know where they were saving a tremendous amount of money... will make those jobs very effective” • “cutting edge technology that nobody else in the world has got at this point in time” • “<Sterilisation Co> ... they’re very keen to support this....we have something which they know would help them because they’re in it for their money mainly....they’ve been working on RFID for two to three years because, I have to say that was after we started, but basically they are trying to get something which will solve their problems. And they can’t find it. And they still can’t find it suitable, because the tags would have to be first of all very expensive and secondly fixed to the instrument which may change the handling of it. So they were very keen in terms of what we were doing in order to try to get new technology into being able to print a tag onto the thing. We were given three tasks. One was the durability of the tag, the second was the medical adhesion to the situation that if in fact it dropped off inside somebody it wouldn’t do them any damage so you had to ensure that that was the case. And the third one was the reading of the tag. We managed to resolve the first two to their satisfaction but we can’t satisfy the third.” | <p>Market Research Networking Contacts Origins/Drivers</p> |
| The Current Situation | |
| <ul style="list-style-type: none"> • “to now to do a research project” • “PhD on the second phase in order to incorporate that” explaining that “it has changed you see....things like this develop” • “30 centimetres was the reading distance because that’s what you would pass under a scanner. But I actually feel we need to do more than that” • “We’d, I’ve had support you see from people even the people in the procurement departments, the Head of the NHS, Head of Innovation they say all the right things but then when it comes to saying would you like to support us by financial it just dies a death.” • “at this stage of seeing what the impact funding would do and how far that would take us and then whether or not <sterilisation company> would be prepared to support us....I must say that if they’re not then I don’t know where we’d go” • “<decided to stick with> the medical route and to keep my powder dry on the other areas” • “we were ground breaking at that stage. We are no longer ground breaking, which I don’t mind because at least you feel you have sort of contributed towards the progress of getting better”. | <p>Current State Collaborating Partners Champions Market Research Funding Progress Challenges Barriers Successes External Environment</p> |
| Barriers and Challenges, Successes and Progress | |
| <ul style="list-style-type: none"> • “the inability for the NHS in this instance to adopt change and innovation.....they say all the right words but when it comes to the actual action there’s no appetite to change. Nobody gets a reward for doing it. It’s all about what’s in it for them in a way and | <p>NHS Change</p> |

| | |
|--|--|
| <p><i>that's not meant to be nasty but there's no point in somebody taking a risk in order to adopt a new system in the unknown because they get no plaudits for it. They don't get any accreditation</i></p> <ul style="list-style-type: none"> • <i>"the NHS ...was impossible because they're cutting things down. And it's a chicken and egg situation really, and we even put forward the fact that if they put money up front, we could amortise it across future orders. We tried to do some financial engineering but I don't think they fully understood"</i> • <i>"we were ready to go in the May 2010 when the election was, we'd lined up a Research and Development Grant of £80,000 but we had to let that go because we couldn't get in and do it".</i> • <i>"trying to break the practice within hospitals who really didn't like new technology"</i> • <i>"TSB Grants you need to match it with money so if you haven't got the money in the first place you can't get a TSB grant really"</i> • <i>"<sterilisation company> was our best bet on that because they operate in America"</i> • <i>"my enthusiasm really....what has driven it all the way through"</i> • <i>"people realise that I've put so much into it they are willing to go along with it and commit themselves also"</i> • <i>"they become disillusioned easier"</i> • <i>"others have got to feed their family"</i> • <i>"getting the concept, getting the principle there" and receiving support for this, "but then we needed finance in order then to put in a pilot plant or a pilot system"</i> | <p>Political Change Funding Change in the NHS Leadership Successes Interdependence Boundedness Barriers External Environment</p> |
| <p>Set Up and Structure of the Project Working Group</p> | |
| <ul style="list-style-type: none"> • <i>"I had already made many contacts through my business as a consultant"</i> • <i>"I have many contacts really, many within the Universities, Medilink"</i> • <i>"Medilink really and attending events and talking to groups of people....I think it is networking that is important because you are not only selling yourself or even selling the idea, you're trying to inspire people in order to come up on board and take that idea on board as their own really.... (Medilink Employee)..he agrees with everything I've said"</i> • <i>"Networking is important, first of all you can communicate what it is you are trying to do and secondly you can get people who say yes"</i> • <i>"support of the people within the NHS"</i> • <i>"They wanted too much too soon which we couldn't offer"</i> • <i>"The difficulty with the health service is they want to see the results before they pay the money."</i> • <i>"the ability to say "I'll take a punt on that, I'll take a you know 50,000 quid to make something on my line". But that's what we need within the NHS, and most of those people do not exist within the NHS."</i> • <i>"realised that what they had at that point in time was not right"</i> • <i>"H University have been most supportive because they see this as a flagship project because it involves all aspects of what they have been doing"</i> • <i>"<University Business Incubator> who was going to provide space for us...just a question then of financing it...But also they've paid for patents and IPR etc"</i> • <i>"the bed partners are very very complementary to one another"</i> | <p>Contacts Champions Collaborating Partners Change in the NHS Funding Barriers</p> |

| Team Practices and Processes | |
|--|---|
| <ul style="list-style-type: none"> • <i>“One of my strengths is I think I know what I can do, but more importantly I know what I can’t do. I am not a technical person, so I needed to bring in people on the technical side.”</i> • <i>“I think you have to be flexible in your approach.....to be honest with people I think that’s the key”</i> • <i>“The project driver I would say, yea, everybody leads in their own department. I think you have to give people that sort of that autonomy sometimes. That might sound counteractive to a team, but everybody within that team needs to have their own ability to do what they want to do. As long as they’re all working towards the common aim”</i> • <i>“I think that’s really the autonomy that’s wanted. If you’re going to drive people they need to be able to clear have a clear indication of what they want to do. Not what marketing people or other people tell them they want to do.”</i> • <i>“rely on what I’m told by people, for this system because I haven’t got a full understanding of the technology”</i> • <i>“being able to communicate what the end result is going to be, you’ve got to be all working towards the same aim.....every single one of those people I believe I think believe in what we are trying to achieve”</i> • <i>“they see the aims are realistic”</i> • <i>“own ability to write a business plan” “easily to be able ... to communicate my own thoughts” “benefits to other people not to you”</i> • <i>“because everybody’s got a different viewpointcommunicating those across <so> that we then have a similar direction”</i> • <i>“I think to communicate that across...not to promise them anything that they I couldn’t deliver or felt that they couldn’t deliver”</i> • <i>“Come a time that you can’t continue to work if you haven’t got a goal. At the moment we’ve got a goal, if that was to disappear then yes it would probably die.”</i> • <i>“obviously we have a debrief....because everybody’s got a different viewpoint about actually how the meeting went”</i> • <i>“own the project really” “Even those on the side lines”</i> • <i>“they see that also, that I’m also working for nothing”</i> • <i>“I am not asking them to do anything that I wouldn’t do myself” “have this ability to be self-employed” “make a real contribution”</i> • <i>enthusiasm get “less and less” “I’m still keen because the people are keen”</i> • <i>“One of the things now is I don’t want to let people down who have taken it this far.”</i> | <p>Shared Objectives and Vision Communication Leadership Team Motivation (reducing) Role Definition Successes Reflexivity Trust</p> |
| The Future of the Project | |
| <ul style="list-style-type: none"> • <i>“not to do it, unfortunately....it’s been a long task, it’s been very interesting”</i> • <i>“thoroughly enjoyable. I’ve met some wonderful people”</i> • <i>“Then comes along somebody that actually said well yea I think we could use that! So that’s been good.”</i> • <i>“I would have gone straight to the hub of things....get the technology up to speed quicker”</i> • <i>“we were making sure that we had 100% watertight situationI perhaps ought to have, rather than being a perfectionist as I am, to have gone forward with the less and perhaps even got support for that.”</i> • <i>“I don’t see it as a waste of money because of what the returns it has given me personally in that sort of aspect”</i> • <i>“got to have a meeting at the beginning of January” in order to discuss their “application for impact funding”</i> • <i>“champions within the hospital”</i> • <i>“So keep the original dream alive”.</i> • <i>“<sterilisation company> need to come on board”</i> | <p>Hindsight Contacts Champions Funding</p> |

In fact these issues had still not been tested by HH even by the stage of the interview, the Tag and adhesion had not been tested in any of the heat based sterilisation processes, in order to ensure it would be resilient, and the attachment of the tag had not yet been developed. During the 2013 meeting, HH were not able to tell the sterilisation company how much data could be stored on the tag, demonstrating the limited extent of technical development that had occurred by that stage.

Following the 2013 meeting, and HD's identification that reading the tags needed more work, the project took a step back and was put back into an academic project as development was still required. This betrayed some disconnection between the pace at which HH was developing the product and the pace at which both larger competitors were moving, and that the sterilisation company needed to move at. HD has an ideal he wants to achieve but this may result in missing the opportunity and being beaten to it by competitors. Bearing in mind HD has great pride in the technology being pioneering, the project is in danger of becoming outdated, particularly going back into developmental phases at this stage.

The project has been largely funded by the University and personally by HD, although HD states the project has received positive support and feedback they have been unable to secure NHS funding. This may reflect the fact the sterilisation company would be the purchasers, and demonstrates the impact that focussing on the end user at the outset of the project has and is having throughout. The funds are now dwindling and this is also affecting the pace of the project and the USP of the product. Instead of investigating the many applications of the technology in the healthcare environment, HD has instead decided to focus on one application. These narrow business decisions are reducing the overall vision and objective for the team, as what started as a "ground breaking" and potential exciting project is much slower.

The key challenges that had been experienced during the project to date are essentially attributed to the external environment. These barriers can be categorised into being related to

the NHS and related to funding availability. Seeking involvement from the NHS has been viewed as difficult due to associated NHS change problems. There is a view that the NHS is impenetrable and that better systems need to be put into place within the NHS in order to support projects such as this one. It is evident that the project had approached some of the NHS bodies set up to support these projects, and that funding had been a priority in the past. They had sought funding from the NHS and had managed to secure some funding which then fell through. It is clear for this project in particular funding has been a real issue. This could be due to a number of situational factors such as impending NHS change resulting in funding being scarce, but could also be due to HH not presenting an appropriate case to the funding body in order to secure support (either due to an insufficiently convincing project, product, team or proposal). However the failure was actually attributed by HD as due to difficulty in changing practice in the NHS.

Other financial sources had been explored, but low reserves of capital in HH had affected these applications, and political change had affected the availability of funds at a time of uncertainty. Funding was a large barrier for this project as this not only prevented development of the product in the UK but was required in order to pursue larger and more lucrative overseas markets such as America.

While barriers and challenges were seen to be due to external forces, HD attributed success and progress points to internal sources. As the MD of HH and the manager of the project, HD states his motivation, hard-work and enthusiasm has kept the project moving forward. HD alludes to his hard-work being the reason others work for him, but motivation in the other team members is viewed to be easily lost. This suggests that HD believes himself to be leading the team by example, motivating and inspiring the team but that they need his positivity in order to keep going. This motivational driving and leading of the project and team suggests coincides with some other comments regarding leadership of the team.

The arrangement of the industry and business based expertise as well as software engineering from the HH and the technical and engineering knowledge from H University has meant that the relationship has therefore been mutually beneficial.

The leadership or project management of the team is mainly from HD. This is tightly bound by role definition within the project team. HD states that he is aware of his limitations and acknowledges that due to limited understanding of the technology he leaves the team to work. He is happy to delegate and role assign but these quotations give a sense that there is a large power and knowledge distance between him and those with technological ability. This could put HD at a disadvantage in terms of truly understanding whether progress is occurring at a satisfactory pace. It also implies that HD has no desire to learn more about what the others in the team do and it seems a ‘hands-off’ approach to project management but also demonstrates a large amount of trust in the team.

Communication and vision are two themes that emerge and sit closely with one another. HD puts much of the communicative effectiveness down to his own style, but communication is clearly paramount in understanding the value of others’ perspectives and opinions. Moreover, as a leader and a communicator looking to gain buy-in from the team, HD is conscious to deliver on promises again signifying the emphasis on trust and creating a shared vision and direction and making sure that goals are achievable and realistic. Moreover, there is evidence that reflexivity is considered to be a common practice in the team. HD values honesty, again an indication that a high level of trust is present in the project.

HD believes that the team motivation is his sole responsibility. However, it is clear that the team has been formed and selected for the value and what they can add to the team. There is respect of each individual’s knowledge and contribution, and they enjoy the feeling that working on the project can give them, namely to “have this ability to be self-employed” and the opportunity to “make a real contribution”. These are more likely to be intrinsically motivating

factors for the whole team, but certainly an enthusiastic leader that is able to motivate will also add to this. In reality it is testament to the levels of motivation that all of the individuals are still working on the project some 5 years on.

2.4.1 Commentary:

There was a clear understanding of the problems underlying the immediate requirement around surgical instruments but there was limited understanding of the practical implications of attaching an “RFID tag” to surgical instruments, such as size, method of adhesions, size of encoding string, durability through operation and sterilisation procedures as well as distance for reading the RFID tag itself. As such the project was based in a solid concept, but had limited true first-hand understanding of the realities of applying the technology to the healthcare setting.

The sterilisation company was approached in early 2013. The researcher was present in this meeting and no product prototype was presented. The sterilisation company listed many of the concerns above, and suggested that HH work on these issues and return to them when this was resolved. Little progress has since been made on the product since that meeting and the concept and technology are still very much in the development and conceptualisation phases.

Networking was a key theme in the interview. HD repeatedly stated that all the contacts approached had viewed it very positively. However, given the observations within the meeting and the lack of funding received, there has been positive support sought from these contacts. Indeed, HH are still very much at the market research phase with no sense of real urgency. That said, HD articulates that they had come up against a lot of barriers such as trying to “break practice within hospitals who really didn’t like new technology”.

Leadership also emerged as a strong theme in the course of the interview, and HD’s enthusiastic leadership is attributed to team cohesion. This resulted in him bringing team members on board based on their value and potential contribution but there is a large power

distance, extremely defined roles and the hands-off nature of his project management style which may not have such a positive influence on the project outcomes. He states several times that he does not understand what the others do and during meetings attended by the researcher has engaged in very limited technical discussions with the rest of the team. The leadership or “co-ordination” is rather disorganized and everyone heads their own section of the project – with others having other responsibilities in their full-time roles for example in the University.

The meetings and communications are extremely formal and disorganized, relying on when everyone is next available. Emails seem to occur regularly but act as updates after long periods of no communication rather than forums for idea sharing, perhaps due to defined roles not overlapping with each other. There are no reviews back to the vision and goals during communications and therefore limited reflexivity, and as such observations contradict the reported team processes from the interview. However, the end goal is kept in sight. At the end of meetings there are no agreed outcomes and action points and the structure of the meeting is disorganized. The suggestion that the other members of the team are motivated by how much he has put into the project is slightly naïve and suggests poor understanding of motivation of employees particularly as he sees that some become disillusioned.

The concept itself and its application have been creative and the technology it utilises is highly innovative. However this initial creativity appears to have become inflexible and market research and detailed contextual research since has therefore slowed down the progression of the project while solutions are investigated. There is no-one on the team that is a specialist in some of the changes and technologies that will be required as the prototyping stage comes closer. It appears that by allowing the individual experts to get on with their own jobs and not reviewing overall progress back to the original and recent timelines and visions, each individual has become responsible for individual creativity and knowledge appears to hold higher value.

As such, psychological safety is not built into the team and although HD articulates that they are a “team” there is little evidence to show they are all working interdependently.

There is some mention of champions of the project, some individuals that HD believes are part of the team who have very limited input on the progress of the project (he included the researcher for example). It is clear that there is difficulty in finding a true common ground in the face of these many conflicting agendas and schedules. It is questionable that neither funding nor input from the sterilisation company were sought earlier, as it appears that little real progress has been made since the beginning of the project. HD suggested that these inputs were not previously desired as they wanted to get the product into a “100% watertight situation” before approaching the potential buyers, however as this has not been achieved, this early stance has changed.

2.5 Project LL ~ Psychological Support Site (Interview 1 with LL NHS Relationship Development Manager)

LL Site is the concept of the CEO of LL and it was set up as an online support network for mental health. It is described by LN as “an online community of people who supported each other”. Users were happy with the support they received and asked for additional professional input. One of the “Wall Guides” was training at a hospital trust at the time, and suggested that LL engage with them. A meeting was arranged with Chief executive of the hospital who was insightful regarding mental healthcare. There is a mutually beneficial relationship expressed extensively by LN and a clear clinical need from the NHS to both improve the model of mental healthcare and increase the online presence of support available. LN expresses that the NHS would never have come up with this format and would also have taken a protracted period of time to develop this. At the same time, LL needed to respond to user demand and also required governance that the NHS trust could lend to the platform.

This kind of “safe and well-governed” management of individuals in risk was not easy to do without the guidance and backing of an NHS trust, both in clinical provision and governance and regulation. Moreover, the partnership lends weight to LL when on the site there is a banner saying “In partnership with” the hospital, aiding with marketing a trustworthy brand. A joint venture was set up featuring a formal agreement, setting out expectations and responsibilities from both sides.

LL engaged also with the NIC, who funded the development of the ‘product’ and presented the company at several showcase events. However this relationship was not close or collaborative in terms of actually developing the platform, and not discussed in the interviews.

Table 11: LN Interview Quotations and Thematic Coding

| Quotations | Themes |
|--|--|
| The Beginning and Origins of the Project | |
| <ul style="list-style-type: none"> • <i>“an online community of people who supported each other”</i> • <i>“LLGuides”</i> • <i>“very forward looking for a consultant psychiatrist”.</i> • <i>“He understood and he understands that our current model for delivering mental health services is really a mental illness model and it’s about treating people when they get poorly.”</i> • <i>“He wanted the hospital trust to have more of an online presence, more of a digital presence. He knew that in the NHS that kind of thing takes forever...would never create this”.</i> • <i>“In partnership with the <hospital name>”</i> • <i>“mutually beneficial”</i> | NHS Relationship Origins/Drivers Collaborating Partners Interdependence Relationship |
| The Current Situation | |
| <ul style="list-style-type: none"> • <i>“it has changed for very legitimate reasons”</i> | Change NHS Relationship |
| Barriers and Challenges, Successes and Progress | |
| <ul style="list-style-type: none"> • <i>“lots of small things”</i> • <i>“if the communication is good you get over them”</i> • <i>“The language that’s used around different ways of accounting and around expectation”</i> • <i>“I find it fascinating how two organizations with such different cultures and people with different outlooks and pressures on them can come together and work together on a day to day basis and genuinely how constructive...How frustrating and difficult it can be on a day to day basis in terms of the friction and the pressures because the drivers are different but actually how constructive it is”</i> • <i>“as a small organization if cash flow is an issue we need to have an upfront conversation about that”</i> • <i>“upfront conversations”</i> | Communication Barriers Challenges Culture Flexibility Funding |
| Set Up and Structure of the Project Working Group | |
| <ul style="list-style-type: none"> • <i>“it’s a combination of who was available but also who was willing”</i> • <i>joint trip to Australia and New Zealand, which was considered “very constructive”</i> • <i>“informal”</i> | Team Members Leadership Communication Relationship |
| Team Practices and Processes | |
| <ul style="list-style-type: none"> • <i>“the language used in the NHS is very different from the language used in the independent sector you know right through to finances”</i> | Team |

| | |
|---|--|
| <ul style="list-style-type: none"> • <i>“the way any issues get resolved and any relationships get built between people working in very different environments”.</i> • <i>“communicating at all levels but in an informal way as well as just through structured monthly meetings”</i> • <i>“making the effort to make sure those sorts of relationships happen”</i> • <i>“if you’re in different buildings and your only contact with people is through formal meetings yea you miss out”</i> • <i>“there’s a lot that gets done in an organization around the water cooler just having a conversation”</i> • <i>have “tough conversations” and being “really honest”</i> • <i>“very interesting for all involved in that I think working with LL outside of the NHS there was probably a sense of frustration at times at how quickly we wanted to move with things, so the pace is very different”</i> • <i>“frustration about the consultant psychiatrist or the governance lead putting the brakes on a bit and saying well no ... we actually this is going to take a few weeks to put this in place but we need this”</i> • <i>“can be frustrating ... each is good for the other”</i> • <i>describes “renewing and constantly revisiting expectations and explicitly stating them”</i> • <i>“I guess kind of reappraisal of why you’re doing what you’re doing and is this still working.... it has changed for very legitimate reasons but let’s talk about where our expectation of that is now”</i> • <i>“why we’re in this partnership and a sense of keeping the bigger picture and really believing that together we can create something that apart we can’t”</i> • <i>“especially for a small organization like LL it’s finding the time”</i> • <i>“LJ is very much a forceful leader.... is somebody who thinks differently and is quite disruptive in her approach....how people want to use it rather than how the NHS tends to think more about it services...”</i> • <i>“without somebody like LJ creating it who just has a sense of let’s just go do and then kind of mop up anything that needs mopping up afterwards”</i> • <i>“I guess that LL was the one that created the vision for what this service is LL is the one that is marketing that, selling that, winning contracts, therefore getting revenue in. What the hospital trust I guess what they did is helped with the quality of the product if you like and make it a robust service that was well governed well managed and therefore could be sold if you like.”</i> • <i>“beneficial to both parties”</i> • <i>“when you add them together what you get is so much greater than just the sum of those individual parts”.</i> • <i>“can be frustrating but each is good for the other”.</i> | <p>Shared Vision and Objectives Communication Relationship Leadership Boundedness Reflexivity Change</p> |
| <p>The Future of the Project</p> | |
| <ul style="list-style-type: none"> • <i>“it has changed for very legitimate reasons”</i> | <p>Change Relationship</p> |

2.5.1 Commentary

There was buy-in from the NHS champion and the type of person and his agenda worked well at the time LL approached the trust. Additionally LL was already established and demonstrated their success and approach, demonstrating the value and need for the product. LL is the driver and LJ is a “forceful leader” and this is all the reason that the project has been driven forward at such speed. There was some funding provided by the NIC but this involvement was very minimal beyond this. LN attributes the success of the project to the fact the proposal to the hospital was mutually beneficial and the importance of articulating these mutual benefits i.e. “what’s in it for both parties”. In describing the driver behind the success of the partnership LN states “why we’re in this partnership and a sense of keeping the bigger picture and really believing that together we can create something that apart we can’t”. Clearly, this is a key feature; the idea of referring back to the bigger picture and reinforcing the mutually beneficial reasons for the partnership to exist in the first place.

In addition, it is an interesting point that the two leaders from the two organizations developed an excellent relationship by attending an important meeting in New Zealand together, thus building a very strong bond and ensuring that this relationship goes beyond formal levels. This is an approach that has trickled down the rest of the project team, as LN has also chosen to travel to meetings with a representative from the other organization and arranged to have dinner afterwards, purposefully to develop a more full working relationship. LN articulates that this makes up for the “water cooler” conversations that are missing when individuals do not work in the same building and only attend meetings occasionally together. This sense of ensuring that informal communication is engaged in is taken for granted within the organizational boundary but inherently is lost when working across organizational boundaries.

LN takes this idea one step further suggesting that it is only during these informal discussions that you can really get to understand the language of the other organization, in order to communicate more effectively and on a similar level of understanding of what the other means in the formal meetings. LN believes that the “way any issues get resolved and any relationships get built between people working in very different environments is the more informal stuff”. The “language used in the NHS is very different...right through to finances”.

LN demonstrates clear respect for the leader and the leadership style used, and marks LL prior to the partnership as already successful. She does acknowledge that sometimes LJ needs to hold back a bit and that she had to accept that LL needed some input from elsewhere. However, there is acceptance that the NHS involvement was important for Governance and clinical guidance. The prestige of “in partnership with the <hospital trust>” is also seen as important from a marketing perspective.

There were clear boundaries and involvement established formally through a legal joint venture agreement, ensuring that expected deliverables were articulated. There is a clear sense of boundedness articulated and formalised.

Organizational culture was a salient topic within which, pace and communication differences were most obvious. There was often a sense of frustration with the difference in pace between LL and the hospital trust, however LN states this could have been mutually frustrating and also accepts that sometimes “we need this”. LN states “each is good for the other” which reflects much of the collaboration and team definitions. Additionally there is a clear sense of reflexivity, having “upfront” conversations about the expectations that have and have not yet been delivered, reviewing the agreements made and revisiting the vision regularly. The idea of explicitly stating the expectations in the agreement and then the difficulty of finding time to revisit these at appropriate times is a challenge but one that she feels has been key to the success of the joint venture.

Additionally, LN identifies the flexibility, honesty and ability to communicate at all different levels as most important for the success of the project. The difficulties have been resolving inherent cultural differences, but that acknowledging that the “sum of the parts being greater than the individual parts” not only reflect the definition of a team but also demonstrates that the partnership has been highly mutually beneficial.

2.6 Project LL ~ Psychological Support Site (Interview 2 with Newly Appointed Change Manager)

LS joined the team 8 months ago as a change agent to assess, agree and implement the change of relationship and dissolve the partnership between LL Site and Hospital Trust.

Table 12: LS Interview Quotations and Thematic Coding

| Quotations | Themes |
|---|--|
| The Beginning and Origins of the Project | |
| <ul style="list-style-type: none"> • <i>“mindful of the fact that there was this relationship or joint venture with the <hospital trust> and that they’d been very involved .. near the beginning <of> the development of LL”</i> • <i>“what they brought to the party really was very much around the clinical governance structure and policies and procedures ...they had a list of things really that they’d signed up to if you like with regards to the joint venture”</i> • <i>“agreement ...responsible effectively for the clinical risk side of things providing supervision for the clinical team in this business”</i> • <i>“we were part of the trust in this joint venture agreement, we automatically had CQC registration as well as a business...gave that rubber stamp and that credibility”</i> • <i>“the joint venture agreement was kind of coming up for renewal really because it was coming towards the end of its three years...what would be the shape of that agreement going forward”</i> | <p>Communication NHS Relationship Origins/Drivers Shared Objectives and Vision Interdependence</p> |
| The Current Situation | |
| <ul style="list-style-type: none"> • <i>“two partners were going in quite different directions”</i> • <i>“LL as business being quite dynamic, quite a digital quite dynamic and fast paced was definitely looking at being quite ambitious in its growth”</i> • <i>“as being a potential area for growth”</i> • <i>“really looking at whether LL now was ready to kind of stand on its own two feet from a clinical point of view”.</i> • <i>“structure so our own clinical team with our own clinical lead”</i> • <i>“We are independent now effectively...all part of the transition that we agreed...they were very engaged with that process so they did things like we worked on the job description together and we went through the recruitment process together...work streams in order to transition us out of the <hospital trust>....whether we were ready to have our own internal clinical structure and whether we would be robust enough”.</i> • <i>“can be quite delicate and quite sensitive”</i> • <i>“worked in conjunction with key people at the <hospital trust> so I kind of drafted a plan and we then had a meeting with them and the key stakeholders from their side were kind of approved of the plan we all agreed what actions needed to be taken who would take those actions”</i> | <p>Communication NHS Relationship Flexibility Challenges</p> |
| Barriers and Challenges, Successes and Progress | |
| <ul style="list-style-type: none"> • <i>“risk averse”</i> • <i>“Risk is important but you can over engineer risk”</i> • <i>“completely two different cultures....these kinds of environments where you have lots of clinicians and they’re quite traditional even in private healthcare...quite challenging”</i> | <p>Communication NHS Relationship</p> |

| | |
|--|---|
| <ul style="list-style-type: none"> • <i>“(in LL) the decision making’s a lot quicker and more down to you really...don’t have as many stakeholders...not necessarily working to this great big master plan so it’s more dynamic, it’s quicker, more immediate which is good....”</i> • <i>“joint, very supportive move”.</i> | |
| <p>Set Up and Structure of the Project Working Group</p> | |
| <ul style="list-style-type: none"> • <i>“<clinical lead of hospital trust> used to spend quite a lot of time on site here....When I came in that wasn’t the case...a lot of our communication was through conference call and email”</i> | <p>Communication Change</p> |
| <p>Team Practices and Processes</p> | |
| <ul style="list-style-type: none"> • <i>“realistic”</i> • <i>“there was a lot of input from the <hospital trust> at the beginning of the relationship with LL and probably that was needed....There was a lot of interaction in the beginning with things like supervision”</i> • <i>“more down to you really”.</i> • <i>“felt really comfortable with me because I could go in and demonstrate that actually I can do this stuff and it’s low risk ... Giving that sort of level of detail and understanding so it’s bringing people on side including your clinicians who are risk averse quite often”</i> | <p>Communication Shared Objectives and Vision</p> |
| <p>The Future of the Project</p> | |
| <ul style="list-style-type: none"> • <i>“interdependent actually on the transition”</i> • <i>“mindful of ... the <hospital trust’s> reputation as well as our reputation”</i> • <i>“formally they’re not our joint venture partner anymore they will always be associated with LL... we need to protect the brand...we’ve left on good terms...a good change...very amicable...still have a connection”</i> • <i>“joint, very supportive move”</i> | <p>Interdependence NHS Relationship</p> |

2.6.1 Commentary

LS had a clear sense that at the beginning of the partnership the collaboration was mutually beneficial, but that it was becoming less so. In order to begin the transition, LS met with the whole team and asked them to articulate their expectations, and agree on a plan of action and who took responsibility for each different section of the plan. Mainly, LL were to seek their own CQC Registration and the hospital trust were going to help with this process in order to provide credibility to LL for the “rubber stamp” to be approved. The evolving relationship is clearly centred on the idea of articulating expectations and how to form the “shape of that agreement going forwards”. There is still clearly a mutual approach to working together despite the changeover being imminent, and the transition was supportive as the partnership has been outgrown as part of the progress and evolution of the project and its success.

LS has not been heavily involved in the team during the period of time that they were really working alongside each other, however she states that there are clear lines of communication established and a culture of regularly updating, as well as setting deadlines for deliverables that are achievable and realistic. In addition, she articulates that regular reviews are carried out and that plans are flexible, allowing for reflexivity even at this closure phase.

The fact that it was acceptable to identify that there was an evolution happening in the needs that each other could fulfil in the partnership demonstrates the open lines of communication, although there is some evidence that the presence of NHS individuals reduced.

LS had previously worked in a larger private sector organization’s change agency, and found that in a smaller company decision making is quicker and there are not as many stakeholders to gain the buy-in of; “it’s more dynamic, it’s quicker, more immediate which is good”. This when compared to LN’s discussion of pace within the NHS signifies a clear shift in where decision making lies.

Organizational culture was still an issue despite the difference in experiences of the time of the project. LS considers the NHS to be risk-averse and very traditional, which seems to have become even more pronounced over time. However LS is attempting to make changes and has identified that she requires detailed knowledge and understanding of their needs in order to appeal to the hospital trust when presenting plans about the changeover. She is conscious of preserving awareness and the reputation of the trust as well as the gravitas they are still able to provide to LL. She suggests there will always be some connection and that the partnership has ended on good terms; “it was a good leave, a good change”.

The two interviews give snapshots of the project at different times, with LN being able to give insights from the beginning of the partnership and LS being able to provide insight on the closing stages of the partnership. It is clear that the partnership has been mutually beneficial, with the NHS obtaining the online presence and approach to mental health care provision they were seeking and in turn providing LL with the Governance, training and appropriate registration they required to function more professionally.

The culture difference between the organizations has been articulated by both interviewees. The NHS is reported to be slow, risk-averse and traditional – often deferring decision making for long periods of time. While this has been frustrating for LL, it has also been recognised as what was needed in order to ensure that delicate situations were handled correctly.

Other themes emerging from the two interviews include communication. Both appear to engage with the NHS in a way that recognises how they prefer to work and acknowledges what the NHS members need to hear in order to be persuaded or engaged. LN distinguishes between informal and formal styles of communication while LS prepares for interactions by anticipating the risk-averse nature of their questions. This not only demonstrates a requirement

for LL to be able to communicate effectively across the organizational boundaries but also to have some clear understanding of the organizational culture and context of the NHS.

An enthusiastic and inspired leader and the concepts supporting team work are also themes emerging from LN's interview. Both interviews also add to the theme of having a strong NHS based champion who believes in the clinical need and the product or technology providing a solution.

3. Cross-Project Comparison

In this section the key themes that emerged and were coded across the interview analysis will be summarised. In the tables in the beginning of this chapter, key quotations from each of the interviews are arranged according to the structural themes questioned within the interview and those which emerged from repeated and iterative coding (Strauss & Corbin, 1998 cited in Kotlarsky, van Fenema & Willcocks, 2008). Some codes were probed and A Priori, while others emerged as the data was repeatedly reviewed.

Some of the themes only occurred in a single interview; however the interest in this section is how these emerging themes compare across the interviews. In Table 13 a breakdown of the frequency at which themes emerged across more than one of the case study interviews can be found. Table 13 contains themes arranged around four common anchors: Environmental Context and Impact, Antecedent and Configuration context, Team Processes and Behaviours, Self-Evaluation. These are the groupings that will be utilised to discuss the commonalities between the interviews.

3.1 Environmental Context and Impact

Close attention has been paid to the effect that the external environment has had on these projects. There has been some effect of the changing political landscape on three of these

projects. Some even attribute better progress being made if the incumbent party had not changed. The political landscape has had a clear impact on these projects, this could be due to a range of reasons which will be explored in more detail within this chapter and the following discussion of findings and conclusion chapters.

Changes in NHS and Government strategy have seen the projects benefit from available NHS funding and this has led to heavy involvement in some cases with the NHS and NIC. The three projects that received funding from the NIC are all very different in terms of how this arrangement was managed. Case LL saw this as a purely financial relationship, Case KK found the funding and direction available extremely useful at a time of great need, while Case II only entered into the project as a result of it being set up by NIC and being invited to participate. Each of these original experiences with NIC has led to different experiences when NIC closed down.

The NHS restructure, regardless of which project, has had an impact on both available funding and available resources – finding the right person to talk to is even more difficult now. There is a perception that the already impenetrable NHS is even more so now and that there is a regional basis for whether the AHSNs are able to take on projects. Instead of a true network, referring projects between each other for the best advice, there are 15 bodies setting their own strategies and remits and preferences.

The change in NHS structure has had an effect on the two projects that were more involved with the NIC, here it is clear that the fact the NIC originated the project for one has had an extensive impact on the project and that the SME has been forced to take the lead on the project where previously that was not why they became involved. There have also been some loose ends left for each project, funding left as a legacy from the NIC has yet to be delivered as originally allocated and ownership of patents and products is now extremely unclear.

The inertia within the NHS has also caused intense confusion for the projects, as with small companies many have expressed that finances are difficult for protracted periods of time, particularly when there is no return on payments that are outgoing. The associated frustration of never being able to reach the right person, or having jumped through the correct administrative and bureaucratic hoop, only to still have to await more movement from another individual mounts throughout the project. This has added to the frustration felt by HH, KK and II. There is a common theme regarding the speed of projects within the NHS and to some extent academia, and the speed at which those from industry are used to working. This may be due to different agendas and priorities such as securing budget vs. securing an open gap in the market to profit from.

3.2 Antecedent and Configuration context

Where the original idea emerged from is interesting to examine against the driving force of the project. In II, the driving force has shifted from the originator of the project (NIC) since its closure and so now II⁶ are driving the whole project. Evident during the interview was a sense of duty and of being stuck with a project over which they have no control. KK originated from an inspirational expert in the field, through a University based start-up project. The NIC involvement was sought at a time where finances meant the company was about to fold. However the inspirational and highly innovative source has been a force that has driven the company to pursue the project further, without the direct help of the NIC since it has closed. There was not as much reliance in this project on the NIC, and even to a lesser extent for LL. HH however, appears to be completely driven by the MD. He has seen an opportunity for application of a technology developed within a University and approached them to become involved in a joint venture. This has meant he has invested a large amount of time and money

⁶ HH – RFID Tracking, II – Splint, KK – Ultrasound Device, LL – Online psychological support

in the project and it could be argued is no longer viewing the project objectively in terms of whether it is viable.

The original idea it seems must be held with the originating organization, is important to come from an inspirational expert and must be a widely applicable concept that has great value for fulfilling a clinical need of the NHS in order to promote the project's performance from the outset. The impact of these not being fulfilled can be that the collaborating organization must take over from a previously NHS run project, that an idea is not immediately clinically applicable or is not sophisticated and based in expertise and knowledge. This results in low levels of support and drive to propel the project forwards.

In two of the projects, so many resources had been put into progressing the project, the objectivity from a business perspective had been lost over time. The ability to view the project with objectivity is closely linked to a number of other variables:

1. Leadership – there are some very clear examples of charismatic leadership in three of these projects i.e. the idea that people want to work hard for someone because of the type of person they are. In II, it is not really clear who the leader really is and if IS, he is not autonomous as IG sees himself as a mentor. There are many instances where the individual identified as 'leader' or 'co-ordinator' demonstrates that he trusts his team with the tasks that they have to do and is confident in their ability and motivation to carry them out. This trust and freedom appears to work well for KK and LL, however this is not the case for HH as each individual within the University and wider project has so many other priorities associated with their other roles, it is very difficult to get them all to find time to meet. This may be related to their having other, paid jobs. Leaders tend to take the role of 'internal' champion, ensuring that through good leadership performance and morale is boosted.

In doing so, there are impacts such as dealing with the frustrations previously highlighted in the cases and maintaining motivation and enthusiasm.

2. Champions – a key theme in much of the discussions, champions work alongside the leader within the other organization to garner support, promote enthusiasm, as well as being a point of advice and contact to the project team. The involvement of a champion was found in LL and II – although it could be said that the NIC were the champion for KK.

The NHS and healthcare champions help to reinforce the impact that addressing the clinical need through the product they are designing could have on patient care and the care provided by practitioners. In addition, as many of the cases have illustrated, during a time of NHS structural change and uncertainty these champions were a presence within the NHS that were supporting their work and project. This will have given a stable figurehead and motivation to the project to continue work whilst waiting for the NHS change to embed.

3. Entrepreneurship – Many of these projects were born out of enthusiastic, entrepreneurial ideas (with the exception of II) and this seems to work well in generating support and maintaining the motivation to continue despite difficulties and barriers during the course of the project. The excitement of the potential implications and applications was found within HH and KK and was evident to be something of a driving force for the interviewees. Similarly to the leaders and champions, the enthusiasm and entrepreneurial spirit within these projects will have been aligned with the problem-solving nature of the NIC calls and NHS clinical needs.

Table 13: A Priori and Emerging Themes from the In-Depth Interviews (Y represents theme found)

| Themes ⁷ | HH | KK | II (1) | II (2) | LL (1) | LL (2) |
|---------------------------------|----|----|--------|--------|--------|--------|
| Origins/Drivers | Y | Y | Y | Y | Y | Y |
| NHS relationship | Y | Y | Y | Y | Y | Y |
| Collaborating Partners | Y | Y | Y | Y | Y | |
| Market Research | Y | Y | Y | Y | | |
| Clear Clinical Need | | Y | Y | Y | | |
| Champions | Y | Y | | Y | | |
| NIC | | Y | Y | Y | | |
| Knowledge | | Y | | Y | | |
| Expertise | | Y | | Y | | |
| Contacts | Y | | Y | | | |
| Implications | | Y | Y | | | |
| Barriers | Y | Y | Y | Y | Y | |
| Successes | Y | Y | | Y | | |
| External environment | Y | Y | Y | Y | | |
| Funding | Y | Y | Y | Y | | |
| Political and Business dynamics | | Y | Y | Y | | |
| Challenges | | | Y | | | Y |
| Flexibility | | Y | Y | | Y | Y |
| AHSN | | | Y | | | |
| Change in the NHS/NHS Change | Y | Y | Y | Y | | |
| Political Change | Y | Y | | Y | | |
| Change | | | | Y | Y | Y |
| Team | Y | Y | Y | Y | Y | |
| Team Members | Y | Y | | | Y | |
| Team Role | | Y | | Y | | |
| Team Work | | Y | Y | | | |
| Role definition | Y | Y | Y | | | |
| Culture (Team Culture) | | YY | Y | | YY | |
| Trust | Y | Y | Y | | | Y |
| Psychological Safety | | Y | | Y | | |
| Shared objectives and vision | Y | Y | Y | Y | Y | Y |
| Communication | Y | Y | Y | | Y | Y |
| Leadership | Y | Y | Y | Y | Y | |
| Interdependence | Y | | | | Y | Y |
| Boundedness | Y | Y | Y | Y | Y | |
| Reflexivity | Y | | Y | | Y | |
| Creativity | | | Y | Y | | |
| Motivation/Motivators | Y | Y | Y | | | |
| Progress | | | | Y | | |
| Hindsight | Y | Y | Y | Y | | |

⁷ The themes are shaded according to the following categories: Antecedent and Set-Up context, Environmental Context and Impact, Team Processes and Behaviours, Self-Evaluation.

4. Market Research – can be inferred to be a key reason for the difficulties of HH and II, and for the adaptability and regeneration of both KK and LL. In maintaining awareness of the market, competitors, suppliers and manufacturers during the project KK and LL have ensured that they can be adaptable and flexible to changes in practices, procedures and policies. In-depth, objective and broad market research was not performed by HH or II. Having observed HH in seeking support, as well as from the interview case study, HD tends to ask closed and leading questions. This has led to limited focus on the company that would actually purchase the product (a sterilisation company) and then awareness of their requirements and advice at a very late stage which has pushed the project back further. II relied on second hand data from the NIC and were not aware of details of how the splint would be used (which led to a much required redesign) or that other splints that fitted the brief were available.

5. Structure – There appear to be common structures across all four of these collaboration projects. There is an immediate core project group and then a wider group of individuals who are included for contacts, individual knowledge/expertise and resources. The boundaries between the collaborating organizations are much more distinct in the lower performing teams, while the higher performing teams (LL and KK) have a clear boundary around the team but the origin boundaries are not as divisive.

3.3 Team Processes and Behaviours

Team variables that have already been investigated in the quantitative data such as interdependence, stability, boundedness, psychological safety, and creativity were coded in the themes that emerged from the interview case-study data. Creativity was previously found to have a significant negative correlation with psychological safety and a positive correlation with intrinsic motivation. This was not an expected result from the quantitative data, however the qualitative data provides an explanation for this. For example, there is evidence suggesting that creativity is not necessarily involved after the initial stages (II, LL) or that it is the leadership arrangement or role allocation that affects whether the whole team believes they are creative or

not (HH). As the team is made up of individuals with specific roles, it could be argued that in teams (other than II) only one individual really has the freedom to be creative. Moreover, if creativity and motivation is high in the team at the beginning of the project and as time elapses this is seen to reduce due to a range of variables, additionally psychological safety will have had time to develop as the team works together.

Reflexivity and referring back to the shared vision are both emerging variables revealed in the interviews, it suggests that this is an important process that more successful projects go through in order to reassess their position. This also links to awareness of the external environment (market research, political awareness, NHS awareness) and ensures that the project is still relevant and can be prepared for changes that may be ahead whether in the short or long term.

The openness of communication and the different forms of communication were both identifiable themes, which were also found in the quantitative data. However, while it was clear that regular communication was important for projects, the case study analysis revealed much more detailed findings to understand this relationship. LL identified that informal communication is just as important as formal communication, in order to attempt to make up for the inherent communication and bonding that goes on when under the same organizational umbrella. This also emerges from the interview with KK as the individuals spend a lot of time with each other, beyond a formal capacity. The other two projects only meet in a formal capacity, although some members of II work with each other on other projects so there is some informal communication inherent in the arrangement. This arrangement seems to create the strong origin boundaries and less distinct interorganizational boundaries revealed in II. The case study data reveals that informal communication as well as formal communication can help to break those boundaries by helping to understand the perspectives of each side, including the different cultures, languages, agendas and pressures that will impact during the course of the

project. It is then communication that has emerged as the solution to issues associated with differences as ensuring that “honest and open” conversations can be had relies on foundations of strong working relationships and excellent communication channels.

3.4 Self Evaluation

At the outset of the project and throughout, articulation and referral back to mutual expectations is also vital. Project HH does not state that they have articulated their expectations of one another, or set out deadlines for deliverables in the way that LL articulates this. This type of communication; being clear at the outset about what is expected in a formal manner seems to lead to more progress in the project. The extent that the arrangement is mutually beneficial undoubtedly has an impact on how involved the different parts are. The NIC were providing funding for projects that really required the input. However there was relatively little benefit, other than maintaining NHS employment and delivering NHS strategy for the NIC.

There were no direct routes to get the products adopted through the NIC. In KK and LL, the partners work alongside each other because without the other it would be impossible to reach the objectives of the project. II was required by the NIC in order to pursue the WIBGI concept, however II now requires extensive input from Professor I. It was unclear whether there is any real monetary benefit (there was some mention of whether he may hope there will be an agreement in the future) at present, so it seems there is less of a mutual benefit. When the project is mutually beneficial it appears that this conversation setting out the expectations of one another in order to work together to achieve the shared vision and objectives is much easier. With more successful projects setting these agreements and expectations out formally, and those projects working in a truly mutually beneficial collaboration, it can be concluded that these two factors are interlinked together and with project performance.

Reflexivity and revision are tightly linked with cultural differences between the types of organizations. The priorities and requirements to continue vary between academic, NHS and

SME organizations, however the SMEs are required by the collaborating partners (and for their own organizational goals) to make the projects work as it is more of a financial risk for the SMEs to focus resources on. However to make it financially viable for the SME to continue with the project, they must drive it forward. This distinction between organizational sectors and the resulting difference in culture can be difficult to overcome (HH).

4. Summary of Findings in In-Depth Interview Phase of Data Collection

In order to overcome these organizational differences, many of the variables presented above have been used as strategies in order to counteract the challenges associated with working across organizational boundaries. These variables include reflexivity, developing a strong team identity, psychological safety, fostering creativity, ensuring true mutual benefits, articulating expectations, revisiting the shared vision, instating project champions, and charismatic leaders. In addition, the project leader must be enthusiastic about the potential of their product, the project must be flexible and dynamic and prepared for changes in the political and external environment.

Key insights drawn from the in-depth interviews suggests the mediating factor of project duration in order to explain the negative relationship found in the questionnaire analysis between creativity and psychological safety. When the questionnaire data is considered in relation to the team characteristics being reported as most strong in higher performing projects that have made more progress, time is clearly aiding these team practices to develop. With this in mind, the interview data has provided rich detail to explain this further. Projects are initially extremely creative and as the project duration proceeds, creative processes are less involved in later project stages. In the meantime, psychological safety develops alongside the overall 'team-ness', therefore the phase of the project and thus the duration has a negative impact on creativity but psychological safety is seen to increase.

The key findings from the in-depth interviews and cross-case comparison are that team variables can explain the differences in performance of the projects studied. In particular, team variables previously identified in the quantitative data have been explained through this case-study data, and more team level variables have emerged. The interview data has allowed much more detail to be collected about the external environment and its impact on project success, building on the findings within the exploratory data phase. Therefore the mixed methods approach has provided a stronger and more rounded set of results than would have been available by selecting a single methodological approach. Furthermore, there is clear and consistent validation that applying insights from the organizational team literature is an appropriate and meaningful application.

There is therefore a case for applying the *intraorganizational* team insights into the interorganizational team context.

Chapter Eight: Exploratory Quantitative Survey Findings and Analysis

This chapter of the results features the data analysis of both the individual level (presented first) and aggregated project mean data (presented second) collected from the exploratory questionnaires administered in Phase 2. The measures are articulated in Chapter Five and were selected based on a thorough literature review and refined based on the data collected in the exploratory qualitative phase (see the preceding two chapters for more detail). The adaptations made to the measures are presented in Appendix 1.

1. Individual Level Responses

In this section, the results of the survey administered to 71 individual respondents are presented. The data was collected using the Bristol Online Survey service, and downloaded in a coded version from the site. The data was examined for incomplete responses and 4 responses were removed from the database as incomplete (one participant did not finish the questionnaire first time around due to an internet service problem) or inaccurate (found in one due to an answering pattern), leaving the 71 total responses. As the data was partially coded it was carefully checked and the rest of the responses were coded. This also involved ensuring that all negatively worded questions were coded or re-coded in reverse to account for the difference in the scale meaning.

1 Demographic Data, Descriptive Statistics and Frequencies.

The descriptive statistics function on SPSS revealed that the sample consisted predominantly of men, with an overall majority percentage of 76.1% of the sample being male

(54 male, 17 female). Additionally, the participants were found to identify themselves along only 4 different ethnic backgrounds out of the 12 options given. 93% identified themselves as White (UK), 4.2% as White (Irish), 1.4% as Asian (Indian) and 1.4% as Asian (Pakistani).

Time of involvement was measured by asking the individuals how long the project working group (PWG) had been together. The majority of those involved in the project working group had been involved for over four years (45%). A sizeable minority (15.5%) were part of projects that had been on-going for just over a year. This suggests that the sample was a mixture of relatively new projects that had only been established just over a year, and projects that had been on-going for more than four years.

Table 14: Sample Descriptives: Length of time Project Working Group had been working together

| | Less than a year | 1-2 years | 3-4 years | 4+ years |
|----------------------------------|-------------------------|------------------|------------------|-----------------|
| Time PWG working together | 15.5 % (11) | 29.6% (21) | 9.9% (7) | 45.1% (32) |

This did not give sufficient insight into how long the individuals themselves had been involved with the project. It is clear from the data that most respondents were relatively new to the project working group, indicating that there is some turnover in these roles. This will be discussed later as it may be related to change within the NHS and also alliances with different organizations.

Table 15: Sample Descriptives: Length of time individual had been working as part of the Project Working Group

| | Less than a year | 1-2 years | 2-3 years | 3-4 years | 4+ years |
|---|-------------------------|------------------|------------------|------------------|-----------------|
| Time individual working as part of PWG | 31.0% (22) | 22.5% (16) | 14.1% (10) | 12.7% (9) | 19.7% (14) |

Information regarding the membership of the team was collected and is presented in the table below. It is clear that within the majority of the sample there are up to 2 members of the

team originating from an NHS organization. In addition, although not in the majority of the sample, it is not uncommon to seek involvement from another organization originating from industry – either for knowledge, manufacturing, or particular expertise. There was some participation from other organizations (including academic or charity) in the majority of the sample too. The reported number of total team members are clustered around 4 and 7 members. This suggests that some of the projects consider their boundaries and sizes to be much larger than others, or were perhaps less discriminating as to who was considered part of the team. Nine members or fewer is still a small project group size but it is interesting to note for the purposes of analysis and discussion, as well as considering sample related biases.

Table 16: Sample Descriptives: Breakdown of Project Team membership

| Number of Members from.... | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|--|---------------|---------------|---------------|---------------|--------------|---------------|---------------|---------------|---------------|-----------|
| Your organization | | 5.6% (4) | 31% (22) | 26.8% (19) | | 36.6% (26) | | | | |
| Commercial Collaborating Organization | 59.2% (42) | 40.8% (29) | | | | | | | | |
| NHS Collaborating Organization | 12.7% (9) | 16.9% (12) | 54.9% (39) | 8.5% (6) | 7% (5) | | | | | |
| Other collaborating organization | 47.9% (34) | 32.4% (23) | 9.9% (7) | 9.9% (7) | | | | | | |
| Total Members in Project | | | | 7% (5) | 11.3% (8) | 7% (5) | 18.3% (13) | 25.4% (18) | 23.9% (17) | 7% (5) |

Communication was also measured in order to ascertain the frequency of meeting and communication and how far reaching this was in terms of the members of the project working group. Meetings were most often reported to take place less regularly with “varies/as required” the most reported (62%), followed by monthly (19.7%), and with fortnightly (12.7%) and weekly (5.6%) being selected less frequently. It is rare for all attendees (14.1%) and one-on-

one meetings (8.5%) to occur when compared to having most members (22.5%) and a small number/half of the members present (54.9%).

The forms of communication and frequency of their use were also requested on the questionnaire. Small group meetings were the least reported method of communication. Emails, teleconferencing, telephone conversations and large scale meetings were the commonly used methods of communication and were either reportedly used often or sometimes.

Table 17: Sample Descriptives: Breakdown of frequency of use and different forms of communication

| | Often | Sometimes | Never |
|-----------------------------|---------------|------------------|--------------|
| Email | 49.9% (35) | 50.7% (36) | |
| Teleconference | 60.6% (43) | 39.4% (28) | |
| Telephone | 56.3% (40) | 43.7% (31) | |
| Small Group Meetings | 63.4% (45) | 25.4% (18) | 11.3% (8) |
| Whole Group Meetings | 45.1% (32) | 54.9% (39) | |

These variables made it possible to ascertain detail about the sample, projects and the general antecedent conditions of how the collaboration project working group operates, communicates and is structured. Correlation analyses were performed in order to understand the relationships between the variable.

II Significant Correlations

The correlation matrix can be found in full within Appendix 4 and demonstrates many significant relationships between the variables, both positive and negative. There are small summary tables throughout the text.

The interpretations will now be discussed with reference to the correlation matrix, and each significant finding presented for the variables. A significant correlation will be either $p < 0.01$ or $p < 0.05$, each demonstrating how confident we can be that this finding represents

most of the sample. The closer to 0 ($p < 0.01$), the more confident that the finding represents more of the sample. Furthermore, the correlations are judged in strength along the parameters outlined in Table 11 and proposed by Swinscow (1997) who also suggested that context must be taken into account when examining the results along these boundaries.

Table 18: Recommended correlation labels (Swinscow, 1997)

| R Value | Label |
|-------------------|--------------|
| 0 – 0.19 | Very Weak |
| 0.2 - 0.39 | Weak |
| 0.4 – 0.59 | Moderate |
| 0.6 – 0.79 | Strong |
| 0.8 – 1 | Very Strong |

Part I Project Plans and Structure

Agreement with Objectives (Shared Vision)

A weak negative relationship with the number of members from another collaborating organization ($r = -0.237$, $p < 0.05$), frequency of teleconferencing between the group ($r = -0.316$, $p < 0.01$) and team satisfaction ($r = -0.248$, $p < 0.05$) was found. The significance level of the negative relationship between the agreement with the project objective and the use of teleconferencing indicates that this is not a method that is used to facilitate the dissemination of the project objectives or to create cohesion and the feeling of having a shared vision. The number of members of the project originating from another organization that is not another business, or the NHS (i.e. a University, charity or research based institution) is negatively correlated with agreement with the objective given by the project lead. This indicates that the involvement of an organization such as a University, with much more divergent agendas and many more similar projects occurring over a relatively infinite period of time due to fewer time-based and money-based pressures, leads to less cohesion and agreement within the group as to

what are the overall project objectives. The idea that team satisfaction is reduced as agreement over the project objectives increases is one which must be referred to when considering other variables in order to truly explain this finding. It may be related to the phase of the project; however these two variables may occur together as a result of other phenomena.

Table 19: Variables correlating with "Agreement with Objectives" (*p<0.05; **p<0.01)

| | Agreement with Objectives | |
|--|---------------------------|------|
| Members from other collaborating org. | -0.237* | Weak |
| Teleconference | -0.316** | Weak |
| Team satisfaction | -0.248* | Weak |

Length of Time the Project Working Group has been working together:

Was positively correlated strongly with the time that the individual had been a member of the working group ($r = 0.830$, $p < 0.01$), moderately with the number of attendees on average at meetings ($r = 0.530$, $p < 0.01$) and weakly with intrinsic motivation ($r = 0.295$, $p < 0.05$). This strong relationship with the time the individual has spent as part of the project is expected, but could also indicate a low rate of turnover in projects that run for a longer period of time. It is important to note that the longer that the project has been working together, the greater the intrinsic motivation and the more attendees from the group are present at meetings. The increased intrinsic motivation could be due to incremental progress and achievement being realised, as well as the intrinsic rewards within the project coming to the surface as the roles and responsibilities and project direction become clearer. The length of time that the project has been working together being linked with the number of attendees at meetings is interesting to consider, in terms of other variables.

Table 20: Variables correlating with "Time Project Working Group working together" (*p<0.05; **p<0.01)

| | Time PWG working together | |
|--|----------------------------------|-------------|
| Time individual had been a member | 0.830** | Very strong |
| Average number of attendees at meetings | 0.530** | Moderate |
| Intrinsic Motivation | 0.295* | Weak |
| Small Group Meetings | -0.446** | Moderate |
| Boundedness (RealTeamSubscale) | -0.346** | Weak |
| TDS Measure | -0.302* | Weak |
| Members from NHS Org | -0.280* | Weak |

The length of time the project working group has been together is negatively correlated in a moderate relationship with the frequency of small group meetings being held ($r = -0.446$, $p < 0.01$) and weakly with the boundedness subscale of the TDS measure ($r = -0.348$, $p < 0.01$), the TDS measure ($r = -0.302$, $p < 0.05$) and the number of members of the project originating from an NHS organization ($r = -0.280$, $p < 0.05$).

Therefore the longer the project has been together, the less frequently small sub group meetings are held, something which is important to note when considering the structure, set up and functioning of the projects as the project progresses. The length of time that the project working group has been working together is correlated with a reduction in the reported boundedness of the team as well as the general characteristics of a team. This may be related to other projects taking over, or shifts and changes in membership. There are also fewer individuals from NHS organizations involved when projects have been running for a longer period of time. This finding must be interpreted with some caution. At the time of data collection for the survey there was a large NHS restructure ongoing which resulted in involvement no longer continuing within several of the projects included in the data. This contextual factor may explain this finding. However another explanation could be that the projects that were running for longer without NHS involvement were not making as much

progress as those with NHS involvement, or that NHS involvement in these types of projects occurred due to NHS strategy and policy being implemented at a specific time.

Length of Time the Respondent has been in the Project Working Group:

These variables had significant, positive, strong correlation with the length of time the project working group had been together ($r = 0.830$, $p < 0.01$), a moderate correlation with the number of attendees at meetings ($r = 0.501$, $p < 0.01$) and weak correlations with gender ($r = 0.339$, $p < 0.01$) and intrinsic motivation ($r = 0.263$, $p < 0.05$). Therefore the number of attendees at meetings increases as the length of time respondents have been working in the group. There is some suggestion that more female members is related to an increase in the longevity of the working group. Intrinsic motivation increases with working group tenure.

Table 21: Variables correlating with "Time respondent has been in the Project Working Group" (* $p < 0.05$; ** $p < 0.01$)

| | Time Respondent has been in the PWG | |
|--|--|-------------|
| Time PWG Working Together | 0.830** | Very Strong |
| Average number of attendees at meetings | 0.501** | Moderate |
| Gender | 0.339** | Weak |
| Intrinsic Motivation | 0.263* | Weak |
| Small Group Meetings | -0.461** | Moderate |
| Boundedness (TDS Subscale) | -0.360** | Weak |
| TDS Measure | -0.3* | Weak |
| Members from NHS Org | -0.238* | Weak |
| Total Number of Members | -0.234* | Weak |

There was a negative relationship between the length of time the individual has been part of the project working group and: frequency of small group meetings ($r = -0.461$, $p < 0.01$); team boundedness ($r = -0.360$, $p < 0.01$); the TDS measure ($r = -0.3$, $p < 0.05$); number of members from the NHS ($r = -0.238$, $p < 0.05$); and the total number of team members ($r = -0.234$, $p < 0.05$).

Membership:

The total number of reported team members was found to have a significant, positive and weak relationship with the alliance performance ($r = 0.260$, $p < 0.05$), and the effectiveness ($r = 0.271$, $p < 0.05$) and efficiency ($r = 0.255$, $p < 0.05$) sub-scales. This indicates that as the number of individuals contributing to the project increases, the performance of the alliance in terms of its effectiveness and efficiency increases.

Total number of reported team members was also found to have a moderate significant relationship with the number of members originating from an NHS organization ($r = 0.446$, $p < 0.01$), so a larger team is more likely to have a larger proportion originating from an NHS organization. Additionally, there was a moderate negative relationship with the average number of attendees at a meeting ($r = -0.485$, $p < 0.01$), indicating that as the number of people involved in the project team increases, average attendance at meetings is lower.

Table 22: Variables correlating with "Total Number of Members" (* $p < 0.05$; ** $p < 0.01$)

| | Total Number of Members | |
|--|-------------------------|------------|
| Alliance Performance | 0.260* | Weak |
| Members from NHS Org | 0.446** | Moderate + |
| Average number of attendees at meetings | -0.485** | Moderate – |

The number of members originating from a commercial collaborating organization was significantly correlated with several variables including; psychological safety with a moderate relationship ($r = 0.396$, $p < 0.01$); creativity with a moderate negative relationship ($r = -0.304$, $p < 0.05$); intrinsic motivation with a weak negative relationship ($r = -0.234$, $p < 0.05$); team satisfaction ($r = 0.249$, $p < 0.05$); and alliance performance with a positive moderate correlation ($r = 0.476$, $p < 0.01$). So with more members of the team originating from the commercial collaborating organization, there is higher psychological safety, higher reported team

satisfaction, and higher reported alliance performance, whilst also being lower levels of creativity and satisfaction.

Table 23: Variables correlating with "Members from a Commercial Organization" (*p<0.05; **p<0.01)

| Members from a Commercial Org | | |
|--------------------------------------|---------|------------|
| Psychological Safety | 0.396** | Weak + |
| Creativity | -0.304* | Weak – |
| Intrinsic Motivation | -0.234* | Weak – |
| Team Satisfaction | 0.249* | Weak + |
| Alliance Performance | 0.476** | Moderate + |

The number of members originating from an NHS organization was found to have significant negative relationships with several variables: intrinsic motivation ($r = -0.235$, $p < 0.05$) and alliance performance ($r = -0.260$, $p < 0.05$). An important finding to compare is that there is a positive relationship between members originating from an NHS organization and project progress ($r = 0.294$, $p < 0.05$). This indicates that with a higher number of members originating from the NHS a team makes better progress, but performance (in this measure rated by effectiveness, efficiency and responsiveness) and reported levels of intrinsic motivation decrease.

Table 24: Variables correlating with "Members from an NHS Organization" (*p<0.05; **p<0.01)

| Members from NHS Org | | |
|-----------------------------|---------|--------|
| Intrinsic Motivation | -0.235* | Weak – |
| Alliance Performance | -0.260* | Weak – |
| Project Progress | 0.294* | Weak + |

The involvement of another collaborating organization (i.e. one that wasn't financially profiting from the alliance, or an NHS collaborator such as a University) was found to have a positive moderate relationship with alliance performance ($r = 0.396$, $p < 0.01$) so that alliance

performance in terms of effectiveness, efficiency and responsiveness increases with more members within the team originating from organizations such as Universities. However, progress ($r = -0.417$, $p < 0.01$) and current state of the project ($r = -0.262$, $p < 0.05$) was found to have a negative correlation.

Table 25: Variables correlating with "Members from Other Collaborating Organizations" i.e. academic institutions (* $p < 0.05$; ** $p < 0.01$)

| | Members from Other Collaborating Org. | |
|------------------------------|---------------------------------------|------------|
| Alliance Performance | 0.396** | Weak + |
| Project Progress | -0.417** | Moderate – |
| Current Project State | -0.262* | Weak – |

Communication:

The frequency of meetings was found to have a weak/moderate correlation with alliance performance ($r = 0.314$, $p < 0.01$) indicating that there was a slight increase in performance scores when respondents reported meetings occurring more frequently. The average number of attendees at meetings was negatively associated with the profile of the team; moderately with the number of attendees associated with the respondent's origin organization ($r = -0.434$, $p < 0.01$); strongly with the number of group members originating from the NHS organization ($r = -0.727$, $p < 0.01$); and moderately with the total number of members ($r = -0.485$, $p < 0.01$). The use of particular communication methods was also seen to correlate with the number of attendees, validating the information collected as more attendees correlated with whole group meetings ($r = 0.492$, $p < 0.01$) and negatively with small group meetings ($r = -0.923$, $p < 0.001$).

The number of attendees also correlated with group processes such as the TDS measure ($r = -0.456$, $p < 0.01$) suggesting that interdependence, stability and boundedness were marked by fewer average attendees at meetings. Intrinsic motivation was linked to more average attendees ($r = 0.360$, $p < 0.01$) but as attendees at average meetings increased, project progress had a negative relationship ($r = -0.226$, $p < 0.05$).

Whole group and small group meeting frequency were both positively correlated with many of the variables which would seem contradictory. However, closer inspection indicates that more progress correlates with smaller group meetings and fewer whole group meetings. Some key differences to note are that there is a significant and positive relationship with large group meetings against creativity and intrinsic motivation, indicating that there is greater motivation and creativity available in those projects frequently engaging in meetings with the whole project or where the number of attendees is higher.

Table 26: Variables correlating with "Small Group Meetings" and "Whole Group Meetings" (*p<0.05; **p<0.01)

| | Small Group Meetings | Whole Group Meetings |
|-----------------------------------|-----------------------------|-----------------------------|
| TDS Measure | 0.521** (Moderate) | -0.278* |
| Psychological Safety | 0.343** | -0.337** |
| Creativity | n/a | 0.234* |
| Intrinsic Motivation | -0.394** | 0.327** |
| Team Satisfaction | n/a | -0.344** |
| Project Progress | 0.343** | -0.316** |
| Alliance Performance Total | 0.279* | -0.340** |
| Reported state of project | 0.330** | -0.263* |

Part II Working Together

TDS Measure:

The TDS measure assessed the boundedness, stability and interdependence reported in the team, in order to ascertain whether the project team in this research context was indeed functioning as a team. While the sub-scales are interesting to examine, the overall team scale is a total score from each of these measures and gives a more holistic view of the team processes and practices when correlated against the other variables. It is interesting that psychological safety was significantly correlated with the TDS measure ($r = 0.707$, $p < 0.01$), suggesting that psychological safety is more likely to be present in teams scoring well on the interdependence,

stability and boundedness subscales. The correlation between performance and the TDS will be discussed at the end of this section.

Other Team Measures (Psychological Safety, Creativity, Intrinsic Motivation and Team Satisfaction):

Psychological Safety was negatively correlated with creativity ($r = -0.570$, $p < 0.01$), some discussion is needed on this point as there are several reasons that could be put forward to support why as the psychological safety felt within the team increases, the reported feeling of engaging in creativity decreases. Additionally psychological safety is negatively correlated with intrinsic motivation ($r = -0.661$, $p < 0.01$) suggesting that intrinsic motivation decreases as psychological safety within the team increases, requiring further discussion. Team satisfaction is correlated positively with psychological safety ($r = 0.570$, $p < 0.01$) suggesting that as the psychological safety increases, so does the feeling of satisfaction within the team.

Creativity and intrinsic motivation were positively correlated ($r = 0.346$, $p < 0.01$) suggesting that there is more investigation to be done between the four variables presented in this sub-section. Intrinsic motivation provides some interesting results, with negative correlations with all performance, progress and team variables except creativity. Team satisfaction is a variable used to validate results in much of the team literature, this positively correlated with most variables except creativity and intrinsic motivation, but the correlations were significant, suggestion that an alternative explanation lies behind this interaction between variables.

Table 27: Variables correlating with "Psychological Safety" and "Creativity" (* $p < 0.05$; ** $p < 0.01$)

| | Psychological Safety | Creativity |
|-----------------------------|-----------------------|---------------------|
| Creativity | -0.570** (Moderate -) | n/a |
| Intrinsic Motivation | -0.661** (Strong -) | 0.346** (Weak +) |
| Team Satisfaction | 0.570** (Moderate +) | -0.462 (Moderate -) |

Part III Performance, Progress and Outcome Measures:

Project Progress

Project progress was measured in order to provide another assessment of ‘performance’ which took into account the incremental progress that may have been made rather than indicators that come with the completion of a full project goal or objective. Progress was found to have positive correlations with the TDS ($r = 0.711$, $p < 0.01$), psychological safety ($r = 0.756$, $p < 0.01$) and team satisfaction ($r = 0.571$, $p < 0.01$). Therefore we can interpret from the data that higher scores on the TDS, psychological safety and team satisfaction are related to more team progress being reported.

Table 28: Variables correlating with "Project Progress" (* $p < 0.05$; ** $p < 0.01$)

| | Project Progress | |
|-----------------------------|------------------|----------|
| TDS Measure | 0.711** | Strong |
| Psychological Safety | 0.759** | Strong |
| Team Satisfaction | 0.571** | Moderate |

Alliance Performance

This was used as a previously published and relevant measure of the performance of the collaboration project (including efficiency, effectiveness and responsiveness). The alliance performance measure was found to correlate significantly and positively with the TDS total measure ($r = 0.495$, $p < 0.01$) although only with the stability and interdependence sub-scales, psychological safety ($r = 0.661$, $p < 0.01$) and team satisfaction ($r = 0.421$, $p < 0.01$). This suggests that alliance performance is higher in those situations where the stability, interdependence, team scale, psychological safety and team satisfaction are reported to be higher also. Creativity ($r = -0.586$, $p < 0.01$) and intrinsic motivation ($r = -0.362$, $p < 0.01$) were found to significantly and negatively correlate with alliance performance measures

Table 29: Variables correlating with "Alliance Performance" (*p<0.05; **p<0.01)

| | Alliance Performance | |
|-----------------------------|----------------------|------------|
| TDS Measure | 0.495** | Moderate |
| Psychological Safety | 0.661** | Strong |
| Team Satisfaction | 0.421** | Moderate |
| Creativity | -0.586** | Moderate – |
| Intrinsic Motivation | -0.362** | Weak – |

Reported State

This was measured in order to obtain an idea of the exact stage the project was at during the time that data was collected. This was not necessarily a measure of performance or progress, but more ‘closeness to completion’ and correlated significantly with the TDS total measure ($r = 0.839, p < 0.01$) including each of the sub-scales, psychological safety ($r = 0.783, p < 0.01$) and team satisfaction ($r = 0.532, p < 0.01$). This suggests that the state of the project is closer to completion in those situations where the team scale, psychological safety and team satisfaction are reported to be higher also. Creativity ($r = -0.546, p < 0.01$) and intrinsic motivation ($r = -0.641, p < 0.01$) were found to significantly and negatively correlate with alliance performance measures.

Table 30: Variables correlating with "Reported State of the Project" (*p<0.05; **p<0.01)

| | Reported State of Project | |
|-----------------------------|---------------------------|-------------|
| TDS Measure | 0.839** | Very strong |
| Psychological Safety | 0.738** | Strong |
| Team Satisfaction | 0.532** | Moderate |
| Creativity | -0.546** | Moderate – |
| Intrinsic Motivation | -0.641** | Strong – |

The three measures of ‘performance’ were found to correlate with each other positively as displayed in the table below. This indicates that there is some similarity in the constructs that they were intended to perform and can be used as a measure of validity, in particular for the two measures designed for the purposes of this research. In addition the differences between which of the subscales correlate with these performance measures must be examined in the discussion.

Table 31: Correlations of Performance and Progress Measures (*p<0.05; **p<0.01)

| | Project Progress | Alliance Performance | Coded Reported State |
|----------------------|------------------|----------------------|----------------------|
| Project Progress | 1 | .399** Weak | .857** V Strong |
| Alliance Performance | | 1 | .559** Moderate |
| Coded Reported State | | | 1 |

III Individual Level Regression Analysis

After so many significant results to the $p < 0.01$ level in the sample, a multiple regression analysis was performed in order to ascertain any further linkages. It was clear that there were some variables with significant relationships with the performance, progress and outcome measures, however some of these variables had relationships with other antecedent and team factors too. In order to understand fully the impact that these relationships may have each other a tentative stepwise multiple regression was performed on four outcome/performance variables: creativity, project progress, alliance performance and reported project state.

A stepwise method was selected as it would eliminate any non-contributing variables and create a model from those contributing the most. Only full scale measures were included, rather than subscales. In addition, it must be stressed that these results are tentative as regression analysis is more preferable to use on much larger sample sizes.

Using a stepwise multiple regression method on the dependent variable of creativity a significant model was found (Adjusted RSq = 0.405, $F(3,67) = 16.872$, $p = 0.000$) with Psychological Safety (Beta = -0.628, $p = 0.000$), Number of Attendees at Average Meetings

(Beta = -0.362, $p = 0.001$) and Project membership Size (Beta = -0.270, $p = 0.013$) emerging as the predicting variables in the third stepwise model output. This suggests that the creativity output of the project working group can be predicted by the reported psychological safety, the average number of attendees reported at meetings and the size of the project working group in terms of total members.

Using a stepwise multiple regression method on the project progress measure as a dependent variable, a significant model was found (Adjusted RSq = 0.748, $F(4,66) = 52.953$, $p = 0.000$) with Psychological Safety (Beta = 0.462, $p = 0.000$), the membership of another collaborating organization within the project (Beta = -0.367, $p = 0.000$), creativity (Beta = -0.197, $p = 0.011$), and the TDS measure (Beta = 0.225, $p = 0.012$) emerging as the predicting variables in the fourth stepwise model. This suggests that the psychological safety reported within the project group, presence within the project from another collaborating organization (classified as an academic/university source), creativity reported in the project group and the reported stability, interdependence and the boundedness of the project group reported through the subscales of the TDS all contribute towards predicting the progress that the project will make.

Using a stepwise multiple regression method on the alliance performance measure as a dependent variable, a significant model was found (Adjusted RSq = 0.696, $F(5,65) = 33.112$, $p = 0.000$) with Psychological Safety (Beta = 0.578, $p = 0.000$), the membership of another collaborating organization within the project (Beta = 0.516, $p = 0.000$), presence of membership from the respondent's own origin organization (Beta = 0.207, $p = 0.007$), team satisfaction (Beta = 0.203, $p = 0.016$) and the frequency of meetings (Beta = 0.155, $p = 0.029$) emerging as the predicting variables in the fifth stepwise model. This suggests that the psychological safety of the team, the presence of members from other collaborating organizations (such as academics/universities), the presence of members from the respondent's

own organization, reported team satisfaction and the frequency by which meetings are held were all found to contribute to the accuracy of the prediction of the alliance performance score.

Using a stepwise multiple regression method on the project status as a dependent variable, a significant model was found (Adjusted RSq = 0.846, $F(4,66) = 97.073$, $p = 0.000$) with the TDS (Beta = 0.710, $p = 0.000$), Psychological Safety (Beta = 0.335, $p = 0.000$), the time that the project working group reported to have been working together (Beta = 0.255, $p = 0.000$), and the total number of members reported to belong to the project (Beta = -0.144, $p = 0.004$) emerging as the predicting variables in the fourth stepwise model. This suggests that the dependent variable of the project status (i.e. how close to completion it was at the time of data collection) was found to be able to predicted by the TDS measure, psychological safety measure, the time that the project working group had been working together and the size of the project working group.

IV Individual Level Analysis Summary of Key Findings:

The results from the individual data analysis indicate that there are several of the variables tested on the sample that have relationships with the other variables tested in the research. Given the relatively small sample size, these relationships cannot be probed too much further with statistical analysis. However, some commonalities can be drawn out from the reported results here.

Part I Project Plans and Structure

The sample was predominantly male with a high majority of the sample identifying their ethnicity as UK White. This could cause a potential sample bias due to the non-stratified sampling strategy, however it is reflective of the engagement that the researcher experienced during data collection. Furthermore, this could be viewed as sample strength as there are minimal individual differences. The sample was a mixture of newly established and long

running projects, allowing for a broad spectrum of the context to be taken into account. In addition, there was a combination of individuals that had been working on the projects from the start and those who had been added to the project working group in recent years.

The length of time that the project had been running was found to have a positive effect on the intrinsic motivation of those individuals involved, perhaps suggesting that intrinsic motivation and more internally rewarding outcomes of the research are able to be realised when the initial challenge of funding and structuring issues during the establishment phase of the project is over. The length of time the project working group has been working together is also negatively associated with the TDS and the number of NHS members within the project team, suggesting that the longer the working group has been reported to have been working together the less team cohesion (boundedness, interdependence and stability reported) is reported. This could be a symptom of conflicting pressures between the other responsibilities within their origin organizations becoming more prominent as the project progresses, or due to changes in origin organization priorities. In addition the negative relationship with the number of NHS members and the length of time the project working group has been together suggests that the involvement of the NHS members within the team is more likely in teams that have been together for less time – this could be due to the sampling, strategy and policy change and implementation during the time of data collection, or the need to have NHS involvement decreases project progress.

The length of time the individual themselves has been involved in the project working group is positively linked with intrinsic motivation and negatively with the TDS score. Again, indicating that as the reported length of time the individual is involved in the project increases, there is a higher reported level of intrinsic motivation suggesting that the intrinsic benefits of the project are important in more long term projects, but also that the team is less likely to experience high stability, interdependence and boundedness.

There was a range of reported total members of the project from three to nine members, with additional commercial collaboration partners being rarer than other types of collaborating partners contributing directly to the project working group itself. NHS members were commonly present as more than one member of the group whereas “other” collaborating organizations presence were usually in a smaller number (for example a University Professor being involved directly but not a whole team that they manage). The size of the project working group was found to be positively related with alliance performance, suggesting that improved alliance performance was associated with a larger number of individuals working on the project (this is not a very large number but a significant difference when considering the range is between 3 and 9 in the sample).

NHS membership in the project working group was found to negatively correlate with intrinsic motivation and alliance performance, leading us to the conclusion that having NHS individuals involved in the project working group would have an adverse effect on the project group’s motivation levels and performance. Conversely the involvement of academic “other” individuals was found to have a favourable effect on alliance performance, perhaps due to the project-based work and cutting-edge knowledge offered by academic institutions, or even perhaps due to a mutual cohesion formed by virtue of learning to work alongside/appeal to the NHS. Alternatively this could be due to several of the samples being an SME start-up brought together with a University based academic research project through University initiatives.

Agreement with objectives/shared vision was found to be negatively associated with team satisfaction. This could be due to the team satisfaction measures being insufficient with only two items, some support for this can be found in the relationship between the time the project has been running and the TDS measure scores. Much in the way that the TDS scores are reported as lower when the time the individual/project group have been working on the project is longer, perhaps during longer projects there is a loss of feeling of cohesion, a lack of

clarity and ‘team-ness’. If this is the case, satisfaction will inevitably also be lower and will be associated with a feeling that the project group are not working together in the same direction, however agreement over the direction and objectives is higher.

Team Measures and Performance

The TDS measure, i.e. the level of interdependence, stability, and boundedness reported (the extent to which the group can be characterised as a team), is significantly and strongly related to psychological safety. This means that as the team is more cohesive, has clearer understanding of who is and who is not involved within the core group, and is more stable and more interdependent at the same time that the team reports higher levels of psychological safety, that is the feeling that taking a risk is acceptable as a member of the team and will not lead to loss of acceptance, respect or judgement.

Psychological safety is also positively linked to higher scores on the team satisfaction measure. Team satisfaction, however, was negatively linked to agreement with objectives. Additionally an interesting relationship was found between intrinsic motivation, creativity and psychological safety, the first two of which were negatively associated with psychological safety. This was not an expected result at all. It suggests that in projects where psychological safety is higher, creativity and intrinsic motivation is lower. This could be explained by the state of the project and the length of time the project has been working together (the time based measures were positively linked to intrinsic motivation), where creative periods at the beginning of the project build the psychological safety and at the cross-sectional period that the data was collected there was less creativity occurring within the project in general. Additionally, with psychological safety increasing, intrinsic motivation decreases. This cannot be explained through time periods. Perhaps as team satisfaction within the team increases with psychological safety, intrinsic motivators are not as salient. As projects draw to a close, individuals want to move on to the next project, as career progression depends on regularly being seen to be

involved with successful projects. Overall these negative relationships were not expected, but were not inexplicable.

The progress measurement was found to be higher with higher TDS measure scores, higher psychological safety and higher team satisfaction. The alliance performance measure found that in addition to these three variables, lower scores on creativity and intrinsic motivation were found in higher alliance performance. The current reported state of the project (i.e. how close to completion the project was at the time of data collection) also reflected similar relationships between the TDS measure, psychological safety, creativity and intrinsic motivation.

The regression analysis demonstrated that the variables that could be used to predict the creativity output, progress, performance and nearness to completion were psychological safety, average number of attendees at meetings, the size of the 'team', the presence of another collaborating organization, (creativity), the TDS measure, presence of individuals from the respondents own origin organization, team satisfaction, the frequency of meetings and the length of time that the project working groups had been working together.

Two key issues arise in this section: the sampling bias and the size of the sample. These must be looked at in more detail in discussion Chapter Ten. However at this juncture, notice must be taken that no causal relationships can be inferred directly from the data due to the size of the sample. More data analysis would be necessary to identify a model of how these predicting variables work together. However, it is clear that we have identified interesting relationships that directly correlate and predict an effect one variable has on another. In addition, the results demonstrate the applicability of the team based literature and findings in this context.

2. Team Level Analyses

In order to examine the data from a team level, means for each of the measures were calculated for each of the project teams. This was carried out despite the clear lack in sufficient numbers in the sample in order to check whether there were any notable findings.

I Descriptive Statistics and Frequencies:

There were 15 project teams in total included in the sample, with respondents replying to the questionnaire on an individual basis. The scores used in the individual analysis were used in order to calculate means for each project. There were 6 projects within the sample that had only male members, and a single project that had all female members. There were only two projects in which the male percentage membership dropped below a majority percentage.

Table 32: Project Level Descriptives: Male to Female Membership Ratio

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|-------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Male:Female Ratio | 3:1 | 3:2 | 3:1 | 6:0 | 2:3 | 4:0 | 4:1 | 7:0 | 4:0 | 4:0 | 2:0 | 0:5 | 3:1 | 6:1 | 4:2 |
| %Male | 75 | 60 | 75 | 100 | 40 | 100 | 80 | 100 | 100 | 100 | 100 | 0 | 75 | 86 | 67 |

The sample was not diverse in terms of ethnic origin. Only four projects have one or more members not of UK White ethnic background.

II Correlation Analysis:

The Pearson's correlation table is found in the Appendix 4, alongside the Spearman's Rank correlation table. Some of the most notable findings are presented in this section. However, caution must be emphasised in taking too many deep conclusions from these results as the sample size of 15 teams is not sufficient for reliable findings. Therefore only tentative conclusions are presented, and with a caveat that further research is required. This is predominantly due to the difficulty of the access and availability of the sample, combined with the uniqueness of the context.

Part I Project Plans and Structure

The mean length of time the respondents from the project had been working as part of the project group was found to significantly and positively correlate with the number of attendees at meetings ($r = 0.547$, $p < 0.05$) and negatively with the frequency that small group meetings were held ($r = -0.523$, $p < 0.05$), suggesting that in project groups that had members with a longer tenure within the team, there were generally more attendees at meetings, leading to larger scale meetings.

Table 33: Variables correlating with Project Mean "Time Respondents in Project Working Group" (* $p < 0.05$; ** $p < 0.01$)

| Mean Time Respondent in PWG | | |
|---|---------|------------|
| Average number of attendees at meetings | 0.547* | Moderate |
| Small Group Meetings | -0.523* | Moderate – |

The presence of a commercial collaborating partner within the project working team ($r = -0.602$, $p < 0.05$) and the presence of NHS members within the project team ($r = -0.566$, $p < 0.05$) were both found to negatively correlate with number of whole group meetings that were reported. In addition the reported total size of the project team was found to negatively correlate with the frequency of whole group meetings ($r = -0.531$, $p < 0.05$). This suggests that with another commercial collaborating organization, NHS membership, and larger team size larger scale meetings are not held as a priority.

Table 34: Variables correlating with Project Mean "Whole Group Meetings" (* $p < 0.05$; ** $p < 0.01$)

| Whole Group Meetings | | |
|--|---------|------------|
| Members from Commercial Collaborating Org. | -0.602* | Moderate – |
| Members from NHS Org. | -0.566* | Moderate – |
| Total Number of Members | -0.531* | Moderate – |

The presence of NHS members within the project team correlated negatively with the number of attendees at the average meeting ($r = -0.675$, $p < 0.01$). This suggests that NHS membership within the team, has a relationship with fewer attendees being able to attend all meetings. The presence of NHS members within the project team was also correlated with the frequency of small group meetings ($r = 0.624$, $p < 0.05$), and the total size of the team ($r = 0.554$, $p < 0.05$). This suggests that in teams with members originating from the NHS, smaller group meetings are more frequently organized but the size of the whole team is larger.

Table 35: Variables correlating with Project Mean "Members from NHS Organization" (* $p < 0.05$; ** $p < 0.01$)

| | Members from NHS Org. | |
|--|------------------------------|------------|
| Average number of attendees at meetings | -0.675** | Moderate – |
| Small Group Meetings | 0.624* | Moderate |
| Total Number of Members | 0.554* | Moderate |

The size of the team (total membership reported) was found to be positively correlated with the frequency of small group meetings ($r = 0.573$, $p < 0.05$), the number of members originating from an NHS organization ($r = 0.554$, $p < 0.05$) and negatively correlated with the average number of attendees at meetings ($r = -0.560$, $p < 0.05$). This indicates that as the size of the team membership increases, the more likely there are to be members from the NHS, and the more frequently small group meetings will be held while on average there will be fewer members attending a meeting.

The frequency that meetings are held was found to significantly correlate with the alliance performance measure ($r = 0.537$, $p < 0.05$), which indicates that in projects that report higher alliance performance, they more frequently engage and communicate in person through meeting attendances.

Part II – Working Together

The TDS was found to have significant relationships with a range of the variables. It was negatively correlated with creativity ($r = -0.590$, $p < 0.05$) and intrinsic motivation ($r = -0.842$, $p < 0.01$). It was positively correlated with psychological safety ($r = 0.806$, $p < 0.01$). This suggests in teams with higher scores on the TDS, there is more likely to be lower reported creativity, lower intrinsic motivation and higher psychological safety. Psychological safety was also found to have a negative relationship with both creativity ($r = -0.724$, $p < 0.01$), and intrinsic motivation ($r = -0.876$, $p < 0.01$), and a positive relationship with team satisfaction ($r = 0.751$, $p < 0.01$) which is similar to the individual level analysis. As discussed creativity was found to have a negative relationship with most of the other variables, however a positive correlation with intrinsic motivation was found ($r = 0.624$, $p < 0.05$) suggesting that creativity is strongly linked to higher intrinsic motivation levels.

Table 36: Variables correlating with Project Mean "TDS Measure", "Psychological Safety" and "Intrinsic Motivation" (* $p < 0.05$; ** $p < 0.01$)

| | TDS Measure | Psychological Safety | Intrinsic Motivation |
|-----------------------------|-------------------|----------------------|----------------------|
| Creativity | -0.590* Moderate | -0.724** Moderate | 0.624* Moderate |
| Intrinsic Motivation | -0.842** V Strong | -0.876** V Strong | n/a |
| Psychological Safety | -0.806** V Strong | n/a | Ns |
| Team Satisfaction | Ns | 0.751** Strong | Ns |

Part III – Progress, Performance and Outcomes

Progress in the project was found to be strongly and positively correlated with the TDS ($r = 0.817$, $p < 0.01$), psychological safety ($r = 0.850$, $p < 0.01$) and this suggests that more progress is found in the projects with high scores in the boundedness, stability and interdependence subscales of the TDS and on the psychological safety measure.

Alliance performance was found to correlate significantly with the frequency with which meetings are held ($r = 0.537$, $p < 0.05$), the TDS ($r = 0.637$, $p < 0.05$), psychological safety

within the team ($r = 0.759$, $p < 0.01$) and this again reinforces that alliance performance is directly related to these variables.

The current state of the project (nearness to completion) was found to be positively correlated with the TDS ($r = 0.914$, $p < 0.01$) and psychological safety ($r = 0.820$, $p < 0.01$) so where these variables were found to score highly, the project was also reported to be closer to completion.

Creativity was found to correlate negatively with progress ($r = -0.643$, $p < 0.01$), alliance performance ($r = -0.735$, $p < 0.01$) and the current state of the project ($r = -0.647$, $p < 0.01$), which reflects the findings reported in the individual level analysis.

Table 37: Project mean correlations between Performance and Progress Measures (* $p < 0.05$; ** $p < 0.01$)

| | TDS Measure | Psychological Safety | Creativity |
|----------------------------------|--------------------|-----------------------------|-------------------|
| Project Progress | 0.817** V Strong | 0.850** V Strong | -0.643** Strong – |
| Alliance Performance | 0.637* Strong | 0.759** Strong | -0.735** Strong – |
| Reported State of Project | 0.914** V Strong | 0.820** V Strong | -0.647** Strong – |

III Team Ranking Analysis

A non-parametric ranking analysis was carried out on the data, seen in Table 38 overleaf. Although the next logical stage of analysis would have included a regression analysis as carried out in the individual data section, the rule of thumb for performing a multiple regression on a data set is to stick to a ratio of five respondents to every independent variable applied to the analysis (Brace, Snelgar & Kemp, 2012). This can be even stricter in some cases, including ratios of 10:1 or even 40:1, however Brace et al., (2012) suggest this is sufficient. However, in the case of aggregating the data into project means, there are by no means sufficient variables and respondents. Instead, each mean was categorised and labelled in order to adequately rank the projects in a suitable order. The projects were first ranked according to

alliance performance and then progress scores (Table 38). With very high performance and progress conditions, the TDS measures were found to be high. This suggests that when members judge that interaction and quality of team relationships are good, then a positive impact on performance and progress is found. The opposite is also true. In addition, along the lines of the correlations discovered in both the individual level and project level analysis, psychological safety was found on the whole to be low in lower performing teams and higher in higher performing teams.

There was less generalizability for intrinsic motivation and creativity, as expected from the correlation results. Therefore a further ranking analysis has been performed on these two variables alone (Table 39), in order to discern whether there are any other patterns that can be discovered. While this seemed to scatter the other variable values (as is expected if the correlation analysis reported no pattern), there are some interesting results to be observed. The negative relationships between the other variables are clear to see in this table, confirming previous findings. In addition it can be seen that the teams ranking higher in the creativity and intrinsic motivation, tend to be those with more diversity in terms of gender. Teams low in creativity and intrinsic motivation have scored highest in progress and performance.

Table 38 Ranking Analysis of Projects. Projects ranked on Alliance Performance and then Progress. Cited in Surtees, Knight & Shipton, 2013

| Project Code | Survey Respondents/ Core Members | Push/ Pull | Collab Resources | Diversity/ Complexity | Bounded-ness | | Stability | | Interdependence | | Alliance Performance | | Progress | | Current State of Project |
|--------------|-------------------------------------|---------------|---------------------|--------------------------|--------------|-----------------|-----------|--------------|-----------------|--------------|-------------------------|----------|----------|----------|--|
| | | | | | Mean | Category | Mean | Category | Mean | Category | Mean | Category | Mean | Category | |
| LL | 5/5 | Push | NHS | V.High | 13.40 | High | 7.00 | Med/ High | 13.20 | High | 69 | High | 65.9 | High | Completed, full understanding of project outcomes |
| MM | 4/4 | Push | NHS | Low | 13.50 | High | 9.00 | High | 13.25 | High | 68 | High | 65.5 | High | Completed, full understanding of project outcomes |
| KK | 3/3 | Push | NHS | Low | 10.50 | High/ Medium | 8.50 | High | 11.50 | High | 66 | High | 62.5 | High | Completed, full understanding of project outcomes |
| HH | 2/3 | Push | N/A | V.High | 3.57 | Low | 4.00 | Med/ Low | 5.14 | Medium | 59 | Medium | 24.8 | V.Low | Not yet complete & significant uncertainty over project outcomes |
| II | 4/6 | Pull | NHS | High | 6.75 | Medium | 4.50 | Medium | 7.50 | Med/ High | 57 | Medium | 41.4 | Medium | Imminent completion, confident in expectations of project outcomes |
| FF | 4/6 | Pull | NHS | High | 3.25 | Low | 5.25 | Medium | 5.25 | Medium | 57 | Medium | 32.6 | Low | Not yet complete & significant uncertainty over project outcomes |
| JJ | 5/8 | Pull | NHS & Other | V.High | 12.75 | High | 5.75 | Medium | 10.00 | Med/ High | 55 | Medium | 53.5 | Medium | Completed, as yet partial view of project outcomes |
| DD | 7/7 | Push | N/A | Low | 7.67 | Medium | 5.00 | Medium | 7.17 | Medium | 54 | Medium | 34.5 | Low | Imminent completion, confident in expectations of project outcomes |
| BB | 6/8 | Pull | DH | Low | 8.00 | Medium | 4.80 | Med/ High | 8.40 | Medium | 46 | Medium | 62.5 | High | Completed, as yet partial view of project outcomes |

Chapter Eight: Exploratory Quantitative Survey Findings and Analysis

| | | | | | | | | | | | | | | | |
|--------------|-------------------------------------|---------------|---------------------|--------------------------|--------------|----------------|-----------|--------------|-----------------|---------|-------------------------|--------|----------|--------|--|
| NN | 4/4 | Push | NHS | Low | 14.00 | High | 5.57 | Medium | 5.14 | Low/Med | 45 | Medium | 37.2 | Low | Imminent completion, confident in expectations of project outcomes |
| Project Code | Survey Respondents/ Core Members | Push/ Pull | Collab Resources | Diversity/ Complexity | Bounded-ness | | Stability | | Interdependence | | Alliance Performance | | Progress | | Current State of Project |
| GG | 5/6 | Pull | NHS | High | 6.20 | Low/ Medium | 7.40 | Med/ High | 7.00 | Medium | 41 | Medium | 58.1 | Medium | Imminent completion, confident in expectations of project outcomes |
| OO | 4/7 | Push | NHS | Low | 10.00 | Medium | 3.17 | Low | 7.00 | Medium | 32 | Low | 36 | Low | Not yet complete & significant uncertainty over project outcomes |
| AA | 5/9 | Pull | DH | Low | 4.67 | Low | 3.00 | Low/ Med | 4.00 | Low | 31 | Low | 35.8 | Low | Not yet complete & significant uncertainty over project outcomes |
| EE | 6/8 | Push | N/A | Low | 4.60 | Low | 6.00 | Medium | 4.20 | Low | 28 | v.Low | 24.5 | V.Low | Not yet complete & significant uncertainty over project outcomes |
| CC | 7/7 | Pull | DH | Low | 8.50 | Medium | 2.75 | Low | 4.75 | Low | 24 | V.Low | 38.9 | Low | Imminent completion, confident in expectations of project outcomes |

Table 39: Exploring Ranking Analysis result further, the projects are presented in order of performance and progress, as well as Creativity and Intrinsic Motivation

| Project Progress Performance Ranking | Project Creativity IM Rank Order | Creativity Measure | Intrinsic Motivation Measure | Gender m:f ratio |
|--------------------------------------|----------------------------------|--------------------|------------------------------|------------------|
| 1 | 15 | 62.2 | 11.8 | 4:2 |
| 2 | 3 | 61.3 | 14 | 3:1 |
| 3 | 5 | 60.8 | 13.8 | 2:3 |
| 4 | 14 | 55.1 | 13.1 | 6:1 |
| 5 | 9 | 54 | 11 | 4:0 |
| 6 | 6 | 52.3 | 13.5 | 4:0 |
| 7 | 11 | 51.5 | 11 | 2:0 |
| 8 | 4 | 51.2 | 14.5 | 6:0 |
| 9 | 1 | 49.3 | 14.7 | 3:1 |
| 10 | 7 | 48.6 | 10.6 | 4:1 |
| 11 | 8 | 47.4 | 14.1 | 7:0 |
| 12 | 2 | 46.8 | 11 | 3:2 |
| 13 | 10 | 46.5 | 8.5 | 4:0 |
| 14 | 12 | 40 | 9 | 0:5 |
| 15 | 13 | 35.3 | 8 | 3:1 |

IV Summary of Project Level Findings

The project level correlations tend to demonstrate similar patterns and relationships between the variables, including the unexpected negative relationships between the other variables and creativity and intrinsic motivation. Many of these relationships are found to be even stronger at the project/team level which supports the findings, but extreme caution must be exercised in interpreting these results due to the small sample size when the individual responses have been put together.

The ranking analysis (cited in Surtees, Knight & Shipton, 2014) demonstrates interesting patterns within the data, which can also be used to inform the proceeding phases of data collection. The label “collaboration resource” is used to specify which organisation (DH or NHS) was involved during the development phase at the beginning of the innovation. Differentiating between push and pull innovation has also been included, helping to distinguish projects that have been initiated by firms creating brand new products and healthcare organisations seeking clinically applicable solutions to their care delivery requirements (Surtees, Knight & Shipton, 2014). In some instances the DH called for a solution to be designed to satisfy a need, with companies that felt they were able to provide a solution applying for prototype funding to put forward a proposal and win further funding to progress the innovation into a product for market. Public funding was also made available in some ‘push’ projects; many SMEs had applied to NHS bodies which allocated seed funding and other resources in return for a stake in the innovative device. In some cases firms also involved non-healthcare providing collaborative partners, such as academic institutions for their academic break through and technical expertise or small consultancy businesses to help with the business and financial approach (Surtees et al., 2014).

The notion of push vs. pull should not be conflated with whether public financial resource has been involved in the project. Whilst pull projects receive high attention from healthcare

providers, push projects may also receive significant resources from the public sector. Certainly, the highest performing projects, both in terms of progress and alliance performance are push projects that have also received input and resources from the DH/NHS. Additionally, none of the 'push' projects that did not receive input and resources from the DH/NHS made sound progress (Surtees et al., 2014).

A suggested reason for the relative low progress in these projects is that when dealing with a product that is already developed, the design must be malleable and flexible enough to take into account the alterations needed to meet medical device compliance. No clear link was found between project complexity (the number of individual participants, and the number of organizations involved) and reported alliance performance or project progress. Nevertheless diversity is found to be lower in the least successful project teams (see Table 38), with no linear pattern amongst the other variables for these projects (Surtees et al., 2014).

Projects that were in the middle of the alliance performance and progress rankings were found to have no clear patterns amongst the other data. However, projects that were grouped together as low in alliance performance and progress were found to have low self-reported scores in stability, interdependence and boundedness (Surtees et al., 2014). The converse is also true: those ranking higher in alliance performance and progress had higher scores in these three variables. No links were discernible between where projects ranked for performance/progress and the type of innovation. For example, project 2 and project 3 have many similarities in terms of the technology involved (product family, user interface), value (type and scale of impact on health outcomes), involvement with DH/NHS and diversity/complexity, however they are separated within the table. The differences between the projects and their outcomes appears to be related to team and alliance performance characteristics (Surtees et al., 2014).

When the data was reviewed in terms of the creativity and intrinsic motivation scores, there was no clear pattern between these variables and the variables that had previously ranked the

projects (Performance and progress) – bearing out the negative correlation relationships previously revealed between creativity, intrinsic motivation, and psychological safety. There was more of a balance of gender diversity within the teams scoring high in creativity and intrinsic motivation.

Many significant results have been found within the correlation analyses which, coupled with strong Cronbach's Alpha scores for the scales used, indicates that insights from the organizational team literature have been translated appropriately to measure the construct as originally intended, and can be extended to interorganizational team activities and behaviours.

The findings were not as strong as those found within the organizational team literature, however this sample was relatively small due to access constraints. Despite this, more investigation is needed regarding the differences in patterns between the within and cross-boundary teams. While significant findings were on the whole as expected, the strengths of the associations were not and this may indicate some slight differences between the two contexts or the presence of a mediating factor not found in the organizational team context.

Two variables which correlated with each other as expected were intrinsic motivation and creativity. These were found to be significantly correlated with many of the variables indicating that there was an association. However it was unexpected that creativity and intrinsic motivation would not be positively indicative of alliance performance and project progress, or of psychological safety. This could indicate an issue with the scales used in the novel context however, the Cronbach's Alpha indicates that there is still strong construct validity. Therefore it is more likely that mediating factors are at work, and that time has an impact on which variables are salient. This is a constraint of cross-sectional data collection, and although unavoidable the sample of projects were not surveyed at the same progress point within their project. Insights on the research process and opportunities for refinement and further research are discussed in Chapter Ten.

Chapter Nine: Interpretation and Discussion

In this section of the thesis, there are two chapters each involving discussion and conclusions from the preceding chapters which have presented the data and findings. In this chapter the results and findings from all of the phases of data collection will be brought together and discussed. The beginning of the chapter focusses on understanding the meaning of the data as a whole, identifying all key themes as a foundation for the end of the chapter in which the findings will be presented in relation to existing theory. In the final chapter the research questions will be answered and the implications and contributions of the research will be discussed.

1. Assimilating Themes and Findings

In pulling together the themes and insights from each of the Phases of data collection, the external environment and the impact this context has had on the data will first be discussed, then what these interorganizational projects look like in terms of shape and membership will be explored. Then finally insights relating to team working, team behaviours and team processes are examined.

1.1 Context and Impact of the Contemporary Environment

A key theme, throughout each of the data collection phases relates to change within the NHS and frustrations of how to move things forward when working alongside the NHS. It is evident that projects such as those belonging to the research sample can run for a long time, even simultaneously with organizational and political changes being made. It is difficult for all companies to pursue their projects through to procurement outcomes. With SMEs however, this creates a much more immediate issue due to the inherently small financial foundations upon

which they sit. For SMEs, they must be able to survive financially throughout the periods of slow progress until the investment begins to provide financial returns. While this creates issues with being able to continue with projects and can lead to the exploration of other markets, it is possible to seek funding and support from a range of organizations which have been encountered throughout data collection.

At the time of the research there were several avenues for SMEs to pursue funding and resource based support; including TSB Grants, the Health Innovation Challenge fund, funding through University project members, funding through NHS project members, creating joint ventures alongside trusts, Medilink and funding through NHS bodies. A proportion of projects for the sample came from an NHS body (NIC) who provided seed money, resources and support to small and medium sized businesses to aid in the development and pre-testing phases of innovation. Qualitative interview data showed that this seed money was important to the projects, often sought at a time where the project was on the brink of folding, and as such the NHS had been aware of the difficulties of resources associated with SMEs.

The NIC was a clear implementation of Department of Health and NHS strategy to engage with industry, in particular with SMEs, in procurement and innovative procurement activities. The loss that is demonstrated by two of the projects during the interview data collection indicates that the NIC was instrumental at key points of the process for these projects. However, it is clear that the NIC required much more visibility and publicity in order to raise its' profile. Indeed, the researcher was not informed about the existence of the NIC by any of the NHS contacts accrued but by Medilink WM.

The gap left by the closure of the NIC has manifested as frustration on the part of these projects with the lack of continuity and the mixed messages communicated to them by the new Academic Health Science Networks, 15 regionally appointed networks aimed to work

alongside industry in development projects. There appears to have been miscommunication with regard to bequests left by the NIC and also in terms of whether the projects are interesting to their regional AHSN. This frustration has led to one project making a low priority of working alongside the AHSN and continuing the relationship directly with the NHS as very low on his list of priorities. Two have not sought out interactions with the AHSNs at all and the final project featured in the qualitative data collection has felt that a project originally started and driven by the NIC has now become entirely their own responsibility.

This transition phase within the time of the PhD research project has displayed that the NHS has implemented change in order to deliver policy and strategy to build relationships with SMEs and industry. However, existing bodies and projects have not been transitioned in a joined up manner. Each of these projects were initially granted seed money and funding and in some cases the patents were purchased by the NIC. If these projects are now being driven wholly or mainly by the SME, having been previously given public money, there is a question about why the NHS' financial investment has not either been pursued or supported since the closure of the NIC.

In addition, while it is evident that the change was implemented in order to deliver these strategies on a more regional basis, the speed of establishing the AHSNs was too slow for SMEs to be able to wait around. It took approximately 18 months from the closure of NIC and the other bodies which were closed as part of the sunset review in 2012 for the AHSNs to be fully set up. This amount of time in the private sector can have real implications for the financial well-being of any company, let alone SMEs working on personal investments. Therefore it seems that the speed of change and action with the NHS at policy and strategy level has been extremely mismatched against the speed at which SMEs need to see progress in projects. For these projects this has been a predominant and large barrier to overcome.

1.2 Structure and Membership of the Project Team

The size and configuration of the project teams was probed within the interview phase. We can see that the size of the project team is correlated positively with alliance performance, so that as the size of the immediate project team increases so too does the alliance performance measure score from the quantitative exploratory survey. This is interesting when considering this result against the interviews. The higher performing teams have distinct but large project group membership whereas the lower performing teams have fewer members within the core group.

A further pattern when considering these variables in relation to membership and shape is observable. All of the projects involved in data collection vary from each other with regard to how the project was set up, the shape of the project and the levels of interaction between the different collaborating organizations. In addition there is another level of difference when considering which types of organizations have been involved in the collaboration. As such it is difficult to discern a particular type of interorganizational project that is successful or unsuccessful. However, the results have indicated that there are some factors that are more likely to be found in successful projects and additionally there is a common structure or shaping of these team collaborations that can be used as a generic profile for these teams.

The exploratory quantitative analysis demonstrated a negative effect of number of NHS team members within the project team on the alliance performance measure. So the more NHS team members identified as within the core team working on the project, there is more likely to be a negative effect on the alliance performance. The relationship with NHS individuals belonging to the team may be related to several factors encountered throughout the data collection phases. During the survey data collection, there was a period of reviewing of the NHS, structural change being decided upon, strategic re-evaluation and the change and strategy being implemented. Some of the changes are still being finalised. Many of the sample project

teams could have been effected by these changes as NHS members may not have been able to commit as much time to the project, may have faced uncertainty and therefore found it difficult to fully support or adequately promote system change or may have been waiting for announcements to be made in terms of their own job security. The sample did feature several projects involved with the NIC and those within the interview sample expressed that there has been frustrations associated with the manner in which the closures and restructuring have been rolled out and lack of clarity regarding where they should turn for similar support.

Conversely, there was a positive effect on alliance performance demonstrated in having either another collaborating commercial organization involved in the project and also in having 'other' collaborators involved i.e. academics and charities. These relationships and partnerships tend to be more formalised agreements, due to both financial or intellectual property concerns and ownerships. As such, it could be explained that there is a more formal relationship created and therefore objectives are more likely to be monitored and delivered. Moreover, one of the projects involving the NHS had a structured formal agreement for their joint partnership and this was one of the highest performing projects in the sample. Although not a similar collaborating organization set up, it could be that more formal agreements and defined expectations allows individuals to feel they know what to expect, when to expect it and that they can ask when it has not been delivered.

It has been observed within the qualitative phases of data collection that these teams tend to have a core project working group and a peripheral group around the team who are mainly present for advice and support, as well as networking. This could help to explain the findings that NHS members in the team can lead to lower alliance performance, given that the NHS members tend to provide this peripheral support. If these NHS members are busy and not formally in agreement with the companies, they may be classed as within the core team but

really providing a peripheral supporting role. This structure is an interesting one to explore further, as it suggests that the strength and level of collaboration with the project team could provide a structure and shape that could be seen as common across all of the teams.

Moreover, the strength of relationships within the team could be argued as being affected by the ‘origin’ of the project. If the project is a “pull” project whereby the NHS has either put a call or competition out with a clinical issue they would like resolving, this will create a different dynamic within the team. Similarly, if the innovation has been developed externally by either a designer or an academic, or both and they are then “pushing” it to the NHS for purchase, there will also be entirely different factors at work. This requires more investigation, however the structural change experienced by one of the interview sample projects which was originally a “pull” project is now being driven by them, as they attempt to “push” it into the NHS. Furthermore, two of the lowest performing teams were “push” projects and as a result it can be suggested that the relationship between project and NHS support is indicative of performance, but that having NHS members within the core project team (and perhaps no other collaborating organization) may support the correlation findings that this damages alliance performance.

1.3 Team Practices and Processes

The psychological measures of being a team (TDS), demonstrated that the boundedness, stability and interdependence of the team positively impacted upon project performance. This suggests that the more clarity over the boundaries of the project, for example who is and who is not within the team, the more likely that project is to progress and perform well. Moreover, if the work is interdependent, or mutually beneficial and the project team is also stable over time, it is also more likely to be successful. This is interesting on a number of levels. Firstly, as discussed earlier there was found to be different levels of membership within the project group and this clarity over the value that each individual add to the project either as a core or peripheral

member, may affect the comfort and stability within the project. This is evident when the interview sample is considered too, as the higher performing teams were able to articulate clearly each individual who was involved but also what sort of contribution they were able to give. The lower performing projects on the other hand encompassed everyone, even those that may not have included themselves within the project team. Finally mutuality of benefit was explicitly mentioned as a strengthening part of the higher performing interview projects, supporting the idea that interdependence is a key factor of success.

Evidence for psychological safety having an effect on the progress of the team was found in the quantitative questionnaire analysis. There was a correlation between team progress, alliance performance and psychological safety. This suggests that, in projects that are performing well and making good progress, there is higher psychological safety. This is a measure of how comfortable and safe the individuals would be in taking risks and making novel suggestions without risking judgement from the rest of the team. This is, in itself, an interesting relationship. However, it is also interesting to consider it within the interviews.

In the project that has essentially succeeded in obtaining its goal, it was not mentioned explicitly. However, it was implied in themes such as open communication and mutually understood and agreed goals for the project. In the medium/well performing projects with still some way to go it was alluded to, but in the low performing project with no NHS involvement it was not alluded to within the interview. It could be suggested that the presence of other factors gives rise to a culture of psychological safety being developed within a team and indeed the circumstances and origins of the innovation and project will have an effect on this as some members of projects will not have the opportunity to engage in any team activities that would help to develop psychological safety.

The relationship found in the exploratory quantitative analysis between creativity, intrinsic motivation and performance measures was not wholly as expected. The quantitative analysis revealed that there was a negative relationship between both creativity and intrinsic motivation and the performance measures. So as creativity and intrinsic motivation went up, the performance scores were found to be lower. This was also true of the relationship of these two variables (creativity and intrinsic motivation) and psychological safety. It could be due to the phase that the project was in at the time and this is a fundamental problem with cross-sectional data. If this was the case, projects undergoing creative, dynamic development stages would be making less progress as these developments occurred, however despite less progress being made one would expect it to be an exciting, creative and intrinsically motivating time. Moreover, this may be at the very start of the project, where funding and financial return are not a main focus and developing both the product and the team relationships (building psychological safety) are very much at the forefront of activities.

This explanation can be evidenced in the qualitative interview data, which appears to explain these findings from the questionnaire data. Again creativity was found in the projects with some way to go, and that had a tangible product with some development needed before it could move any further. Financial concerns were expressed by those past development stages with members reporting feeling themselves stagnating in bureaucracy and awaiting adoption. When creativity was described it occurred at the beginning of the project. The relationship found in the quantitative section could also demonstrate that these particular scales were not suitable to being applied in this context, however the Alpha scores and significance of the correlations suggest that this is not the case.

The idea of communication was explored extensively within the quantitative data, and revealed that more regular communication had a positive effect on alliance performance. In

addition, the number of attendees at these meetings was found to have a negative relationship with project progress and overall small group meetings were found to have a positive relationship with team factors, psychological safety and the performance measures. Thus more regular, small group meetings seem to be more indicative of better performing teams engaging in positive team practices. This is an expected finding. However, the negative correlations with whole group meetings were not expected and remain largely unexplained as it would be expected that everyone working together and catching up would give rise to several benefits of working together. During one of the interviews however, an insight from the respondent raised something that had been observable but intangible throughout data collection. It is the level of formality that is important in these situations.

The respondent explained that actively engaging in informal as well as formal communications and meetings helped to ensure that the discussions taken for granted in every day interactions within the same organization in the same building took place. The benefits included building stronger relationships, building trust (often suspicion is strongly felt within collaborations) and also help to ensure that there was an understanding of the different languages inherent in the different organizational cultures.

Leadership and the types of relationships and methods of management observed throughout the data collection, revealed several insights. The lower performing interview project kept a large power distance between himself and those working on and developing the technology, even though they felt they “owned” the project and were very much part of a “team”. This distance was evident when comparing with another project. Both admitted within the interview that they knew very little regarding the technology or software and were by no means able to do what the other members of the team could do as they were not experts. However, during the interview the lower performing project (8) did not go into any detail about

the project and was observed in several meetings making technologically impossible suggestions for development.

In contrast the higher performing project likes to ensure that everyone feels they are adding to the project, demonstrates more understanding of the technology that he has picked up and can talk convincingly in detail about the technical aspects of the software. This also demonstrates that discussion with each individual about their job, what they have achieved and if they need support is necessary in order to keep track of what is going on.

By virtue of all being small companies, the leaders prefer to see the workings as democratic and them only having the final say – echoed in each of the interviews. The leader does have a large responsibility when it comes to patents for medical devices and so in order to be particularly hands-off requires a large amount of trust in the team. This is a theme that really only emerges in the interviews – the trust that the ‘owner/leader/co-ordinator’ displays in his/her project work team.

During the qualitative data collection, specifically during the interviews, evidence suggested that the leader must be enthusiastic and motivate the team members. Across the four projects, all leaders report themselves or are reported to be enthusiastic and responsible for driving the inspiration of the project. Perhaps this is another explanation for why intrinsic motivation was not found to have the expected correlations with other factors in the individual responses, perhaps other factors such as the enthusiasm and motivation of the leader mediates the relationship.

2. Interorganizational Team Interactions

2.1 Communication and Relationship Building

Nissen, Evald & Clarke (2012) have stated that research is limited regarding how individuals in collaborative partnerships work together. Nissen et al., (2012) began to address

this and reported that high levels of collaborative interaction allowed organizations to participate in user needs-based knowledge development as well as obtaining deeper understanding of the public sector and its operation. This maps onto the higher performing organizations featured in the qualitative interviews (Phase 1i), which found that successful projects had engaged in high levels of interaction at formal and informal levels. Furthermore, the questionnaire data from Phase Two reveals that team psychological safety developed through interaction and relationship development was correlated with high performance. Nissen, Evald & Clarke (2012) report that different forms of interaction are required, although little is known about how these different forms of interaction influence progress.

The suggestion that different forms of communication are required can be evidenced in the results from Phases Two and Three, where the frequency of small group meetings was found to positively correlate with team climate measures as well as progress, performance and the current state of completion. Furthermore the in-depth qualitative interviews (Phase 1i) revealed that teams working within the same building regularly, or those that made the effort to engage in informal meetings and communication beyond the prescriptive formal relationships within structured meetings were those which were performing more successfully and had progressed the project more. Moreover, there was indication that these informal relationships at the higher levels of the hierarchies were extremely important in ensuring that this was a culture adopted throughout the project team. This suggests that ensuring that working relationships within the interorganizational team emphasise informal and formal relationships and conversations, as would happen within a single organisational boundary can help to achieve: more transparent organisational boundaries, understanding of each other's language, understanding of each other's pressures and a suitable environment to have difficult discussions.

The communication and relationship dynamics within an interorganizational collaboration have been suggested to occur at two levels; interorganizational and interpersonal and while these are considered mutually exclusive due to the different content in the relationships, they are inextricably connected (Oliver & Liebeskind, 1998; Rousseau, 1985) and more research into how they affect the interorganizational collaboration has been called for.

This research demonstrates that interorganizational (formal) and interpersonal (informal) relationships both need to be present if the project is to be successful and reach their desired objectives. This is articulated by one of the interviewees who explains that ensuring the “water cooler” conversations are not missed despite not working within the same building, has led to deeper insights into the working of the NHS, its’ culture and language. This in turn is seen to allow for difficult conversations to be had and discussions entered into with an approach that would suit and appeal to the NHS decision-makers.

These interpersonal ties are especially important for more senior members of the organizations involved in the partnerships. Interpersonal interaction between senior executives have been found to support the formal partnership in interorganizational collaborations (Ring & Van de Ven, 1994), supported again in the qualitative interviews. More research is still needed on *how* these relationships and interactions become successful (Nissen et al., 2012), and also to understand these interpersonal and interorganizational level relationships (Brass et al., 2004, Marchington & Vincent 2004, Gulati, 2007).

The concept of embeddedness of organizations within a collaborative partnership refers to the extent to which the decision-making is free or constrained by the not-for-profit organization involved and is often described as contextual embeddedness (Sydow, Lindqvist & DeFillippi, 2004). It is dependent on the individual, interpersonal ties and serves as a factor in shaping the relationship dynamics at play within an interorganizational project (Barden &

Mitchell, 2007; Granovetter, 1985). The level of embeddedness has undoubtedly been confirmed as strong within the NHS portion of the interorganizational team.

This is demonstrated in the level of understanding regarding the political environment and the NHS strategic and decision-making processes that the SMEs in Phase Three demonstrate. These insights into the culture and external environment can be seen not only to be used as a mitigating explanation to explain away slow progress being made, but also in the intention to use their insights of the context to moderate the approach used by the SME. For example, being aware that the decision-makers are risk averse and ensuring that all possible risks have been considered and expressing this during a meeting, or understanding that AHSNs are positioning themselves in alignment with NHS strategy and allowing for the speed at which this is happening by explanations such as poor communication from policy makers.

In order to better understand these relationships, the organizational team literature insights have been applied to the context of interorganizational teams formed between the NHS and SMEs. The back drop of the exploratory, ethnography data show that this was a suitable fit and much of the historical team literature has sought to identify the intricacies of how a team works together. It has been reported that interpersonal level connections at a more informal level eventually transform into self-reported interorganizational trust (Zaheer et al., 1998), however the literature review identifies that much more research is required to understand which team processes are involved and also which other team climate factors are important to the success of the project team.

2.2 Building Effective Organizational Innovation Teams

There are difficulties in arranging a team that spans organizational boundaries, particularly when the two organizations are diverse. The commercial private-sector nature of the SME in this case is extremely different from the extremely large public-sector NHS organizations. Brown & Eisenhardt's (1997) study of tensions and differences between

collaborating organisations' long and short term goals can be transcended when the two organisations have closer strategic alignment. This supports the findings in the qualitative data that the projects that started as a result of NHS "pull" innovation strategies or those which were highly mutually beneficial in terms of fulfilling each other's strategic goals made significant progress and displayed high performance.

The team literature reports that team size is optimal between a range of three and seven members (Robbins & Judge, 2007), which can be supported somewhat by the results given that all of the sample featured teams of 3 or more members, with the median number of members as 7. However the results indicate that as team size increases so does alliance performance. That said the correlation reveals only a weak relationship and this would need more research with a larger sample to suggest that in fact in these interorganizational teams there is a different relationship with team size. Rese, Gemünden & Baier (2013) have found that too many individuals involved in interorganizational projects effect performance negatively.

With regard to the structure of a successful team, there is evidence in the findings that this is: a core group of individuals actively working on the project; and a peripheral group that are a support resource for the core as and when required or available. More research is required here to determine whether there are other successful structures, however this is difficult to separate from context and innovation project-specific factors. What can be clear from these findings is there are strong distinctions between acting and advising roles in membership and varying individual perspectives on who belongs or doesn't belong to the core interorganizational team is an interesting but confounding variable.

The findings also indicate that:

1. Including members from other collaborating organizations (such as academics) is related to a relationship with low agreement with the project objectives, lower progress and reported

current state as being further from completion. However there is a relationship between academic collaboration with higher levels of alliance performance. This suggests that more tangible outputs and performance outcomes are likely when working alongside an academic institution.

2. Project progress is higher in teams with more NHS members but alliance performance is lower. So the project may feel that movement is occurring and progress is occurring but performance outcomes are less likely to be reported.

3. Involving another commercial collaborating organization is related to higher levels of alliance performance, psychological safety and team satisfaction. Therefore another organization with similar objectives for the project and drivers behind collaboration will be more strategically aligned and aware (Brown & Eisenhardt, 1997).

Not only does this support the literature surrounding closer alignment of organizations supporting more effective interorganizational collaboration (Brown & Eisenhardt, 1997), but also the finding that collective identification in networks, as well as diversity can improve effectiveness (Van der Vegt & Bunderson, 2005). Another commercial collaborating partner will have similar general strategic goals while the diversity from NHS and academic involvement serves to improve the effectiveness. However this effectiveness is demonstrated in different ways, progress is higher with NHS involvement and alliance performance is higher with academic involvement. This distinction lies in the difference in outputs of product development vs the progression of a project being adopted by the NHS, and that the NHS is seen as a driving force for projects while commercial and academic collaborators are able to deliver outputs.

It could be inferred that this is due to the different stages of the project and NHS involvement is seen as more beneficial at times of greater innovation and development (Primo

& Admundson, 2002) and NIC advocated this principle. However, the literature suggests that generalists are better suited to projects that are extremely innovative (Rese, Gemünden & Baier, 2013), so deploying individuals that can understand and adapt to each of the requirements of the broad role. A key theme of the research is that insights into each other's organizational cultures is vital in understanding the associated pressures and how they are impacting upon the projects progression. The findings from Phase Three also indicate that clear roles are a key feature in the projects which is also supported by Rese, Gemünden & Baier (2013), who state that role definition is key but that project generalists should be within the more all-encompassing roles as they will be able to adapt to different phase requirements.

2.3 Developing Effective Interorganizational Teams

There was no relationship found in the data between the time that the individual had been a member of the interorganizational team and performance measures. This was not expected as familiarity of team members has been found to significantly affect team performance (Gruenfield et al., 1996). However, the expression of belonging to the interorganizational project team and the feeling of working as a team which is a theme throughout the data collection, could map onto collective identification well. Collective identification in collaboration has been found to indicate the effectiveness of the collaboration (Van der Vegt & Bunderson, 2005).

Team identification has been found to be developed through rich communication (Rockmann et al., 2007) which is demonstrated in the results from both the questionnaire and the qualitative interview data, demonstrating that frequent communication and a commitment to formal and informal communication helps to develop strong relationships. Undoubtedly these relationships do develop over time and more than half of the interorganizational teams had been working together on the project for three or more years. The fact that the projects are

on-going for a long period of time works in the favour of developing interorganizational team cohesion (Bakker, Boros, Kenis & Oerlemans (2013) and reducing the impact of team conflict. Bakker et al., (2013) found that project duration has a positive effect on team processes, reflected in the results in this research related to team characteristics.

Hackman (2002) reported six characteristics of teams: shared objectives, interdependence, boundedness, stability, specified roles, autonomy, with reflexivity being added by Richardson & West (2010). All of these characteristics have been supported and observed within the phases of data collection, and in particular the measures that were tested in the quantitative survey were found to significantly correlate with all performance measures, demonstrating that the presence of these team characteristics were linked to team effectiveness. Reflexivity was revealed strongly within the Phase 1i data collection. Reflexivity will be discussed in more detail in the next section as it corresponds better with team activities witnessed in this research.

As a result of these findings, the full TDS (Team Diagnostic Survey, featuring these six characteristics) must next be tested within the context of interorganizational team setting. However, we can conclude that Phase 2 exploratory testing suggests that these characteristics can go beyond teams within an organizational boundary. An additional characteristic must be added to the scale in order to sufficiently identify interorganizational teams; boundary spanning. Boundary spanning is the extent to which an organization's sphere of activity, resource use and interaction goes beyond its own tangible boundary in order to continue to survive (Aldrich & Herker, 1977). In pursuing boundary spanning activities it is down to individuals to establish and maintain relationships (Stock, 2006). Therefore this sits well in the team characteristics as it reflects the scope of the activities and also is a member level responsibility. In this research

boundary spanning has not been measured, and a scale for this as an interorganizational team measure is required in order to include this in an interorganizational TDS.

It has been found that these team characteristics are linked to interorganizational team effectiveness and the development of these characteristics must be understood more closely (Albanese, 1994). Albanese (1994) found in public-private interorganizational teams that there were large benefits, including financial benefits, associated with team building processes. This research indicates which characteristics of the team must be built through these processes, and the interview data indicates that these practices and processes can be developed over time and through informal and formal relationships when objectives and strategies are closely aligned.

2.4 The Role of Leadership and Champions in Interorganizational Teams

The theme of leadership was explored within the Phase 1i qualitative interviews and important styles and practices were identified. Previously it has been reported that leadership attitude towards collaboration and the innovation it drives is the most vital factor in collaborative innovation (Zach, 2011). Chiefly, Zach (2011) found that leadership was responsible for driving the communication between the organizations and also in formalising the innovation process. This maps onto the example of the project engaged in a project delivering an online mental health care community where the agreement was formal and different types of communication were engaged in by the leaders and this extended to the activities of the other members of the team.

Moreover, the enthusiasm, unwavering motivation and commitment to continue with the project despite pressures and challenges were characteristics found in each of the project leaders. Several of the leaders revealed extensive knowledge of the political and strategic environment through their discussions. All actively engaged as part of the team but felt that they maintained the ultimate decision-making power. This sits well with the notion of transformational leadership from the organizational behaviour and work psychology literature

(Dubrin, Dalglish & Miller, 2006) with its four dimensions: motivation through inspiration, idealised influence, consideration at an individual level and intellectual stimulation (Yukl, 2008). Transformational leadership characteristics include a focus on more longer-term goals, innovation (Samson & Daft, 2005), long-term change, motivating subordinates to increase effort and performance through inspiration (Davidson & Griffin, 2003) and vision and commitment towards more challenging and pressured situations.

Huxham & Vangen (2005) devised a more simple set of characteristics that are important in interorganizational collaboration leadership. They assert that the leader must be aware of the political and cultural climates involved and must be able to face them. Moreover the leader must display a facilitative and directive nature when leading in an interorganizational collaboration. These are both found in the data set. However, while the leadership styles and characteristics are important (Slater, 2005) within interorganizational collaboration projects, more understanding of the practices that they manifest themselves in is required. Some evidence has been collected with regards to engaging enthusiastically, motivating through inspiration, communication. One key observation has been made between one high and one low performing project involved in Phase 1i.

While both leaders admitted that they were not technological experts when it came to the project technology, one displayed excellent knowledge of the intricacies of the technology and one did not. This insight displays the difference in interaction between these leaders and their team members. One leader (P1) did not understand the technology and left those that did to their role, perhaps demonstrating trust but demonstrating no interest in learning more detail about the project he was apparently enthusiastic about. The other leader (P2) asked questions and sought to understand at a basic level what each individual was working on. It is unsurprising when we consider transformational leadership as a leadership style that the practices observed

of the leader of P2 were also linked to the higher performing and most progressed project of the two.

Rese, Gemünden & Baier (2013) state that generalists are more effective as members in interorganizational collaborations. While this gives rise to individuals understanding a more holistic perspective of the collaboration, in this context of interorganizational teams formed of SMEs and NHS, the differences between the organizations mean that this is extremely difficult to achieve. Awareness of the need for a holistic perspective on issues has been observed through the involvement of healthcare or NHS-based champions. Many of the projects have key members that work within the NHS and devote large amounts of time as well as lending their expertise and gravitas to the collaborative project. Without these champions, NHS strategic change meant that NIC promoted projects suffered. Those that did have a champion were able to draw on this connection. Whilst none of the champions were interviewed, they were spoken about with a high level of respect and esteem bestowed upon their expertise, knowledge and ability to get things done within the NHS.

The use of innovation champions has featured in recent research examining the roles that these champions play during the different stages of collaboration projects as well as how these map onto performance (Muzzi & Albertini, 2014). Innovation champion behaviour has been linked to the strength of the team, external channels of communication and performance of the collaboration project (Howell & Shea, 2001; 2006), which this research supports as those without key champions (P1) were found to be one of the lowest performing teams in the questionnaire data.

Practices such as enthusiasm, supportive behaviour, external communication, awareness of the external environment, enthusiasm for the innovation, networking and

motivating members were found to predict champion behaviour (Howell & Shea, 2006). Therefore this is an important factor identified from the data.

2.5 Fostering a Climate for an Effective Interorganizational Team

Having conducted a thorough literature review on trust and psychological safety within teams, the following conclusions were reached. Although trust has been widely applied to interorganizational team literature and psychological safety less so, trust does not explain the feeling of being comfortable and valued within a team. Trust can be associated with home organization factors. Psychological safety and trust are linked, although psychological safety can be associated with the TDS characteristics. However, psychological safety provides a better insight into the decision-making and innovative processes occurring in the context of this research. Psychological Safety was therefore deemed better able to determine more information about the quality of the team interactions and development.

Throughout Phase 1i and 2, the data clearly demonstrates that when psychological safety within the interorganizational team is high, the team is more likely to have high team satisfaction, high performance, make more significant progress and to be closer to completion. While this was expected, it was not wholly expected to correlate so widely with all variables given the difference in the context. Psychological safety has not been as widely applied to the interorganizational team literature previously, and this finding demonstrates that the assumptions made regarding the context and how psychological safety may be insightful in this context has been supported.

The literature that previously highlighted that psychological safety would be an interesting team measure to apply to the context linked psychological safety to team stability (Edmondson, Bohmer & Pisano, 2001). Wong et al., (2008) also found that psychological safety was linked to boundary spanning, trust and an improvement in the interorganizational relationship.

In Phase 1i interviews, it is often difficult to distinguish when the interviewee is articulating trust or psychological safety. However, in a few cases psychological safety is quite clearly demonstrated. Trust does emerge as an important theme within the team, particularly the trust that the leader must bestow upon members of the team that are not always present and accountable, as well as in team members that are not formally bound to work on the project and do so because they believe in the benefits beyond financial reward.

The relationship between trust, performance and interorganizational working has been widely cited in the interorganizational relations arena. Sundstrom, De Meuse & Futrell (1990) demonstrated that there is a link between trust and the values that the team adopt. This is shown in P2 when the leader articulates that the organizational culture developing within the partnership is one which involves everyone, and makes the SME a place people enjoy working in. Maurer (2010) found that antecedents of trust include stability of the team membership and that trust promoted product innovation through encouraging knowledge acquisition from external sources. Trust has been linked to co-operative behaviours (Jones & George, 1998), increases satisfaction (Bresnen & Marshall, 2000a) and has been found to make alignment between partners easier (Atkinson et al., 2006).

Evidently psychological safety and trust within the interorganizational team has significant benefits as well as being influenced by the team characteristics, particularly team stability. More research must be done to understand the other factors which lead to the development of psychological safety and trust within the interorganizational team. However, this research project has highlighted that psychological safety in particular is extremely important which is all the more interesting given that it goes beyond the concept of trust and indicates that members of the team feel comfortable contributing to the team and feel that they are not judged and are valued for their contribution. Moreover, Newell & Swan (2000)

examined networks and propose that there are different types of trust at work in the interorganizational collaboration setting; companion and competence trust are posited. An examination of these concepts in the interorganizational team setting alongside psychological safety may reveal the differences in these different measures of team climate and safety.

Within the project and team level data, psychological safety and trust seem to sit well. However, during the exploratory qualitative Phase One, it was noted that senior level members of the NHS and Department of Health speaking at the NHS Innovation Exposition 2013, felt that a major barrier that the NHS experienced in engaging with industry was a general mistrust of their agenda. This has important practical implications and will be raised later in the discussion.

Reflexivity and revisiting of the vision and objectives of the project at times of difficulty in order to guide the next stage was observed throughout the phases of data collection. Reflexivity is the adaptation of action in ensuing work phases based on what has been learned in the preceding stages (McGrath, Arrow & Berdhal, 2000; Richardson & West, 2010). Reflexivity had not at the time of this data collection been applied to boundary spanning team contexts (Schippers, den Hartog & Koopman, 2007). It has been extensively linked to innovation in teams within the organizational boundary (De Dreu, 2002; Carter & West, 1998; Tjosvold, Tand & West, 2004) as well as with team performance, innovative behaviour and team effectiveness.

The research indicates that these interorganizational project teams constantly refer back to the original brief and concepts in order to guide themselves in the future, as well as using difficulties in the project to learn and change their direction for the next time. There is sufficient suggestion that this would be a suitable measure to be applied in future research into the interorganizational team context.

While reflexivity was not a team behaviour that was wholly expected to come out of the data collection, creativity was expected to play a significant role in the data. Furthermore, cross-functional team working has been found to be the key to creativity and overall firm success (Bolwijn & Kumpe, 1990). Moreover, intrinsic motivation is a well-established predictor of creativity in much of the team literature (Amabile, 1996; Shalley et al., 2004) with intrinsic motivation holding an important part in driving the behaviours that result in creative outcomes (Amabile, 1983) and so these were both included in the questionnaire.

Intrinsic motivation is the difference between team members being able to and actually choosing to engage in achieving team goals, it controls the attention of team members so that they are committed to achieving the team vision (Simon, 1967). The results from the Phase Two survey data do not correlate creativity or intrinsic motivation in a positive relationship with either alliance performance or progress of the project. However, it does demonstrate a negative relationship between alliance performance and creativity. This suggests that as the alliance performance improves, creativity decreases. Given that intrinsic motivation and creativity correlate with each other, we can see that they have accurately measured the constructs so there must be another explanation for why this relationship is found.

Intrinsic motivation and creativity both correlate negatively with psychological safety. When considering this, a suggestion to explain the finding can be made. Psychological safety takes time to develop, while creativity is very much involved in the initial design and prototype development stages early in the product/project innovation stage. Very few of these projects were engaged in creative stages of the innovation. It is reasonable therefore to infer that creativity, as a behaviour, is involved at the beginning of the project when intrinsic motivation is ignited due to the tangible impact that the device or technology could have on quality of care and efficiency in the NHS. As the project leaves the creative development stage, the focus

becomes more centred on getting the product to market and funding it through these stages, thus motivation becomes more balanced between intrinsic and extrinsic. Furthermore, psychological safety has had time to develop and the project is progressing.

This is based on inferences taken from the data set as a whole and more detail is needed from future research to explain this. However, the measure of creativity is designed for teams engaged in holistically creative projects within the organisational boundary. When asked about creative processes in Phase 1i, in particular the design team (P3) discussed creativity as a process that occurred historically and not as something that was always on-going. Therefore future research may consider measuring creativity during the design process, as well as considering measuring creativity as an outcome of the whole project.

The theory does support these findings and assumptions. Creative problem solving behaviour is linked to project performance but less so in climates and cultures associated with risk and change aversion. (Rickards, 1997). Creative behaviours require support for idea and concept generation and change as well as a climate of trust (West 2002; Isaksen & Lauer 2002; Chen 2006). While creativity is necessary for innovation it is not enough to deliver creative outcomes (Amabile, 1983), so it is clear that the complexities of fostering creativity have been previously cited and this finding may be a case of cross-sectional timing biases or due to the risk-averse climate. There is a final explanation highlighted by P3, the design engineering SME, that they were the only members of the team actively involved in the creative process of concept generation. Not all members of the team may be responsible or even involved in the conceptualisation and therefore may not feel that creativity was a large part of the project.

3. Interorganizational Collaboration and Partnerships

Looking at the results beyond the team and project level, the involvement of the NHS early in the development of the product is found within many of the projects in the sample. Wert (2012) asserts that it is particularly difficult for SMEs to involve themselves in public procurement and for this reason the NHS has recently positioned itself with the strategic aim to build relationships with SMEs. Early supplier involvement (ESI) is critical for all types of product innovation (Johnsen, Calvi & Phillips, 2012) and as such many medical device developers seek involvement with the NHS if the project has not originated from the NHS themselves. These different types of involvement can be described as “push” or “pull” innovation which is similar to the concepts of direct and catalytic Public Procurement for Innovation (PPI) and sets of distinctions depend on the involvement of the end user, in this case the NHS (Edquist et al., 2012). In the ever changing landscape and environment of the public sector (Loader, 2007), procurement is very difficult and the involvement of the end user at the start of the project can imply more commitment on their part to the overall outcome of adoption of the product.

A number of challenges and causes of conflict have been identified within the findings of this research and are supported by Vaaland & Hakansson (2003) in particular, differences in goals, trust, learning about the partners, legalising partnerships, expertise, satisfaction (and frustration) with performance have all been noted throughout the exploratory data collection and these require much more detailed research. In addition, differences in pace between the NHS and SMEs can be seen as a source of conflict as well, demonstrated in the findings in many ways: through frustrations with bureaucracy, change, implementation of change and decision-making.

Huxham & Vangen (2005) present seven insights on the challenges associated with interorganizational collaboration. Of these seven, two are particularly salient to this research.

The difficulty of building trust whilst being suspicious of one another's motives and agendas, has been a theme emerging from the data and particularly mistrust is articulated by policy makers and strategy level Department of Health executives. This is an attitude that the NHS must address if it is to achieve its strategic goals of building stronger relationship with industry. Secondly, the idea of constant change and upheaval is resonant with the findings in the research and the frustrations and difficulties articulated as a result of these changes. The impact of change and upheaval on existing projects was not accounted or prepared for at strategy level, only at the level of NIC who did try to prepare and hand over their existing projects. However, this was lost in the chaotic early stages of building the AHSN and has resulted in projects feeling a frustration at having to now drive communication, to start again and at having no consistency.

That said, it seems the answer to overcoming these barriers and challenges associated with the context and with interorganizational collaboration lies in the social capital and relationship orientation (Bartsch, Ebers & Maurer, 2013; Ibrahim, Costello & Wilkinson, 2013). Ibrahim et al., (2013) argue that strong relationships within projects are influenced by human behaviours and practices, including trust and shared vision. The social capital or the relationships of the interorganizational project teams have been found to contribute to overcoming barriers to learning in interorganizational projects (Bartsch et al., 2013). Therefore, although the difficulties lie in the practical environment, the relationship development and the practices influenced by the relationships within the interorganizational project team can serve to assuage these difficulties.

4. Summary

The chapter has documented the relevant literature that supports the findings interpreted from the collected data. The results from this research project can be summarised at three levels: NHS and policy level, project level and interorganizational team level. At the NHS and policy level, findings have suggested that frustrations have amassed in relation to the speed at which

change was implemented and the slow set up of the AHSN. Moreover there are difficulties for SMEs in maintaining themselves during projects that must involve waiting for changes and decisions to be made. For SMEs the financial implications of waiting for bureaucratic decisions to be made and for structures to be set up and able to identify their own remits are felt acutely in comparison to larger organizations in industry. SMEs and interorganizational projects require protection from these difficulties, by the NHS deepening their understanding of SME pressures and through these insights the NHS will be able to understand SME need for increased speed in decision-making, for continuity and joined-up, clear communication.

At the project level there are antecedent and structural conditions that have been found to impact upon performance, these include the size of the interorganizational team and the origins of the project and innovation. The NHS deals well with “pull” projects where they announce funding availability for the solution of particular clinical issues identified within the NHS, however there is little evidence that the NHS is able to effectively and successfully maintain collaborative partnerships that do not feature this and also that do not have formalised agreements.

The results indicate that the presence of NHS and commercial collaborators is linked to the progress of the project while involvement of Universities is negatively linked to progress but positively linked to performance⁸. As such the presence of NHS individuals within the team increase the sense that things are moving forward within the project, while academic involvement does not. However, academic involvement is linked to performance, and therefore outcomes are more likely to be realised. There is scope for further research here in order to assess whether these findings can be mediated by the phase that the project was in at the time

⁸ N.B. Alliance Performance was measured separately and considered as entirely different to project progress. Alliance Performance is related to the achievements of the collaboration, while progress measures the progress of the project as it travels towards achieving its objectives.

of data collection. There are different relationships on offer when collaborating with different types of organizations and these will have varying effects on the progress and performance of the team. More focus on which collaborating organisations are involved in interorganizational teams would provide evidence for the mediating factors occurring. The NHS is able to deal with projects of particular origins but as yet there are not sufficient mechanisms in place for collaborating on projects that approach the NHS with a novel idea in order to refine the clinical applicability.

At the interorganizational team practice level the development of ‘real’ team characteristics is vital in ensuring the team is able to perform effectively and progress the project. Moreover, team-building, leadership and communication practices are important in developing a climate and context which fosters and develops individual team member satisfaction and psychological safety throughout the project and which also allows creativity and intrinsic motivation to be involved in the early development stages while the team relationships are still solidifying.

The combined evidence collected throughout the PhD therefore suggests that there are many factors to consider when engaging in interorganizational team collaboration, and that different collaborating partners may be more useful at different times. In the same way, certain team behaviours and processes are salient at different times of the project. These phases of the project life-cycle mean that external and internal resources must be emphasised differently and supported as appropriate in order to work effectively in the interorganizational team.

Table 40 provides a summary of the key findings emerging from this research and the academic literature which supports these findings.

Table 40: Summary of Key Insights and Literature Support

| Phase and Method | Finding | Supporting Literature |
|---|---|---|
| Phase 1 Exploratory Phase, document scanning, ethnography | <ul style="list-style-type: none"> • Focus on productivity and efficiency • Budget saving • Implemented through new strategy and structure • More relationships with industry • NHS to understand initiating, developing and maintaining industry relationships through learning • Imminent and contemporary change effects | Department of Health (2012, 2008) NHS (2009) Her Majesty’s Government (2010) Her Majesty’s Treasury (2013) NHS England News (2013) NHS Choices (2013) |
| Phase 1 Exploratory Phase, ethnography, presentations, expositions, events, networking, meetings, discussions, team observations | <ul style="list-style-type: none"> • Long awaited restructuring • New strategic direction to engage with industry • Procurement and Innovation on agenda • Variety of approaches to industry collaboration including “push” innovation where innovating organisations approach the NHS and “pull” innovation where the NHS makes seed money available to fund projects which answer a clinical need • Divided opinion over the way NHS works with industry • Disharmony regarding closure of NIC and movement to AHSNs • Difficulties for SMEs associated with funding themselves for protracted periods of time. | Department of Health (2012, 2008) NHS Choices (2013) |
| Phase 1i Exploratory In- depth Qualitative Interviews | <ul style="list-style-type: none"> • NHS restructure and introduction of AHSN creates a temporal factor associated with change that the projects were navigating at the time of data collection. • If the original idea is passed onto a collaborating organisation for responsibility there are difficulties in operationalising contacts introduced through the other partner. • Leadership found to be built on trust and enthusiasm, with more successful leaders taking a generalist role to ensure they know what is going on in each arm of the collaboration. • Champions in the NHS useful in operationalising NHS support and contacts. • Creativity evident at start of project, while team processes build over time. • Reflexivity important in maintaining direction towards the end goal. • Communication important in making organisational boundaries more transparent and ensuring that understanding between the different organisational cultures and languages is obtained. | Ring & Van de Ven (1994) Nissen et al., (2012) Brown & Eisenhardt (1997) Zaheer et al., (1998) Primo & Admundson (2002) Rese et al., (2013) Van der Vegt (2005) Stock (2006) Zach (2011) Yukl (2008) Huxham & Vangen (2005) Howell & Shea (2001; 2006) |

| | | |
|--|--|---|
| Phase 2 Exploratory Quantitative Analysis, Individual Level | <ul style="list-style-type: none"> • Mixture of projects reflecting diversity of approach to collaborative innovation in the medical device sector • Length of time project had been running linked to increased intrinsic motivation, so the project is motivated through the protracted phases internally. • Length of time project team has been working together, reduced ‘teamness’ (interdependence, stability, boundedness) suggesting that time means that other peripheral resources are drawn upon and other ‘home’ organisational pressures are impactful • NHS involvement leads to reduces intrinsic motivation and reduced alliance performance, suggesting that the project loses driving force and innovation outputs are not realised. • ‘Teamness’ and psychological safety linked, team cohesion built alongside psychological safety. • Psychological safety linked to improved team satisfaction • Psychological safety & satisfaction increases as creativity & intrinsic motivation decreases • Progress improves with ‘teamness’, psychological safety and team satisfaction, suggesting that team beliefs and team characteristics being built are related to the progress the individuals feel is being made on the project. | <p>Rese et al., (2013) Brown & Eisenhardt (1997) Van der Vegt (2005) Bakker et al., (2013) Hackman (2002) Richardson & West (2010) Edmondson, Bohmer & Pisano (2001) Wong et al., (2008) Edmondson (1999)</p> |
| Phase 2 Exploratory Quantitative Analysis, Project Level | <ul style="list-style-type: none"> • Low progress in ‘push’ innovation projects without NHS resources, suggesting that some NHS involvement is needed. • High progress in ‘push’ innovation projects with NHS resources, meaning that these projects perform higher than NHS sponsored ‘pull’ innovation projects • Projects with low stability, low interdependence, low boundedness (low teamness) also have lower progress and alliance performance scores, suggesting team relationship building is important for outcomes and progression towards objectives. • Ranking suggests that higher progress means less creativity, which has implications for the point at which creativity is involved in the project. | <p>Nissen et al., (2012) Bakker et al., (2013)</p> |
| Overall | <ul style="list-style-type: none"> • There is a case for using the intraorganizational team literature in the interorganizational setting within the data as ‘teamness’ has been measured and linked to psychological safety and project performance and progress. • The beginning of the project is creative and innovative and with time these phases reduce and so creativity decreases. This could explain the negative relationship between creativity and psychological safety. Time and project phase may mediate this relationship, so as the creative but new team develop team practices and behaviour, creativity decreases. • These ‘teamness’ processes/ practices may explain interorganizational interactions and dynamics. | <p>Bakker et al., (2013) Maurer (2010) Stock (2014)</p> |

Chapter Ten: Conclusions and Implications

Having discussed the meaning of the results and applied the findings to the existing theory from the literature in Chapter Nine, the overall summary discussion will first be presented in this final Chapter. The first part of this chapter will focus on answering the overarching research question as well as presenting the implications of the results from the data and the contributions that the research makes in the academic, methodological and practical senses. Finally the limitations of the research and suggestions for how this research can impact upon future research will be presented.

1. Summary Discussion

The research question that this research has addressed is:

What are the antecedent (input) and emerging factors (process and mediating) that impact upon interorganizational team effectiveness?

From the evidence collected in each of the three data collection phases, insights from the team literature can be mapped onto the findings. Phase One allowed more detail to be collected on the contextual situation and to provide the detailed backdrop for the two exploratory studies. In Phase 1i, the qualitative, in-depth interviews found emerging themes that are easily mapped onto constructs from the organizational team literature suggesting that beyond those explored in this research project, there is merit in continuing to apply further concepts from the organizational team into the interorganizational team. Furthermore, the Phase 2 exploratory quantitative, exploratory survey allowed these themes to be measured. The understanding garnered from the contextual backdrop of the ethnography phase was applied to the most relevant published measures developed in the team literature. The measures have been adapted to apply outside of an organizational boundary and incorporate the concept of boundary spanning. The results have been significant and have correlated with many of the progress and

performance project measures. In answering the research question, an exploratory approach has been utilised (outside-inward, applying existing theory to the context; Adler, 1983) with initial information collected about the context in order to ensure relevance (Buckley et al., 2014).

This question has been addressed by building on the extant organizational team literature, and extending the literature to include teams that span organizational boundaries (Edmondson, 1999; Stock, 2014). Moreover, following on from the move in interorganizational relations literature to adopt findings, concepts and methods from social psychology (Bergenholtz & Waldstrom, 2011), the recent call for papers exploring the “black box” of practices, processes and behavioural factors (Lauche, Berends & Carlile, 2014) involved in collaboration has been explored in this research using an emic approach (examining a contextually specific setting from the inside outward; Adler, 1983). In doing so the group processes and interorganizational interactions have been studied from the team psychology perspective. Although by no means all possibilities have been explored, there have been some important findings that can begin to explain the “how” (Nissen et al., 2012) in relation to these interactions bringing forth successful interorganizational outcomes.

The practices that have been examined within this research can be considered along three categories: leadership and champion practices, communication practices and team practices. Leadership practices such as encouraging and facilitating activity as well as holding ultimate decision-making have been found to allow the leaders to play a role within the team through actively engaging and encouraging individuals in their roles, whilst also maintaining some authority so that work is delivered and team members are answerable. Although role definition within the team is common, projects where leaders attempt to understand intricacies of technical knowledge and encourage discussion between individuals with different roles were found to have made more significant progress.

Communication has been found to be vital in these interorganizational collaborations. Regular meetings and communications support the development of the relationships within the team. However, the correlation between all of the performance and progress indicators and the frequency that small meetings are held suggests that benefit occurs even if meetings are organized and not all are able to be in attendance. Moreover, the results have indicated that beyond the formal, interorganizational relationships, different forms of communication can be used to build more informal, interpersonal relationships. These different forms of communication have been found to provide insight into each other's organizations and the organizational culture and language used therein. As such, with insight and understanding of the direction each are coming from, decision-making and difficulties can be more efficiently approached and dealt with. Team practices that develop, may encourage and maintain a range of different team level variables such as climate, behaviours and attitudes have been found to affect the performance and progress of the team.

Team size and psychological safety were found to have a positive effect on team progress or performance. Therefore as team size, feelings of psychological safety and team satisfaction increased, so too does performance and progress. However, team creativity was found to have a negative correlation with reported current state of the project and alliance performance. No significant relationship was found between creativity and project progress. Creativity and intrinsic motivation were found to correlate significantly with each other, whilst negatively correlating with psychological safety and team satisfaction. This suggests that creativity is present at the outset of the project, during development phases where intrinsic motivation is also high. As the project progresses, interactions help to build psychological safety but the development stage is no longer occurring and financial pressures become more important than the implications for the benefits of the product.

Psychological safety correlated with team satisfaction and is therefore a vital part of the development of the interorganizational team climate, facilitating working relationships.

In applying insights from the organizational team literature to the interorganizational team, it was first important to identify whether the key characteristics recognised by Hackman (2002) were present and therefore whether the sample could in fact be described as an interorganizational 'team'. There was evidence collected on the scales that were deemed to be the most important to demonstrate as being present: interdependence, stability and boundedness. These were all found to correlate with project progress, alliance performance and the reported current state of the project. Shared objectives, autonomy, specified roles and reflexivity (Richardson & West, 2010) were all also found to play a role in team and relationship development. Therefore given that the organizational team insights have mapped onto the interorganizational setting and these key characteristics of teams have been identified in the context of the research, interorganizational teams can be defined along the similar categories, although the addition of boundary spanning behaviour should be incorporated. This is a possible direction for future research.

Many of the findings in Phase 1i and Phase 2 support the insights existing within the literature and the relationships that the factors have on performance and progress measures as well as with each other are reflective of findings in previous research within the organizational boundary. Some surprises were found with regards to the relationship between creativity and psychological safety. This may, however, be due to data collection timings occurring at different phases within the project lifecycle since Phase Three research data did unveil creativity as occurring at the very beginning of the project.

In Chapters Two and Four, the input-process-output and input-mediator-output models of team effectiveness (McGrath, 1964; Ilgen et al., 2005; Stock, 2014) was posited as framework for the exploratory study of interorganizational teams. Having conducted the

research, the data is not sufficient to be able to develop a model, or indeed to test and prove mediating/moderating relationships in the existing model. Previously the team beliefs and attitudes were included within the all-encompassing and ambiguous process, also including team practices and behaviours. This mixed methods research has found some important team behaviours as well as team interpersonal and attitudinal variables that individually have a relationship with progress and performance. As such, an additional model has been identified from the virtual interorganizational team literature (Powell, Piccoli & Ives, 2004), to incorporate and separate emotional processes from activity based processes. This mirrors the models discussed in depth in Chapter Two (McGrath, 1964; Ilgen et al., 2005; Stock, 2014; Edmondson, 1999) which have been used to inform much of the team literature review. However while the model of the focus of a virtual interorganizational team (Powell et al., 2004) includes the concepts of input-process-output (Stock, 2014) as well as contextual factors which have been found to be highly important in this research, it does not include distinctions between mediating variables.



Figure 8: Model of Virtual Team Focus (from Powell, Piccoli & Ives, 2004: pp. 8)

The Powell et al., (2004) model of virtual team focus does provide some guidance in understanding the relationship between team antecedents, beliefs, behaviours and outcomes,

however the direct causal relationships depicted in the diagram cannot be tested using this data set as the sample is too small for such statistical testing. However using the results from interorganizational innovation team context in between the NHS and SMEs in the UK medical device sector, the models have been merged and used as a framework to present the factors and themes emerging throughout the data collection phases of this research. The TDS Team Characteristics develop over time and as such at this time have been positioned to overlap the inputs and processes, as this research was cross-sectional assumptions cannot be made as to whether these should be inputs or processes (or indeed whether they are all task processes or socio-emotional processes).

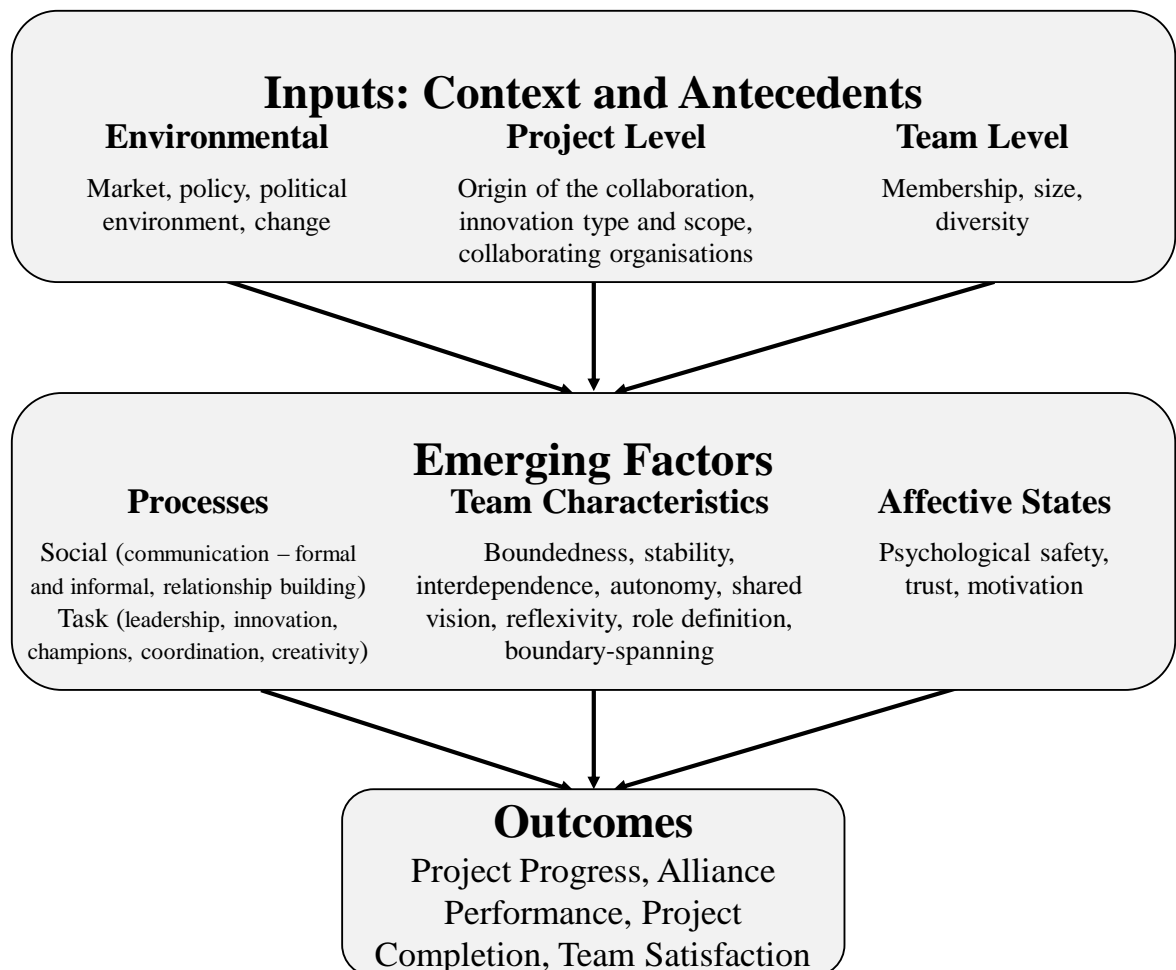


Figure 9: A framework of findings. Factors associated with interorganizational team effectiveness arranged as articulated in Figure One, Chapter Four. Influenced by McGrath, 1964; Ilgen et al., 2005; Stock, 2014; Edmondson, 1999.

2. Contributions and Implications

2.1 Academic

There are several contributions that this research offers to the academic literature.

Firstly, the research has extensively explored a range of existing *intraorganizational* findings and extended this literature into the interorganizational team setting. The findings from the team literature have helped to examine the interpersonal dynamics and relationships at work in a team that spans organisational boundaries and may not be as physically close when compared to the average organisational team. As a result the research has identified that despite a higher level of diversity and with added complexity, factors impacting on traditional team effectiveness can be extended and translated into the interorganizational context. This provides the team literature with an exciting area of application and testing of theories.

Contributions are also made to the interorganizational collaboration literature.

Interorganizational relations as an area for academic study has historically involved applying insights from many disciplines into the context of working across organizational boundaries. Since these early stages, much of the research has concerned structure, functions, learning, innovation and associated antecedents and outcomes and it has become an area for research focus in its own right.

This research has addressed a gap in the literature that concerns how the interpersonal dynamics are developed and maintained in order to achieve successful project outcomes. This has been motivated by a recent call for papers examining the “black box” described by Carlile (2002; Lauche, Berends & Carlile, 2014) which surrounds the behaviours, practices and processes involved in these collaborative interactions. Previously the research has addressed the antecedent factors (Carlile, 2002), and this research has sought to open up understanding of the interpersonal interactions and interorganizational team practices which begin to unpack these gaps in the literature. There have been some recent trends in applying social psychology

(Bergenholtz & Waldstrom, 2011) to interorganizational dynamics, but this research has demonstrated that rather than tentatively applying individual psychology theory, it is possible to apply a range of team psychology and individual psychology to examine these processes and behaviours more closely.

In doing so, the literature review identified that interorganizational team research is a growing area of research and that the organizational team literature featured many findings that could prove useful in understanding the factors associated with effective interorganizational team innovation and performance. The extensive literature on the organizational team based antecedents, practices, beliefs and behaviours involved in team performance and team innovation has provided insights which have been applied to the interorganizational team literature and these insights have been found both to fit within the interorganizational team literature and further this academic field. This research has also served in beginning to examine collaboration interactions, practices and processes involved in interorganizational collaboration projects at the level of project team interaction.

2.2 Methodological

The research project has involved several methods of data collection and has involved a truly mixed method approach. This has been influenced by the reality of the contextual motivation. In order to understand the context ethnography, document collection, website research and networking was carried out during Phase One, revealing detail about the policy and strategic context of the NHS and the difficulties that SMEs were experiencing. This Phase also marked the beginning of negotiating access to potential projects that would be involved in the research and provided the background understanding of what characteristics these projects may have.

This information provided insights for the Phase Two questionnaire development, and allowed the most relevant scales to be identified in order to mitigate for response fatigue by

ensuring the participants weren't bombarded with too many scales asking either irrelevant or similar questions. The scales were adapted by changing team to 'project working group' and options were expanded to accommodate the many different antecedent and structural aspects found in various projects (adaptation information is found within Appendix 1).

The manner in which the questionnaires were adapted to be contextually sensitive and relevant, is a contribution to methods as it has resulted in many of the scales generating the correlations expected based on prior use in research. Alongside this assertion, the Cronbach's Alpha signifies that the adaptation of the scales was done appropriately and sympathetically and that reliability and validity was preserved in applying the scales to the novel context and in their adaptation.

A further methodological contribution is related to the use of mixed methods. Mixed methods research is becoming more than a simple mixture of quantitative and qualitative methods or a middle ground between the two, it is emerging as a third methodological strategy in its own right. By utilising a mixed methods research design featuring exploratory qualitative research with an exploratory quantitative adjunct (Sandelowski, 2000), the level of detail and richness of data as well as the confirmatory use of quantitative data provides an example of this template in use and the benefits that it can bring in allowing the first phase of data to inform and guide the ensuing phases.

In exploring a novel context and applying existing measures to a new contextual setting, mixed methods has been demonstrated as not only an approach to tackling similar research but also in allowing the researcher to become fully immersed within the research whilst maintaining some objective distance. The use of mixed methods has ensured that the dialogue and academic area remains open for researchers originating from both of the origin literature disciplines, so that future research can be approached both by interorganizational collaboration scholars as well as organizational team scholars alike.

2.3 Practical

Effective collaboration between the NHS and SMEs has been examined through three different data collection phases. These have revealed various levels of factors associated with success in interorganizational collaboration. The first level encompasses the contextual and policy based factors. The NHS has made it clear through policy documents and strategic realignment, that it is committed to innovation as its means to delivering strategic goals of improved efficiency and productivity as well as better quality patient care. Moreover the implementation of these strategies has indicated that engaging with industry and in particular with SMEs, has been identified as the best way to become more 'pioneering'. The implementation through massive structural change demonstrates that the NHS has recognised the work the NIC has been engaged with is required at a regional level. However this implementation has revealed that there are still challenges for the NHS to learn from. The speed of the restructure and the lack of joined-up thinking in continued involvement with existing NHS-SME collaboration projects has not only led to frustrations within these projects and difficulties for them, but has also exhibited the NHS' limited understanding of how the pressures faced by industry (and more acutely within SMEs) do not match well with a slow paced change.

Regarding the project practice level, the research has found three different areas of practice associated with effectiveness of the collaboration: leadership and champion practices, communication practices and team level practices. Having enthusiastic, driven and directive leaders with knowledge of the external environment and its associated politics have been found to improve team work, stimulates reflexivity and promote the shared vision of the interorganizational team. Moreover the presence of an innovation champion, particularly one with gravitas and expertise, has been associated with better performance and progress, although some difficulty is experienced in transcending the different organizational cultures, languages

as well as the pressures and time constraints the champion must overcome in their main employment role.

Promoting different types of communication and ensuring it occurs regularly even if only between a small sub-section of the project group is associated with higher performance and progress. Particularly, less prescriptive, more informal communication and engagements with the collaborating partner can help to develop the understanding of their work based pressures, cultures and language. This understanding therefore helps to ensure that the differences between the organizations are recognised and can be dealt with more appropriately.

Team development through characteristics such as developing a shared vision, boundedness, stability, interdependence, autonomy, reflexivity and specified roles have been found to be present in interorganizational teams high in progress, alliance performance and further along in the reported state of the project. As such, practices that promote these characteristics must be engaged in during relationship development. Furthermore, as the project progresses and performance increases psychological safety was found to be higher. Engaging in practices promoting psychological safety within the team, or ensuring it is not destroyed, will also lead to more favourable project outcomes as well as higher team satisfaction.

Finally, there are some antecedent and origin based factors that have been identified as having implications on the performance and effectiveness of these collaboration teams. Examining the origins of the collaboration, projects that were working with the NIC prior to its closure were generally found to be performing well and had a clear understanding of the political environment surrounding their project. Many of the more successful projects were working with the NHS in “pull” projects and had successfully won funding for their solution to a problem the NHS had identified. Unfortunately change affected several of these projects significantly. However, those that had formed formal joint venture partnerships were not affected and continued to perform effectively and make significant progress. The change in the

NHS and lack of joint venture agreements meant that existing champions were time-poor and this significantly affected the progress made by those projects impacted by NHS change. Projects that were very “push” oriented, found it extremely difficult to engage with the NHS and this is a challenge now being faced by some of the historical NIC projects.

Overall, there are a number of antecedent and practice-based insights that can be utilised by the NHS in order to facilitate the smooth running and development of relationships within interorganizational teams that provide the vehicle for collaboration between the NHS and SMEs. Moreover at a policy level consideration of the factors discussed could facilitate the delivery of the strategy to facilitate effective innovation and relationship building with SMEs.

However, in doing so the NHS must learn from the key insights which answer the research question. The NHS must become more flexible. There is evidence that the way in which the NIC was set up and managed collaboration projects was both pleasing to the SMEs as well as effective in promoting project success and progress. However, this was essentially a “pull” project model whereby the NIC set out known clinical needs with available seed funding and invited applicants to provide solutions. There is no doubt that this worked well and that the NIC employees had significant insight into both the workings and pressures of the NHS and of industry. However as the sample in this research indicates, many of the most innovative concepts are “push” projects where an organization has developed a product or concept and is attempting to obtain support from the NHS.

This has two implications. Firstly the NHS is stifling innovation if it is only seeking to resolve issues that it has already identified, as well as missing out on truly novel inventions that can be applied to issues they have not yet identified. Furthermore, while the NHS can deal with “pull” innovations which are established on NHS terms, there is evidence that involvement in “push” projects do not lead to such desirable outcomes unless the project becomes a joint venture and is based on formal agreements. These tend to occur when the collaboration is

equally mutually beneficial to the strategic goals of both organizations, and when the NHS has already established a requirement and need for the innovation.

Evidenced through many respondents' experiences articulated throughout the data collection, bureaucracy and speed of change implementation caused intense frustration for projects. While the structural change the NHS initiated was required, the slow pace at which it was implemented and the way AHSNs were set up, left many projects uncertain of what to do next and where to seek the support lost from the closure of the NIC. This slow pace is also reflected in the experiences of bureaucracy within the NHS, whereby projects wait several months for decisions to be made and procedures and processes to be followed. Although innovation and engaging with industry does not immediately impact at patient outcome level, it is a strategic change that the NHS has committed itself to. Therefore understanding of the context of collaborating organizations and implementing procedures that recognise the needs of their partners would only serve to strengthen the relationships between the NHS and industry and avoid the frustrations articulated by many of them.

2.3.i NHS/Political/Policy

This research project has several discernible contributions to make to the practical setting, namely in assuaging the inherent and basic differences between SMEs and the NHS. When collaborating with SMEs, this research demonstrates that effective innovation is related to a number of interorganizational team based factors and these factors must be developed and maintained in order that the interorganizational team can perform effectively and make progress.

The research has identified that the NHS engages effectively with SMEs when the project originates from a call for solutions to clinical issues from the NHS. However, there are difficulties associated with organizing themselves to help projects that approach them with a

“push” product. The NHS must ensure that the restructuring and development of the AHSNs can deal with industry and medical device innovation flexibly.

If the NHS can build channels and facilitate the adoption, ethics, decision-making, trial and bureaucratic processes to occur more speedily this will help to accommodate all different type of product development product. Having these channels ready to accommodate as many different, clinically applicable projects, will widen variety as well as opening up innovation beyond the innovations wanted and imagined by NHS staff.

The NHS also needs to find a way of ensuring the suspicious default approach to industry no longer happens. Perhaps safeguarding, payment incentives or educating NHS employees to understand the challenges and pressures associated with the commercial perspective can help in this. This mistrust damages the relationship between the team as trust and psychological safety must be strong in order for project performance to be high and for progress to be made. Moreover, understanding of the need for increased pace in industry and especially for SMEs will help the NHS to understand how the procedures and channels they install are impacting upon the other side of the partnership.

There are also contributions at the team and project level, the research highlights that team development, focussing on building the team characteristics and psychological safety will directly and positively affect performance. Moreover, by implementing a development framework of these practices, the NHS can ensure that stronger working relationships within the team are realised.

So, how can relationships between NHS and SMEs in the UK medical device sector be facilitated in order that the NHS can collaborate with industry effectively?

In answering this overarching research question, this research project demonstrates that the NHS needs to learn to engage effectively with a wide range of different types of projects

both in terms of “push vs pull” as well as involving different collaborating partners, and even including different types of innovation (concept, technology, software, device). In opening up the channels for innovation and adoption and ensuring that the NHS can be as flexible as possible, the NHS can also utilise the insights from the project level research to guide the development of team relationships, interactions and practices. This flexibility comes through understanding the pressures, challenges and requirements of private-sector industry and particularly of SME-specific pressures. By understanding what SMEs require from them, the NHS can not only learn to engage more effectively with a wider range of types of collaboration project but can also ensure that mutually beneficial collaboration is sustained and successful, ultimately resulting in a more innovative, flexible and progressive NHS.

2.3.ii SME

The research has demonstrated how intensely difficult it can be to get a product adopted by the NHS even with excellent trial data demonstrating the benefits of the product and the clear clinical need that it can fulfil. In addition the research has demonstrated how much strain the changing NHS structural and political landscape can put on collaborating relationships.

The SMEs involved in these projects must learn to educate themselves about the structure of the NHS, of emerging policy and strategy changes and about the adoption and innovation focussed organizations within the NHS. With this knowledge, SMEs must seek out the right individuals, present the case for their concept in alignment with NHS strategic goals as well as with clinical needs and prepare for any changes that may occur and impact upon their project.

The research also presents SMEs with the knowledge and understanding that could help them develop the appropriate team collaboration practices that will lead to the development of team characteristics and psychological safety and ultimately project

performance. In understanding the NHS, actively engaging in informal and formal discussions to understand the differences in culture and language will ensure communication practices have beneficial impact. Moreover, understanding these basic differences can help SMEs engage on the appropriate level with the NHS so that they are less suspicious of the commercial sector and so there is less risk-aversion associated with building these relationships.

3. Limitations

Although every effort has been made to counteract unavoidable limitations of the research, there have been some inevitable and unavoidable limitations which could not be overcome. The main limitations with the research are related to the sample and selection techniques, the available contacts and time available.

The use of snowballing (Goodman, 1961) technique for sample identification is always considered to have implications on the sample given that the sample is not random or representative. There is likely to be a community bias and it may therefore not be indicative of overall trends in the sample used (Biernacki & Waldorf, 1981). However while a random selection of a population would have been ideal, this just wasn't available in this context and every project that came into contact during the ethnography phase was approached to take part in the research and agreed to do so. The key aspect of answering the research question is furthering understanding of what is going on in the field which required networking with anyone involved in medical device innovation who was willing to be involved in some way. The size of the sample could not have been increased in the time available for the research project and a significant part of the PhD was taken up in contacting and collecting data from the sample represented.

The use of cross-sectional data in the final two sections, although some longitudinal background has been also collected, has caused some difficulties for interpretation of the

results. In particular finding that creativity was high within the beginning of one of the projects during a case study interview illustrates this best. While creativity was found to have a negative correlation with progress and performance and a number of other variables that had correlated positively with progress and performance, this does not mean that creativity has an adverse effect on successful outputs. Instead, the case study data confirmed suspicions that the projects were long out of their creative stages and progressing further towards completion.

In addition, the time available for the PhD was somewhat constraining. Due to the proposed structural change, which NHS employees were aware of in 2011, many interactions were tentative and individuals extremely busy. Much of the data will be tainted with the before, during and after effects of this vast structural change. NHS employees involved mainly originated from the organisations under review i.e. those outside the trusts. SMEs that had involvement with these bodies were and in some cases still are trying to move on from the withdrawal of NHS support. Frustration with the NHS expressed to the researcher at the start of the project mostly focussed on how hard it was to get seen by the right people and decision makers within the NHS. Frustrations with the NHS became more widely expressed during data collection and many reasons were to do with the implementation of change and the disappointment that bodies perceived to be doing an excellent job to those involved with them were leaving them back in square one.

The advantages of collecting data in a time of turbulent political and strategic change include the richness of contextual data available. While there are biases and limitations associated with collecting data during this period, which include confounding factors and potential limited relevance of the research in the practical context following implementation of change, there are still important findings that could contribute to the NHS managing the industry relationships with SMEs as effectively as possible. This would not only improve the

success of future NHS-SME innovation projects but enable relationships where funding is involved to maximise return on investment whilst also supporting the SMEs involved.

This has undoubtedly provided an excellent and rich research context, with political and organizational changes occurring. However, in a piece of research attempting to identify factors affecting success of interorganizational projects there are bound to be some biases meaning that the data will be limited in its scope. However, this research can be still utilised in the practical context to inform strategic decision makers prior to the next, inevitable change to NHS structure.

4. Suggestions for further research

As an emerging context for research, the interorganizational team researchers should continue to seek out and apply insights from existing bodies of literature which are applicable. In particular, by virtue of its focus on interactions at individual and project levels the team literature insights are ideal to apply. An approach to translating existing measures to the novel context is presented in this thesis.

The interorganizational team literature can also now incorporate public/private teams as the translation of findings has also managed to prevail across different sectors. This may provide additional avenues for a more intimate level of understanding of SME public-private partnerships, or those involving a small number of people.

Whilst the emphasis here has been on applying the insights from the organizational team literature, evaluation of how well existing measures apply to the interorganizational team can be carried out and a comparison between organizational and interorganizational teams could be carried out.

This research has started to examine the ‘black box’ (Lauche et al., 2014) and further research using the methods and approaches within this research project can help to carry on this work.

Finally, research could be done to evaluate the impact that findings of this and subsequent research applying team insights to the interorganizational team have on innovation outcomes and project success. This evaluation would be able to therefore identify the differences in team interactions and outcomes when awareness and development of the factors identified as important are present from the outset of the medical device innovation project.

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List of Appendices

Appendix 1: Questionnaire

Including the questionnaire, item origin and translation detail, coding information.

Appendix 2: Exploratory Data

Including more detail of sources and information collected during secondment and exploratory data collection phases

Appendix 3: In Depth interview Schedule

Appendix 4: SPSS Outputs

SPSS quantitative analysis outputs for both individual level and project level analyses.

Appendix 1- Survey

Underlined text indicates translation from original published measure.

(N) = Negatively Coded

(number) = Coding Scheme



| |
|---------|
| ID Code |
|---------|

If you are satisfied with the information provided and are happy to take part in the research please complete this questionnaire.

This questionnaire refers to the <NAME OF PROJECT/description> innovation project and the collaboration occurring between <SME NAME> and <NHS ORGANISATION NAME>.

When answering the questions you should think of the working group of employees from both organisations that are/were involved in this project. If the project has now been completed, try to answer to the best of your knowledge.

The project may be a small part of a wider programme of work between these two organisations, but when answering the questions you should consider the project named above which you are working on/which you have recently completed.

Part I: Project Plans and Structure

a. Please read the statement below regarding the aim(s) of the project which you are involved in.

Statement outlining project aims.

b. To what extent do you agree that this statement describes the aims of the project working group. Please circle the relevant number.

1 (Strongly Disagree) – 5 (Strongly Agree)

c. Are there any other aims that you would like to add to the statement above? Your comments may be to do with the project working group, the innovation project or personal to your involvement in the working group and project.

d. How many core members of the project working group are there? Please indicate the number of core members from each organisation?

Number of members from SME, Number of members from NHS, Total members

e. How long has the project working group been working together?

f. How long have you been involved in the project working group?

g. On average how often does the project working group meet?.

NEGATIVELY CODED Monthly, Fortnightly, Weekly, Daily, Other

If 'Other', please specify:

h. On average how many core project group members of the project working group would attend these meetings?

i. Using the table below tick all of the options that best describe the communication that occurs between the project working group members and how frequently. (Tick as appropriate).

| Coded | Often (2) | Sometimes (1) | Never(0) |
|-------------------------------|-----------|---------------|----------|
| Emails | | | |
| Telephone Conference | | | |
| Telephone | | | |
| Other Method | | | |
| Small Scale Meetings | | | |
| Whole Group Meetings | | | |
| Within your organisation | | | |
| Between the two organisations | | | |

Part II: About the Project Working Group

In this section, the questions may appear to be repetitive, however, we are using existing measures to research an emerging area of research. Thank you for your patience and care with your responses.

j. To what extent are the following statements accurate in terms of your project working group?

Please circle the most relevant answer.

| | Highly Inaccurate | Inaccurate | Neither accurate nor inaccurate | Accurate | Highly Accurate |
|---|-------------------|------------|---------------------------------|----------|-----------------|
| Project working group membership is quite clear— everybody knows exactly who is and isn't in the group. | 1 | 2 | 3 | 4 | 5 |

| | | | | | |
|--|---|---|---|---|---|
| There is so much ambiguity about who is in this <u>project working group</u> that it would be nearly impossible to generate an accurate membership list. (N) | 1 | 2 | 3 | 4 | 5 |
| Anyone who knows this <u>project working group</u> could accurately name all its members | 1 | 2 | 3 | 4 | 5 |
| Different people are constantly joining and leaving this <u>project working group</u> . (N) | 1 | 2 | 3 | 4 | 5 |
| This <u>project working group</u> is quite stable, with few changes in membership | 1 | 2 | 3 | 4 | 5 |
| Members of this <u>project working group</u> have their own individual tasks to do, with little need for them to work together. (N) | 1 | 2 | 3 | 4 | 5 |
| Generating the outcome or product of this <u>project working group</u> requires a great deal of communication and coordination among members. | 1 | 2 | 3 | 4 | 5 |
| Members of this <u>project working group</u> have to depend heavily on one another to get the team's work done. | 1 | 2 | 3 | 4 | 5 |

k.To what extent is there a clear, overall leader/co-ordinator in your project working group?

Please tick the most relevant answer.

| | |
|--|--|
| There is a single very clear leader/co-ordinator. (4) | |
| A number of people lead/co-ordinate the group. (3) | |
| There is no clear leader/co-ordinator. (2) | |
| There is conflict over who leads/co-ordinates the <u>project working group</u> . (1) | |
| We all have clear leadership/co-ordinator roles. (0) | |

I. Answer the following questions, indicating the extent to which they apply to your project working group. Please circle your answer.

| | Not at all | | Neutral | | | Completely | |
|--|------------|-------------------|----------|----------------------------|-------|----------------|---|
| How clear are you about what your <u>project working group's</u> objectives are? | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| To what extent do you think they are useful and appropriate objectives? | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| How far are you in agreement with these objectives? | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| To what extent do you think other <u>project working group</u> members agree with these objectives? | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| To what extent do you think your <u>project working group's</u> objectives are clearly understood by other members of the group? | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| To what extent do you think your <u>project working group's</u> objectives can actually be achieved? | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| How worthwhile do you think these objectives are to you? | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| How worthwhile do you think these objectives are to your organization? | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| How worthwhile do you think these objectives are to the wider society? | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| To what extent do you think these objectives are realistic and can be attained? | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| To what extent do you think members of your project working group are committed to these objectives? | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| How worthwhile do you think these objectives are to your <u>project working group</u> ? | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| m. To what extent do you agree with the following statements? | | | | | | | |
| | | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree | |
| We share information generally in the <u>project working group</u> rather than keeping it to ourselves. | | 1 | 2 | 3 | 4 | | 5 |

| | | | | | |
|--|-------------------|----------|----------------------------|-------|----------------|
| We have a 'we are in it together' attitude. | 1 | 2 | 3 | 4 | 5 |
| We all influence each other. | 1 | 2 | 3 | 4 | 5 |
| People keep each other informed about work-related issues in the <u>project working group</u> . | 1 | 2 | 3 | 4 | 5 |
| People feel understood and accepted by each other. | 1 | 2 | 3 | 4 | 5 |
| Everyone's view is listened to even if it is in a minority. | 1 | 2 | 3 | 4 | 5 |
| There are real attempts to share information throughout the <u>project working group</u> . | 1 | 2 | 3 | 4 | 5 |
| There is a lot of give and take. | 1 | 2 | 3 | 4 | 5 |
| Cont... | | | | | |
| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
| Disagreeing with another's idea is not a rejection of that person. | 1 | 2 | 3 | 4 | 5 |
| People try to control each other. (N) | 1 | 2 | 3 | 4 | 5 |
| We try to blame each other. (N) | 1 | 2 | 3 | 4 | 5 |
| This <u>project working group</u> is always moving toward the development of new answers. | 1 | 2 | 3 | 4 | 5 |
| Assistance in developing new ideas is readily available. | 1 | 2 | 3 | 4 | 5 |
| This <u>project working group</u> is open and responsive to change. | 1 | 2 | 3 | 4 | 5 |
| People in this <u>project working group</u> are always searching for fresh, new ways of looking at problems. | 1 | 2 | 3 | 4 | 5 |

n. Answer the following questions, indicating the extent to which they are true of your project working group.

| | A Very Little Extent | | Neutral | | A Very Great Extent |
|--|----------------------|---|---------|---|---------------------|
| How friendly or easy to approach are the people in your <u>project working group</u> ? | 1 | 2 | 3 | 4 | 5 |

| | | | | | |
|---|---|---|---|---|---|
| To what extent are the members of your <u>project working group</u> critical of new ideas? (N) | 1 | 2 | 3 | 4 | 5 |
| How threatening do you find putting forward new ideas to the <u>project working group</u> ? (N) | 1 | 2 | 3 | 4 | 5 |
| How supportive are the other members of your <u>project working group</u> ? | 1 | 2 | 3 | 4 | 5 |
| To what extent is there a feeling of trust between members of your <u>project working group</u> ? | 1 | 2 | 3 | 4 | 5 |
| To what extent are persons in your <u>project working group</u> willing to listen to your problems? | 1 | 2 | 3 | 4 | 5 |
| To what extent do others foster an atmosphere of non-threatening co-operation amongst members of the <u>project working group</u> ? | 1 | 2 | 3 | 4 | 5 |
| To what extent do you feel at ease with the members of your <u>project working group</u> ? | 1 | 2 | 3 | 4 | 5 |
| Do other <u>project working group</u> members have a genuine concern over your personal well-being? | 1 | 2 | 3 | 4 | 5 |

o. To what extent are the following statements and questions true of your project working group?
Circle the most appropriate response.

| | To A Very Little Extent | | | Neutral | | | | To A Very Great Extent |
|--|----------------------------------|---|---|---------|---|---|---|---------------------------------|
| In this <u>project working group</u> we take the time needed to develop new ideas. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
| People in the <u>project working group</u> co-operate in order to help develop and apply new ideas. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
| Members of the <u>project working group</u> provide and share resources to help in the application of new ideas. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
| <u>Project working group</u> members provide practical support for new ideas and their application. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
| Cont..... | | | | | | | | |
| | To A Very Little Extent | | | Neutral | | | | To A Very Great Extent |

| | | | | | | | |
|--|---|---|---|---|---|---|---|
| Your <u>project working group</u> colleagues provide useful ideas and practical help to enable you to carry out your tasks to the best of your ability. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| You and your colleagues monitor each other so as to maintain a higher standard of work. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| <u>Project working group</u> members are prepared to question the basis of what the team is doing. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| The <u>project working group</u> critically appraises potential weaknesses in what it is doing in order to achieve the best possible outcome. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Members of the <u>project working group</u> build on each other's ideas in order to achieve the best possible outcome. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| There a real concern among <u>project working group</u> members that the <u>project working group</u> should achieve the highest standards of performance. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

p.Indicate how far you agree with the following questions and statements with regards to the project working group. Circle the appropriate response.

| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|--|-------------------|----------|----------------------------|-------|----------------|
| The <u>project working group</u> have clear criteria which members try to meet in order to achieve excellence as a project working group. | 1 | 2 | 3 | 4 | 5 |
| Your <u>project working group</u> colleagues provide helpful advice and constructive feedback in order to encourage you to carry out your tasks to the best of your ability. | 1 | 2 | 3 | 4 | 5 |
| The <u>project working group</u> continually monitors its own performance in order to achieve the highest standards. | 1 | 2 | 3 | 4 | 5 |
| The <u>project working group</u> continuously evaluates its progress in order to improve its effectiveness. | 1 | 2 | 3 | 4 | 5 |
| People express their own views fully. | 1 | 2 | 3 | 4 | 5 |

| | | | | | |
|--|---|---|---|---|---|
| We first try to understand the problem fully. | 1 | 2 | 3 | 4 | 5 |
| People try to win by pushing and keeping their own original views. (N) | 1 | 2 | 3 | 4 | 5 |

q.To what extent are each of the following statements true of your project working group?

| | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|---|-------------------|----------|----------------------------|-------|----------------|
| We understand the problem before we seek a solution. | 1 | 2 | 3 | 4 | 5 |
| We seek a solution that is good and acceptable to all. | 1 | 2 | 3 | 4 | 5 |
| Opposing views aid in the full consideration of all the issues. | 1 | 2 | 3 | 4 | 5 |
| All ideas are expressed before we begin to evaluate them. | 1 | 2 | 3 | 4 | 5 |
| We keep in touch with each other as a <u>project working group</u> . | 1 | 2 | 3 | 4 | 5 |
| We keep in regular contact with each other. | 1 | 2 | 3 | 4 | 5 |
| Members of the team meet frequently to talk both formally and informally. | 1 | 2 | 3 | 4 | 5 |
| We interact frequently. | 1 | 2 | 3 | 4 | 5 |

r.Read the statements below and indicate how accurate they are in reference to your project working group.

| | Very Inaccurate | | Neutral | | | Very Accurate | |
|--|-----------------|---|---------|---|---|---------------|---|
| If you make a mistake on this <u>project working group</u> , it is often held against you. (N) | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Members of this <u>project working group</u> are able to bring up problems and tough issues. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| People on this <u>project working group</u> sometimes reject others for being different. (N) | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| It is safe to take a risk on this <u>project working group</u> . | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| It is difficult to ask other members of this <u>project working group</u> for help. (N) | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| No one on this <u>project working group</u> would deliberately act in a way that undermines my efforts. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Working with members of this <u>project working group</u> , my unique skills and talents are valued and utilized. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

s. Read the two statements below and indicate the extent to which you agree with them.

| | Strongly Disagree | Disagree Somewhat | Neither agree or disagree | Agree Somewhat | Strongly Agree |
|--|-------------------|-------------------|---------------------------|----------------|----------------|
| I am satisfied with my present colleagues. | 1 | 2 | 3 | 4 | 5 |
| I am satisfied with working in this <u>project working group</u> . | 1 | 2 | 3 | 4 | 5 |

Part III – Current Progress

In this section we will ask about the achievements and project performance. If the project is not yet completed please consider the current progress and anticipated or expected results upon completion.

t. To what extent do you agree with the following statements? Please circle the appropriate response.

| | Strongly Disagree | | Neither Agree or Disagree | | Strongly Agree | | |
|---|-------------------|---|---------------------------|---|----------------|---|---|
| The project working group has so far made good progress. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| To date the working group is on track to achieve its aims. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| There is uncertainty regarding whether the aims will be met within the timescales originally planned. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| The achievements made to date exceed the expectations at the beginning of the project. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

| | | | | | | | |
|--|---|---|---|---|---|---|---|
| There are some barriers preventing the working group from desirable progress at present. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|--|---|---|---|---|---|---|---|

u. To what extent do you agree with the following statements. If the project is not yet completed, consider the progress to date. *Please circle the appropriate response.*

| | Strongly Disagree | | | Neutral | | | Strongly Agree |
|---|-------------------|---|---|---------|---|---|----------------|
| The <u>collaboration project</u> has achieved its set goals. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| The time and effort spent by partners in developing and maintaining the <u>working group</u> has been worthwhile. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| This <u>collaboration project</u> has not been productive enough. (N) | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| In this project, resources are deployed efficiently. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Procedures and mechanisms for <u>project</u> resource allocation are cost-effective. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| The <u>project</u> is not effective in converting resource inputs into venture outputs.(N) | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| The <u>project working group's</u> operations can adapt quickly to environmental changes. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| The partners are able to make adjustments in the collaboration to cope with changing circumstances. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Whenever some unexpected situation arises, the alliance management is capable of modifying the existing structure and strategies of the alliance. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| In the face of problems or special circumstances, managers cannot make adjustments to the project as required. (N) | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

v. Please use the space below to indicate the achievements that the working group has had to date since starting work on the project. Please describe any major changes or innovations that have been achieved by the working group to date. These may be small or large contributions, planned or unplanned

achievements, or related to the project as a whole, your part of the project or the role the project working group has played.

w. Please use this space to indicate the overall achievements and outcomes that you believe the working group is likely to have reached/has reached by the end of the project. Please describe any major changes and innovations that you predict the working group will have achieved by the end of the project, if the project is not yet complete.

x. Please indicate the date of completion or the expected date of completion.

y. Which of the following statements applies best to you/the project at the time of completing this questionnaire?

Tick most appropriate answer.

Completed with full understanding of the outcomes from the project.

Completed and as yet a partial view of the project outcomes.

Imminent completion and confident in expectations of project outcomes.

Not yet completed and significant uncertainty over project outcomes.

Part IV: Demographic Questions

The following questions are related to your background. The responses are important to get an understanding of the sample of people responding to the survey. The responses on this page provide important control variables used in the data analysis.

Please indicate the option that best describes your gender (*Please circle as appropriate*)

Which organisation do you belong to: SME Name, NHS Name, Other Name, Other please specify

How long have you worked for the organisation?

What is your current role within the organisation?

How would you describe your ethnic background? (Please tick) – standard selection

We can assure you that no identifiable data will be reported and data will be anonymous and treated confidentially, as stated on the information sheet and cover letter. Thank you for your responses. The cover letter gives details on how to return the completed questionnaire. For any problems, please email Jennifer Surtees (surtejr1@aston.ac.uk).

Appendix 2 – Exploratory Data and Diary

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|--|--|--|--|----------------------|---|
| | | | | IG Interview Excerpt | <p>“if you make it too complicated or too difficult for the nursing staff they won’t use it or they’ll take it off because they can’t be bothered to roll it with it on...for any project to be successful in the NHS it has to be holistic...There’re a lot of people within the NHS who are very opinionated...they’ll have a completely different point of view to another....No agreement no there’s no consensus. It true to say that yes every consultant has probably some techniques which are better than others....they run against those...they have standard pathways...they don’t have an agreement that each Hospital Trust will adopt a standard pathway for a standard procedure. ...each Hospital Trust becoming its own entity then that’s fine then they can do that within their own entity and share...for as long as the NHS is pretending not to be privatising then it’s a mess. So it’s that political disconnect which also causes disconnect within the functional processes of the NHS....that’s where the politics starts...Miles was saying the SMEs don’t understand the NHS because they think it’s one cohesive group but it’s not NHS is a brand and then there’s independent users of that brand all with different opinions and that is absolutely spot on. It’s become a brand. And that’s what dislocates the NHS from being able to embrace good practice and put it right the way through the NHS.... It’s one or the other...until that happens, SMEs working within the NHS will always be problematic. And also SMEs are very ignorant about how the NHS works and that’s their fault. SMEs do not spend enough time understanding how the NHS works and if SMEs did I think that a lot of them wouldn’t even bother.....So I learnt about how the NHS tends to work there so therefore I had a better understanding of it all before we started. I wouldn’t say cynical but more sort of realistic view of how difficult it is to get change in the NHS.”</p> |
| | | | | KA Interview Excerpt | <p>the NIC process and the way in which it was set up was good...a focus team who would take ideas from the NHS and they’d take hold of that idea and exploit it</p> |

Appendix 2

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| 13/03/2013 | C1 | NHS Innovation Expo, 2013, EXCEL London | Speech Masterclass | Mike Farrar, Chief Executive NHS Confederation | <p>"Spreading innovation: from rhetoric to reality & why the NHS has to have skin in the game".</p> <ul style="list-style-type: none"> • Challenges and Improvements are linked but changing NHS patterns difficult. • Pulling innovation to bring value not addressed at all in any material way due to difficulty engaging with the organizations with answers to key NHS problems. This cannot continue. • Must examine: 1. Story of why change is necessary? Many people remain unconvinced, need public and staff support. More transparency in how we provide services. Call to be more honest, visible and transparent. 2. Do mechanisms underpin and support? Must make it the right thing to do. Rapid innovation and spread of innovation. Must incentivise and support spread from within. Problems with commercialisation of partnerships. Problems with intellectual property – return on IP. 3. The mindset and opinions of leaders. Why are CE and boards not pulling technology through. Uncomfortable about public-private partnerships. Mistrust and fear of the commercial agenda. • Correlation of you understanding need and engaging with those that have the answers to the problems. • Opposition to innovation – the psychology and mindset of those needed to engage in adoption. Flexibility of financial portion of the NHS difficult • Call for present evidence of real world examples that can then be showcased |
| 03/2013 | KK | Event | Meeting | KA | <ul style="list-style-type: none"> • NIC as a trailblazer of the NHS working with industry. • Very disappointed that it will be closing down - invaluable support • Now questioning if they should continue to aim in an NHS direction or is it too regionally based. • There is no real clarity over which body will be taking them on. • Funding and support from the NHS has weakened offers and bids from or to other investors. • Very unhappy with the NHS regional change decision. • "Now who do I talk to?" |
| 03/2013 | KK | Telephone | Meeting | KA | <ul style="list-style-type: none"> • "team" and "objectives" • Expo was an opportunity to network with <local> AHSNs • Last minute feeling to the NHS change decision – NIC CEO described a different event when inviting them to the Expo – with a clear direction. • How does this new model suit companies with no academic or NHS associations? UK NHS not really considered their market now. |

Appendix 2

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| | | | | | <ul style="list-style-type: none"> • “Memorandum of understanding” but no insights or handover discussed properly. • Bad start to the AHSN relationship, the remit was promising but requires proper dialogue. Still setting themselves up. • Meeting to begin access negotiations • “team” and “objectives” • Expo was an opportunity to network with Oxford AHSNs, not commercial. • Spoke to Devices for Dignity at the Expo but tot taking technologies and while they have a big budget they are the opposite to the showcase hospitals. • Last minute feeling to the NHS change decision – NIC CEO described a different event when inviting them to the Expo – with a clear direction. • Regional basis of the AHSNs – NIC was going to be regional. • Not heard back from NIC since Expo – still trying to understanding ACHR. Meeting with OAHSN Chairman soon. • How does this new model suit companies with no academic or NHS associations? • UK NHS not really considered their market now. • Pushing back access means global marketing of new innovations and technologies. • NIC tried to create a more joined up platform • Positioning on the starting gate important and so board is keeping a watch and wait brief but not expending any resources in the direction of the NHS. • “Memorandum of understanding” but no insights or handover discussed properly. • Feeling nervous as he is accountable to the board but no choice in the change. • Bad start to the relationship, the remit was promising but requires proper dialogue. Still setting themselves up. • Value creation tensions. • Four co-founders, contacted NIC retrospectively. |
| 13/03/2013 | C2 | NHS Innovation Expo, 2013, EXCEL London | App Presentation | Vitri-care Application | <ul style="list-style-type: none"> • Aimed at GPs – patient centred • Demonstration of need, but also ease of adoption of this technology • Focus on quality and efficiency, providing better patient experiences as well as improving health outcomes. • Published in the Health Service Journal (2010) – QUIPP & Care Plans for Long Term Conditions • Presented at a large stand featuring all Apps – demonstration of industry and technology movements in the NHS? |

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| 13/03/2013 | C3 | NHS Innovation Expo, 2013, EXCEL London | Speech Main Stage | Lord Darzi, Head of Surgery, Imperial College London | <p>"Innovation Goes Global"</p> <ul style="list-style-type: none"> • Southern and Eastern hemisphere include the workforce in the innovation process • The key challenge is dissemination • Labour as driving innovations, and associated shortages damage this. • Need to accelerate innovation to meet health care challenges of the future. • Needs to be the right kinds of innovation. • • Must look outwards (to industry) for inspiration. • Need to learn to work more closely with private partners. • Darwin once said It's not the strongest or most intelligent that survive but the most adaptive to change. |
| 03/2013 | II | Event | Meeting | IG IS | <ul style="list-style-type: none"> • Approached by NHS for product innovation, but has developed into process, system and pathway innovation too. • Feel that the NHS do not engage well in partnerships • NHS have no understanding of industry perspective and the fact that SMEs have limited financial resources. • Approached by NHS for product innovation, but has developed into process, system and pathway innovation too. • 2 products – [REDACTED] • Want to be involved in the research |
| 13/03/2013 | C5 | NHS Innovation Expo, 2013, EXCEL London | Presentation | Dr Paul Stoffels, Johnson & Johnson | <ul style="list-style-type: none"> • "Creating value through innovation and collaboration" • Larger organisation perspective of innovation and procurement within the NHS • More innovative collaboration required between NHS and external organisations • Suggestion of creating incubators for seed investments, in order to provide resources. • Share the learning between those that are engaging in innovative collaborations. • Public – private partnerships as the solution to driving innovation in the NHS and delivering the NHS Innovation Challenges. • Innovation is found where people, ideas and technologies can intersect. |
| 03/2013 | MM | Event | Meeting | MM | <ul style="list-style-type: none"> • Scanned docs • Introduction through NIC CEO • [REDACTED] Operating Table Extension • Device developed and have approached NIC for involvement |

Appendix 2

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| | | | | | <ul style="list-style-type: none"> • [REDACTED] is an orthopaedic surgeon – he needed it and asked to develop and invent. • Having a champion both within the NHS and the SME considered by both as the most important factor in opening doors – not through the NIC involvement. • Extensive appraisals of the product have demonstrated that there is an estimated saving but has been no uptake by the NHS. • Have managed to sell elsewhere (US, Germany, France) • Frustration over the lack of uptake from the NHS – “been a very long no” |
| 13/03/2013 | NN | | Meeting | NN | <ul style="list-style-type: none"> • Feel they have had unclear information defining the role of the NIC • There is a lack of clarity in the NHS, particularly during this period of time • Express uncertainty for the future – worried. • [REDACTED] is a Clinical Quality and Clinical Decision Support System (CDSS) working on providing software auditing, decision making and patient support. • Very small company, have sought support from NIC |
| 13/03/2013 | C8 | NHS Innovation Expo, 2013, EXCEL London | Presentation | Sir Andrew Witty, CEO, Glaxo-Smith Klein | <ul style="list-style-type: none"> • “Innovation through collaboration: Leveraging the expertise of industry” • 17.8 bn dollar business of which 20% taxed – only 4% of sales in the UK • Will be 8 more diseases in 2020 • In the last decade research has been redesigned. • Partnership is key – how to use partnerships and how to bring products to market. • Must “pick your way through the path” and be critical throughout. • As a potential industrial partner with the NHS and be part of the dialogue must be trustworthy, reliable and transparent. • Access value for money. • Differences between NHS and other healthcare systems: <ul style="list-style-type: none"> ○ Heterogenous ○ America – Obamacare consolidation – greater sense of system evolution – flux, change constant. ○ UK parallels – constant pressure for equilibrium, change, quality and efficiency ○ Similar direction, but disparate travel • Proposes need an increase in appetite for innovation in the NHS • Key decision makers are not involved early enough • Need a different relationship with suppliers – procurement needs to be more flexible. |

Appendix 2

| | | | | | <ul style="list-style-type: none"> • Drug development as an example – reduce the “fail rate” of new drugs would lower costs and increase the rate of return in L&D investment. • Needs better decision making, pricing of new innovations below pre-existing. • Will create complexity • Need to create degrees of negotiation and flexibility, get engaged in discovery and create a more open innovation environment • Proposed prize programme to encourage and create more diverse approaches • Pharmaceutical branch needs 4-5 University engagements |
|---------|------|---|-------------------------------|---------------------|--|
| 03/2013 | LL | | Meeting | LJ, Chief Executive | <ul style="list-style-type: none"> • SME rapid growth company strategy – difficult to match this up with the speed of adoption within the NHS, Funding received from NIC • Power differentials between NHS and █████, NHS association has added weight. Working together has created issues with timings and speed between the two. • Approached a medical and clinical need from an academic basis. • Introduction through CEO NIC • SME Rapid growth company strategy – difficult to match this up with the speed of adoption within the NHS • Funding received from NIC • Power differentials between NHS and █████ • Branding has been important and NHS association has added weight. • Working together has created issues with timings and speed between the two • Licensing/Take Up vs Changeability across and within trusts • Approached a medical and clinical need from an academic basis so big learning curve • 10 people in █████ – most are currently part-time. |
| Date | Code | Location | Description | Person | Notes |
| 2008 | D1 | High Quality Care for All: NHS Next Stage Review Final Report | Department of Health Document | | <ul style="list-style-type: none"> • Seeking to foster a pioneering NHS through: • The introduction of new funding opportunities and prizes aimed at supporting innovation. • Focussing on clinically effective and value for money medical device and technology innovation. • Simplification of the development to adoption pathways. • Focus on “clusters” and relationships between NHS, academic and industry to encourage pioneering innovation and development. |

Appendix 2

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| 04/2013 | II | | Meeting | IG IS | <ul style="list-style-type: none"> • Meeting to discuss project in more detail and to negotiate data collection (following meeting at Expo) • Keen to get on with the project but are now in the driving seat since NIC closure – confusion over AHSN – funding • Idea from ██████████, NIC commissioned ██████████ to design and introduced them to Professor ██████████ who is the clinical lead (orthopaedic consultant) and works in a confirmatory role • ██████████ Ambulance Trust trial saw 10 prototypes in a pilot which demonstrated the reduction of pain killer use, increased comfort. When individual is scared there is more chance of them asking for pain relief, this provided security. • Concern over communication – what is replacing the NIC? • Challenges over how to secure consistent sponsorship. • NHS procurement strategy creates difficulties and the efficiency in procurement is not across the board. • The project will require a change to the clinical pathway in existence for ██████████ so Phase 2 pilot required – now exploring how to make 150 prototypes • Identification of the requirements has been better from the NHS however it has been a challenge and has required tenacity and understanding of the NHS (knowledge of business as well as development, innovation and NHS processes) • Want continuity and visibility • “short circuit ideas” (with SMEs) instead of formal intellectual systems • Ambulance forum was important and worked better with prototypes rather than visuals however it is bound up by bureaucracy and protection. • How do you design a fast-track? Too much NHS structure which is not good for creativity. • This is the 5th year – June 2009 was 1st meeting. • Clinical teams – no job role overseeing improvement at all times • Change has been influenced by tacit cross-party agreement on the NHS Strategy Change. • Proven that 16 days of care requirement can be reduced by 3days with the ██████████ Splint. |
| 07/01/2014 | II | | Meeting/Interview | IG IS | <ul style="list-style-type: none"> • Notes from discussion arranging interview date • Champion important – respect and gravitas of NHS professional • Looking at other markets |

Appendix 2

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| | P | | | | <ul style="list-style-type: none"> • MacDonalds are franchised... good idea? • Old Matron on wards – use franchise and Matron systems as commercial model in NHS • NIC existing contact – consider themselves successful despite the NHS not because of them • Pioneering but CE mark signature denotes responsibility which they are taking seriously. • NIC CEO now on contract to NHS, met up at Westminster forum • More fragmented regional approach in AHSNs now all still up in the air, no cohesive strategy, have had to form own strategy as have not been given much direction. |
| 2009 | D2 | National Innovation and Procurement Plan | Department of Health Document | | <ul style="list-style-type: none"> • NHS Chief Executive - NHS will face a budget shortfall of between £15bn and £20bn by 2014. • Must innovate in order to deliver “quality and productivity”. • NHS suppliers can be a source of this. • NHS called to be a more challenging and smart customer in order that suppliers will respond through exploring novel solutions for clinical issues. • NHS must make adoption and diffusion swifter. |
| //2013 | HH | Telephone | Conversation/Meeting | HH | <ul style="list-style-type: none"> • Invitation to meeting with [REDACTED] sterilisation company and for update on progress • Major players who like the sound of the technology, interested in their technique. • Also inviting general manager of the WM hospital • Don’t want to be overwhelmed • NHS Healthcare opportunities • Data collection could be revolutionary • Survey at [REDACTED] Hospital was very rewarding and identified several key areas to look at. • Questions about AHSNs and Institute (NIC) – to build credibility and expertise – commercialise – partnership. • Don’t want a spin out from [REDACTED] University |
| | HH | | Meeting | HH | <ul style="list-style-type: none"> • Update to discuss data access and catch up after meeting with [REDACTED] sterilisation company • Telegraph article – UK ranked lowest for supporting innovation • Personal drivers in meeting were interesting – unveiled evidence that as suspected there was a major clinical need (time, cancellations, loss of money – backing up 8 areas identified in the survey at hospital). • Networking important priority at the moment as well as getting the limitations tackled with suitable solutions |

Appendix 2

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| | | | | | <ul style="list-style-type: none"> • 3 Tasks for the development – durability, medically suitable adhesion, reading from a distance. • Funding also a priority – ██████ sterilisation company as a possibility, ██████ University impact funding • NHS and change a much anticipated future barrier • Safe Surgery Systems as a role model project? |
| 02/01/2014 | HH | Telephone | Update discussion | HD | <ul style="list-style-type: none"> • Can't currently meet the requirements set out by ██████ sterilisation company • Long range reading is tricky • Been ill for a while and taking some time off – able to meet for interview |
| 10/05/2013 | D2d | H University | Meeting (with investor/buyer) | HD, H University | <ul style="list-style-type: none"> • Not called ██████ any more – have moved on (although concepts are still relevant) butt needed to display more potential • ██████ hospital survey confirmed suspicious and are still supportive – it identified hardware and software solution as can't reinvent the whole wheel due to restricted finances. • ██████ expertise very much sought, want to look at building a "relationship" with ██████ – perhaps a partnership contract. • Hospitals not trying to impose their view on businesses. • ██████ an outsourced healthcare sterilisation service in EU, Asia, America. Infection prevention and cost effectiveness of sterilising stainless steel surgical equipment over single use implements. • Hospital staff SHOULD check all instruments are on a tray, there are legal quality compliance regulations and they must also follow manufacturer's instructions. • Several phases of sterilisation, can fast track or do next day but always a rapid turnaround. • Looking to reduce the cost of process, risk, efficiencies, and maintaining a historical record (as well as alerts and changes in devices) • ██████ hoping RFID can achieve: • 10year interest in the technology, missing implements, time and accuracy of counting instruments, New variant CJD (1997 must now keep data about use), auditing, clinical record of use, delays in operations impact on health outcomes, missing instruments is the biggest quality issue for ██████. • However issues associated with retrofitting of RFID tags and sterilisation, the auditing and tracking software. • Problems associated with the line of sight from a scanner required to read it, the adhesion cannot fail during surgery, linking codes together. • There have been improvements in RFID and its moving quickly, they are keen to implement. |

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| | | | | | <ul style="list-style-type: none"> • Longevity of retrofit, needs testing extensively • [REDACTED] tag could have a printer on each site but still big milestones to overcome. • Synergy struggle to see difference to barcode as still issues with distance of reading, durability, size, how to read, sterilisation temp, durability of charge, adhesion. • Need them to develop it further so no need for tag/scan line of sight, and attachment to device must be reliable and not interfere with instrument handling. • [REDACTED] want focus on readability and efficiency... • need to see facility and process and take on board issues raised. • need a significant difference to existing RFID or must be better than existing solutions. • Reluctant to pay for it unless it only had one issue to resolve. Think of reality of nurses scanning in theatre. |
| 01/09/2012 | HH | | | HD | <ul style="list-style-type: none"> • Scanned document • Contact with [REDACTED] at NTAC over CE Marking. • Explained to NTAC what they wanted and asked for an introduction to someone within the hospital – a champion. • Arranging a meeting with NIC • theatre managers positive over proposed technology • Re-established initial findings validity • Have identified– the main potential buyer – have issues associated with this too and HH are establishing lots of layers of needs for the technology. • Another survey this week and meeting at the University next week. |
| 25/07/2012 | HH | University | Project meeting | HD | <ul style="list-style-type: none"> • Scanned document • Started meeting with objectives – application and technology development • Update – hospital trial arranged for [REDACTED] process. Proof of concept to demonstrate great need and cost savings as well as improved efficiency (can help them do things better). Cost saving as zero tolerance for lost equipment through sterilisation. Need a tracing system to save on searching and putting trays together as lease trays and fast tracked trays are most expensive. Implications for infection control, and contamination. • Document detailing [REDACTED]'s progress with the technology • Suggestions for other applications include [REDACTED] Bed. • Need to look separately at the technical, business and University (publication) aspects of the project. – Action Point University • Who owns the IP? – \Action Point University • Priority date can then come through – Action Point HH |

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| | | | | | <ul style="list-style-type: none"> • Enthusiastic, tremendous application – HD • Reader still needs to be innovated. – University • Need to set up and have it running before a trial is arranged but HD disagrees. • How to move forward: trials to see if the tags survive sterilisation, HD concerned with differentiation from barcoding and time commitments as difficult to keep to deadlines for PhD Student. • Clear implications but a question of degree of impact – cautious. • PhD Student limited availability but MSc student resource from September agreed. • Question over another company or stick with HH – want to do it right and must look into the middle distance – suggestion of investigating a University spin-out situation. • Mentioned team and teamwork HD keen to make it feel like team work. • Project descriptions to be added to HH website and HD will provide the information. • Agree reporting meetings every 6-8 weeks, possibly via Skype • Next meeting agreed end Sept. |
| 28/12/2012 | HH | IIPSI, Warwick University | Team Meeting | HD & H University | <ul style="list-style-type: none"> • Plan is to finalise the setting up, look at the current and future situations, explore the University facility and discuss PhD. • Applications for technology needs to be explored – magnetic and electrostatic engineering challenges and will need to be offsite to look at more closely. Will it need to be read through metal and which types of instruments would be tagged? • Carried out Survey. Previously sceptical about savings potential but seems more than 1st survey (£250,000 est). Hopeful of sterilisation company support. • Application in the brewery, automotive and pharmaceutical industries. • Need a holistic real-time auditing trail to be different. • Incubator space available at University, can create a demo model and clinical trial in Hospital. • Exploring contacts with NTAC and orthopaedic hospital. • University ventures gives two options 1. Uni Set up and Uni holds the IP or 2. Joint (spin-out) company IP licensing done by the company themselves. Could have several separate IPS. • Principles of HH is to drive technology, must establish need. • Three thirds is the standard model for IP. Licensing model may be more use. Some ownership of the company by the University, standard start-up and company pay shares. Negotiation needed. |

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| | | | | | <ul style="list-style-type: none"> • University ventures not sure spin out is needed, would give the backing of University facilities as well as company space and students. In reality the patent and IP is held by the University. • Looking to take it forward and University lends location and kudos, facilities and resources. • Hospital expects to be involved – application focussed opportunity, not a one of purchase. • Time lag . • Action points of application for incubator space and 6 months support to get everything in place, meeting with Hospital next week, business plan with concepts and objectives needs writing. • Interaction with the technology? NHS dislike enforced technology. • Cloud software useful? Is a computer right? But connectivity and interference issues. • Maybe better to develop bespoke systems for legitimacy. |
| 2012 | D3 | Innovation, Health and Wealth | Department of Health | | <ul style="list-style-type: none"> • Innovation must become the core business of the NHS in order for it to meet the challenges and requirements of efficiency and quality expected. • Strengthen relationships with academia and industry • Make NHS adoption and diffusion faster and demonstrate its ambition for innovation. • Identifies 6 barriers to innovation (diagram). |
| 07/01/2014 | KK | Telephone | Meeting/discussion | KA | <ul style="list-style-type: none"> • To arrange interview • Still have questions over the wrapping up of the NIC • HITF – task force – Lord Hunt • Harvard Business Review – December – Davenport • IIA International Institute of Analytics • Last Labour NHS Plan (1999) Margaret Mythen |
| 24/02/2014 | LL | Telephone | Interview | LN | <ul style="list-style-type: none"> • Notes taken during interview (phone interview) • At times frustrating and difficult but constructive • “forward looking” for an NHS Chief Exec. • Hospital needed online presence and knew it took forever to organise in NHS • Leadership is disruptive – key to team membership is willingness to take part • Culture been interesting – speed of movement and pace differences – frustrating • Expectations, refer to beginning, “sum of parts” |
| 28/02/2014 | LL | Telephone | Interview | LS | <ul style="list-style-type: none"> • Previously worked for BUPA Psychological Services • Risk, responsibility and clinical risk – rearranging supervision arrangements |

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| | | | | | <ul style="list-style-type: none"> • Credibility through NHS involvement and CQC registration • Move on 31st December 2013 |
| 09/10/2012 | EE | Telephone | Meeting | EE | <ul style="list-style-type: none"> • Small portable muscle stimulator – skill in using it and good knowledge of nerves and muscles required – osteo, nurse, physio, radiographer could use. • Range of applications such as sports injuries, muscle building and strength, female incontinence, possibly bowel incontinence but need someone to do research and trials on this. • Not an unused technology or novel but a new application for it. Still discovering that it can help with other rare problems. • Small firm, didn't have any other people – at the very beginning it was a slimming technology for 20 years. • Some input from clinicians at very beginning – at the time a family member was a Dr and worked with them. • Occasionally have worked with others in trade • Haven't worked with the NHS as they feel the NHS doesn't want to work with industry. • Academics have belittled and ignored it • Feel that if the NHS tells you what to do and you make it they will buy from you ("pull") but if you design and take it to them they aren't interested ("push") – very little support. • As a small company they feel they aren't picked up on the radar. • In production, the product is small but not beautiful – medically approved in the EU and could do with more NHS help – but they don't want to help. • Approval of consultants • Wouldn't try to make another medical device would now first ask how they were going to buy and market it first. |
| October 2011 | E1 | Telephone | Meeting | Senior Exec. at UK Department of Health (previously Head of Policy and Innovation at PASA) | <ul style="list-style-type: none"> • Structural change on horizon – changing landscape • Now considering leadership of the networks and the transparency of information, Implications for practice, Connecting in local need, Pay offs for behaviours, Governance • A priority is collaboration and partnerships between buyers and encouraging collaboration between trusts • Large hubs have large overheads • Developing Academic Health Science Arm – want to create more "pull" |
| 05/03/2012 | E2 | Telephone | Meeting | Procurement, Investment and Communication Division, | <ul style="list-style-type: none"> • Telephone discussion in order to learn more about the different collaborations occurring in the NHS. • There is a protocol for sharing. Imperial college are very interested in innovation and share some overlaps, commissioned by PICD to look at the benefit of sharing and scope – showcase |

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| | | | | Department of Health | <ul style="list-style-type: none"> • Small Business Research Initiative – leading project £20m, set out challenges and present calls for ideas, give funding and work together on clinical problems – present bids with proposals. • National Innovation Centre – remit is the same –used to work for NTAC. Companies approach them when they have a technology. • Projects of focus are SMEs, business growth, context, seeking help but problematic political climate ahead • Previous examples of collaboration to explore – <ul style="list-style-type: none"> ○ Healthcare Associated Infection ○ Design Bugs Out (Design Council) ○ Showcase Hospitals Programme ○ E3 • Trade Associations: for suppliers perspective (ABHI, BHTA as starting points, PharmaONE, BIFTA, HCAI) • Innovation Health and Wealth big agenda and will raise lots of questions – some new initiatives being promised • NHS confederation is a pipeline project, companies to share with the trusts • NICE review evidence of medical devices • MTech Programme – provide assessment of usefulness |
| 06/06/2012 | E3 | | | Showcase Hospitals, HCAI Department of Health | <ul style="list-style-type: none"> • Testing devices in hospital setting • Identifying the technologies (push and pull) • Showcase set up in 2008 by HCAI through Technology Innovation Programme, motivation and interest a factor as well as geographic and demographic – performance important too in selecting. • Initially there were 7-9 projects • Rapid Review Panel Health Protection Agency, DH, Quick Assessment 1-7 rating system (1=highly innovative, TIPP implement, evaluate, disseminate) • Over 300 products, 10 were rated 1. • Worked alongside Supply Chain • Less barriers • Design Bugs Out Programme: put out a competition from the design council to focus on bedside equipment – the commode, cabinet, chair and table. Teams looked at them and three SME manufacturers created prototypes and fitted in 2 wards in 8 hospitals. Ran evaluation of clinical observations and usability (scanned document). • Worked with SMEs which lead to some implementation challenges • Introduction to Showcase |
| 07/02/2012 | E4a | Telephone | Meeting | Chief Executive of the NHS | <ul style="list-style-type: none"> • Telephone meeting after being introduced by E2, to discuss access to projects they may be involved with. |

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| | | | | Innovation Centre (part of NHS Institute) | <ul style="list-style-type: none"> • 70% a business arm of NHS • Recently put out a brochure of their strategic aims • Set up a Health Industry Task Force – development support, proactive and reactive, identifying issues and demonstrating benefits. • Support across 5 stages ID1-ID5 (this mirrors NTACs 5 stages to adoption?) • ID1 Define the Need • ID2 Design the Solution • ID3 Develop the Opportunity • ID4 Demonstrate the Benefits • ID5 Distribute the Product • Resources and practical support • Financial support and royalty agreements • Shadowing development projects – there are 12 active, invitation to join meetings which happen around once a month • May need Non-disclosure agreement • Half of their projects originate from the front line of the NHS • 4 new ones recently – particularly in imaging technology. |
| 10/01/2013 | E4b | NHS Institute, Innovation Park, Warwick University | Meeting | Chief Executive of the NHS Innovation Centre (part of NHS Institute) | <ul style="list-style-type: none"> • Meeting to discuss projects that NIC are currently dealing with and their progress – and possible introductions • Understanding the differences of NHS Staff and the “challenges of entering the NHS market”. • To what extent do the needs and values drive criteria by clinicians and managers for healthcare innovation technologies? • Pace and scale of adoption needs to be better. |
| 05/09/2012 | E4c | NHS Institute, Innovation Park, Warwick University | Team Meeting | NHS Innovation Centre (part of NHS Institute) | <ul style="list-style-type: none"> • Scanned document – minutes and project updates • Attendance at NIC Team meeting • 2. Institute is 1/8 closing down under the NHS restructure, although NIC may be hosted by the commissioning board according to Miles Aisling, closure timeline to be released, must give notice to customers. • 3. Website hosting and developers looking at working on development stages (ID1-5) • 4. Project tolerances must look and feel like strategic objectives. Finance; learning; innovation and growth; quality service delivery; operations. Projects not as uniform as NTAC • 5. MDT review information is lacking – need more on the assessment process, the demonstration of the product, the idea, the development and commercial viability. |

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| | | | | | <ul style="list-style-type: none"> • 6. Updates to all projects. New ones too – avocado in ulcers (ex drug addict) and wound care; nutrition management in Newcastle, clinical decision tool for breast cancer. • 7. Expo in March |
| 22/08/2012 | E4d | NHS Institute, Innovation Park, Warwick University | Meeting | CEO NHS Innovation Centre (part of NHS Institute) | <ul style="list-style-type: none"> • Continued access negotiations and update • Value of feedback for NIC so keen to be involved with PhD • 2 interesting projects just come in – Image processing needing practical and financial support which is 2 weeks in so very ‘young’; and splint for stability of an arm fracture with 3-4 partners needing clinical trial support. • Updates – ██████ not very active currently – too many partners suggested as the reason; ██████ – very small company so interesting for PhD. ██████ has launched. • Barriers to development – Colin wants to know about these. • Invitation to team meetings as well as the Expo in 2013. |
| 28/02/2012 | E5 | Telephone | Meeting | Trustech & Manchester Biomedical Research Centre | <ul style="list-style-type: none"> • Need to create and put together the right environment and team. • Trustech “Improving healthcare through innovation” – Member of HIA (Healthcare Innovations Alliance) part of a national network of NHS Innovation Hubs Trustech is a point of contact to build relationships providing innovation management to the NHS and consultancy services to companies. • 50 trusts are reconfiguring into 25, must now work with trade and companies • Need to create and put together the right environment and team. • http://www.trustech.org.uk/ • Trustech “Improving healthcare through innovation” – Member of HIA (Healthcare Innovations Alliance) • Part of a national network of NHS Innovation Hubs Trustech is a point of contact to build relationships providing innovation management to the NHS and consultancy services to companies. • 10 years as part of the NHS, regional expertise, resource identification, protection and commercialising IP, there was innovation services in each region which evolved into innovation suppliers. • 50 trusts are reconfiguring into 25, must now work with trade and companies |
| | I1 | | Interview | | <ul style="list-style-type: none"> • “if you make it too complicated or too difficult for the nursing staff they won’t use it or they’ll take it off because they can’t be bothered to” • “any project to be successful in the NHS it has to be holistic” • “There’re a lot of people within the NHS who are very opinionated...they’ll have a completely different point of view to another....No agreement no |

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| | | | | | <p>there's no consensus. It true to say that yes every consultant has probably some techniques which are better than others....they run against those...they have standard pathways...they don't have an agreement that each Hospital Trust will adopt a standard pathway for a standard procedure. ...each Hospital Trust becoming its own entity then that's fine then they can do that within their own entity and share...for as long as the NHS is pretending not to be privatising then it's a mess. So it's that political disconnect which also causes disconnect within the functional processes of the NHS....that's where the politics starts...Miles was saying the SMEs don't understand the NHS because they think it's one cohesive group but it's not NHS is a brand and then there's independent users of that brand all with different opinions and that is absolutely spot on. It's become a brand. And that's what dislocates the NHS from being able to embrace good practice and put it right the way through the NHS.... It's one or the other...until that happens, SMEs working within the NHS will always be problematic. And also SMEs are very ignorant about how the NHS works and that's their fault. SMEs do not spend enough time understanding how the NHS works and if SMEs did I think that a lot of them wouldn't even bother.....So I learnt about how the NHS tends to work there so therefore I had a better understanding of it all before we started. I wouldn't say cynical but more sort of realistic view of how difficult it is to get change in the NHS.”</p> <ul style="list-style-type: none"> • “the NIC process and the way in which it was set up was good...a focus team who would take ideas from the NHS and they'd take hold of that idea and exploit it” |
| 12/2013 | N1 | New Appointment | Announcement | Tony Davis, CEO Medilink West Midlands | <ul style="list-style-type: none"> • Announced in December that Tony Davis, previously CEO of Medilink West Midlands has been appointed as Interim Executive Director at Academic Health Science Network (NHS) West Midlands • Interesting impact on the contacts of Medilink? • This implies certain strategic goals of the AHSN in that the values and strategies of Medilink have been identified as useful for the NHS to learn from and integrate? |
| 14/02/2012 | N2 | Birmingham | Meeting | MD Expert and Consultant | <ul style="list-style-type: none"> • MDTI (Medical Device Technology International) • Strategic Partners – NHS Supply Chain, Medtrak, Centre for Healthcare Innovations and Developments, Maxwell, NHS Innovations • QUANTAFS –as “good practice – range of devices • Team development varies – can come from clinicians, NHS driven or on own • Medlink – working together to create medical devices – regulations, clinical requirements and speed to market • There can be various people involved including those with medical knowledge, designers, manufacturers etc |

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| | | | | | <ul style="list-style-type: none"> No protocol at present, can be through a company but depends on the remit of the company |
| 2012 | N3 | Telephone | Meeting | Contact, Manufacturing Advisory Service | <ul style="list-style-type: none"> Speed to market extremely impeded by the NHS |
| 15/11/2011 | NTAC1 | NTAC, Piccadilly, Manchester | Team Meeting during secondment | NTAC offices | <ul style="list-style-type: none"> Team meeting – minutes in numbers, observations in bullet points Responsibilities for different teams, clear leadership, encourages objectives and action points, discussion encourages and brings group back to focus. <ol style="list-style-type: none"> Monday audits training – team planning regular audits as useful in hotdesking situation, work to high [REDACTED] score and maintaining customer relationship management using database. Accessing and capturing the same information, commonality and prevention of time loss, effectiveness and performance. OH encouraging all to get vaccine Policies – code of conduct, phones, meetings Public service pensions changes – industrial action. Board meeting with key stakeholders 1-2pm Communications – quarterly newsletter, innovation review, industry as well as NHS – progress. GAP – think about having a fee associated with use but free to NHS. Implies need industry differentiation and restricted pages. Could be flexible in pricing, bio filters, filter questions, functionality. Blog needs updating – key projects. Raise profile. Health Service journal? Northwest focus day, Showcase, ITAPP newsletter, explore internal events and SHA events as well as external. Adoption packs YHEC model too positive. % uptake of [REDACTED] NICE costing level scope of opportunity. Adoption packs – How To Why To Guides and NICE guidance, commonality, business cases, techniques and technologies. Selecting three soon. Must work with commissioners – forward planning, payment by results. Innovation review, key item in meeting. Raising profile of activities of concern, producing adoption packs of pull projects. |
| 25/09/2013 | U1 | Telephone | Interview/Discussion | Contact | <ul style="list-style-type: none"> Worked in HR for City Council, some interesting insights about the Public Sector difficulties being experienced – extensive change and redundancies including more temporary contracts Confusion and disruption due to changes – need close relationship between council and leaders, needs to be open to amendment Funding recently forced extensive savings and efficiencies – making fewer financial commitments L&D moved online for accessibility and cost reduction |

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| | | | | | <ul style="list-style-type: none"> • Increased accountability and focus on improvement • Difficulty maintaining prior commitments whilst trying to deliver newer projects • Seeking innovation but must be cost effective |
| 2012 | W1 | Website | Research | Medilink | <ul style="list-style-type: none"> • http://www.medilinkuk.com/ • Hold database of medical device and medical technology SMEs • Private sector membership fees – mymedilink • Separate from NHS • Strategy of networking and supporting these organisations and attempting to help them with procurement/research/development/adoption processes through events and introductions • Funding advice |
| 04/2014 & 02/2012 | W10 | Website & NTAC Launch Event | Research & Meeting | Rob Berry, Technology Strategy Board | <ul style="list-style-type: none"> • https://sbri.innovateuk.org/ • Small Business Research Initiative (SBRI) • established process to connect public sector challenges with innovative ideas from industry • Support companies to generate economic growth and enable improvement in achieving government objectives. • Rob Berry said usually have one to two companies involved. • Supports learning about collaboration and keen to hear more about the PhD research – will give introduction to companies. |
| 09/2012 | W11 P | Website | Research | Devices for Dignity Healthcare Technology Cooperative | <ul style="list-style-type: none"> • http://www.devicesfordignity.org.uk/ • Set up to encourage NHS management and clinicians to engage in more innovation and development of medical devices • Also set up to incorporate more collaboration with industry. • Also collaboration with academics • Wheelchair – an example device designed to carry more. |
| 2012 | W2 | Website | Research | MidTech | <ul style="list-style-type: none"> • http://www.midtech.org.uk/ • R&D arm of NHS • Taken over from PASA in some ways – interested in development • Very similar NHS version of Medilink but concerned with innovations originating from within the NHS • “identify, develop and protect innovations from within the NHS” |
| 2012 | W3 | Website | Research | QUANTAFS | <ul style="list-style-type: none"> • http://www.quantafs.com/ • Pioneering and successful medical device company |
| 10/2011 | W4 | Website | Research | NHS Supply Chain | <ul style="list-style-type: none"> • http://www.supplychain.nhs.uk/ • A joint venture between areas of Department of Health and the NHS. Absorbed some of NHS PASA when PASA closed. |

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| | | | | | <ul style="list-style-type: none"> • Aims to provide a dedicated supply chain to the NHS – but by no means all procurement occurs nationally and through the supply chain. • Obviously tends to be products from larger manufacturers and suppliers |
| 02/2013 | W5 P | Website | Research | Medtrak | <ul style="list-style-type: none"> • http://www.medtrak.co/investors.html • Originated from within the NHS – an example of clinicians designing devices that solve important clinical issues • This system is a novel MRI scanner which does not require the patient to be moved. |
| 01/2013 | W6 | Website | Research | NHS Institute of Innovation and Improvement, Coventry | <ul style="list-style-type: none"> • http://www.institute.nhs.uk/ • Now closed, the institute was set up with a remit of innovation and improvement. |
| 02/2013 | W7 | Website | Research | Official Journal of the European Community | <ul style="list-style-type: none"> • http://www.ojec.com/ • A website that all tenders that are above a specified threshold in the public sector must be registered (EU regulation) • Tendering rules • Aims to facilitate procurement in the public sector (also opens gateways for suppliers overseas) |
| 02/2013 | W8 | Website | Research | Department for Business Innovation and Skills | <ul style="list-style-type: none"> • https://www.gov.uk/government/organizations/department-for-business-innovation-skills • Investments in skills and education to boost the economy and innovation in the UK • Funding and prizes awarded |
| 04/2014 | W9 | Website | Research | National Institute for Health and Care Excellence | <ul style="list-style-type: none"> • http://www.nice.org.uk/ • Survived the 2013 restructure, and absorbed some of the other bodies and their remits such as NTAC <p>Exploration of the value, effectiveness and conformity to regulations of all medical devices. “NICE's role is to improve outcomes for people using the NHS and other public health and social care services. We do this by: Producing evidence-based guidance and advice for health, public health and social care practitioners. Developing quality standards and performance metrics for those providing and commissioning health, public health and social care services; Providing a range of information services for commissioners, practitioners and managers across the spectrum of health and social care.”</p> |

Secondment Ethnography

The researcher and her supervisors won extra funding for the student to carry out a secondment in the NHS Technology Adoption Centre, Manchester. Having met CEO Sally Chisholm at an event, it was suggested that the researcher may be able to help with the analysis of a website tool whilst also learning more about adoption, innovation and NHS structure.

The researcher kept a diary of the experiences and knowledge gained in the setting, the script of which is written up and found in the Appendix alongside the work produced during the secondment for NTAC.

The Generic Adoption Process (GAP) tool had been developed by previous incumbents of NTAC, with very few of the original team members left in the organization and the existing being a newly formed team it was decided that the online resource centre required some reviewing. The researcher was tasked with improving it in relevance and efficiency, giving a fantastic opportunity to not only contribute but also to learn more about the extremely complex procurement and adoption processes within the NHS.

The researcher attended group meetings; presenting a proposal, findings and suggestions for how to improve the online resource. First the researcher decided to approach all registrants with access to the GAP tool, asking them to complete a brief questionnaire about their experiences of using the tool and what they found useful or useless. Many respondents found it disjointed, unnecessarily wordy, inconsistent and too complex to understand quickly – as well as mainly being aimed towards those working in the NHS. Given that the tool was originally developed as a simple, one-stop-shop for both NHS and industry parties to utilise in order to understand the adoption process and what they were required to do prior to adoption considerations being made. It was decided to rework the existing tool to be concise, consistent

and to be easily understandable by both NHS and industry. Being available to a wide audience was difficult but necessary as often these tasks are delegated to junior members of staff.

The researcher worked on the website for the period of 12 weeks, obtaining a sign off and putting the alterations live onto the website. It was clear to the researcher that the adoption process within the NHS was highly complex. The model identified 5 stages through which a device must pass in order to achieve adoption (Figure 2); and then provided the relevant forms, resources and documents in order to guide the individual through each stage.



Figure 10: 5 Stage Generic Adoption Process from NTAC website

This provided the researcher with an invaluable view directly into the intricacies and many barriers presented to an organization when attempting to get their product adopted. This is demonstrated in the appendix, however after learning and understanding more about the processes and structures at play, the researcher became acutely aware of observations within the office. There was a board on the wall with each of the technologies and devices being represented by NTAC. Each of these devices had gone through each of the stages described by the GAP tool. However, in the case of one in particular was still on the board at least 5 years after it was first put there, despite clear evidence of its value and effectiveness in reducing recovery and hospital stay times. NTAC had 10 technologies that they were representing as implementation projects, in their own words

“NTAC are currently working with teams in the Implementing Trusts to: Manage the implementation and systems integration issues; identify where additional changes to clinical pathways and services are required and unlock the full benefits of the technologies” (www.nhs.ntac.uk, 2013). It seemed that even if the technology conformed to all of the requirements, there was still the barrier of getting the product integrated into the trust and the care pathway that lead to difficulties. This is a problem that most companies encountered by the researcher in the duration of the project mentioned, however it seems that even an NHS body such as NTAC encountered these problems in attempting to get a change integrated.

In addition to the tangible outcome of project completion, the researcher also discovered some key themes which are drawn out and presented here from the experiences of being immersed in the organization:

Efficiency At the first team meeting attended by the researcher, it was discussed that a lean office management strategy was to be put in place. In effect the work spaces would act as hot-desking, also allowing different members of staff to easily manage the different business relationships as and when required. The idea was also to ensure that the overhead costs of running the organization were kept as low and within budget as possible.

Staff Uncertainty It soon became clear that the hot-desking and concern for lean management was born out from the uncertainty over where NTAC would be following the NHS review (described privately to the researcher as a “sunset review”). This uncertainty also meant that winning contracts with organizations was extremely important as not only a source of revenue but also in demonstrating the value of the newly set up NTAC. There was a high level of stress and uncertainty with staff choosing to leave before their position was made redundant as well as meetings being interrupted by phone calls being returned to the CEO from very senior NHS management.

Staff Frustration A particularly interesting observation about a medical device suggested to NTAC by a senior ministerial figure was somewhat controversial and a contentious issue. Many of the NTAC staff had worked as nurses and practitioners and this particular device – a hydrant – was felt to not only add to the duties of the ward staff but also to hold some inherent problems when considering the device for a hospital setting. As such there was much reluctance to take the project by all members of the team but given the difficult situation of the review and the seniority of the individual championing the device, it was reluctantly taken on.

Stagnancy In reiteration of the points raised about regarding the length of time items that had been through all required test and regulations were still waiting for their adoption, there was a feeling of loss of motivation. The initial passion for a technology that could drastically improve care and patient outcomes seemed to dwindle as the review date came closer and as the adoption and implementation of a technology took more and more time.

Appendix 3: Interview Schedule

Interview Schedule

| Date | Interviewee ID Number | Interviewer |
|--|---|-------------|
| <p>PROBE THEMES</p> <p>Project</p> <p>Market Research</p> <p>Contextual</p> <p>Awareness</p> <p>Current State</p> <p>Set Up</p> <p>Shared vision</p> <p>Development</p> | <p>Set up: Please describe a little about the project, the device itself and the set-up of your project working group.</p> <ol style="list-style-type: none"> 1. Please explain a little about the current state of the project. <ol style="list-style-type: none"> a. Current situation, major improvements and changes in the situation. b. Breakthroughs, current problems. 2. Think about when you started out on the project. Can you explain what your key priorities were in putting together a suitable team to work on the project? <ol style="list-style-type: none"> a. Objectives, aims, what were you hoping to achieve? b. Did you communicate these across the team? c. Ad hoc basis – was it formed as you made breakthroughs, contacts? d. Or planned – what was the premise and basis for putting together teams? e. Where do the main decisions get made? Where is the responsibility for the outcomes? f. Touch on communication arrangements, regularity of meetings and who ‘runs’ the project in between meetings. 3. What have been the main barriers you have encountered? <ol style="list-style-type: none"> a. Challenges, problems, issues and barriers. b. How did you overcome them? Was this an individual resolution or did it involve the whole team/few people’s efforts? 4. What have been the key factors in contributing to your progress/achievements? <ol style="list-style-type: none"> a. Achievements, breakthroughs, forward movements. b. How did you come across them? Harness them? Approach them? c. Who took responsibility? Was it celebrated? 5. What are the main things that could have benefitted/ did benefit the progress of the project? 6. If you could approach the project in hindsight what would you have done differently? What knowledge that you have now would have benefitted you prior to embarking the project? 7. If you knew someone starting a similar medical device innovation project, what advice would you give them? <p>If team factors are mentioned....</p> <ol style="list-style-type: none"> i. You mentioned..... Could you tell me a little more about the team interaction and behaviour that you think contributed to the team success? To the problems and barriers encountered by the project team? Which project team factors do you think could have been improved upon to contribute to a more successful outcome? | |

Appendix 4: SPSS Outputs

Individual Analyses

Variables Key

1. Agreement with Objectives (Agreement Objective)
2. Length of Time PWG working together (TIMEPWG)
3. Length of time respondent working on the project (TIMEINDIV)
4. Members from your organisation (Members Home)
5. Members from a commercial collaborating organisation (Members Commercial)
6. Members from a NHS Collaborating Organisation (Members NHS)
7. Members from another collaborating organisation (Members Other)
8. Total Members in Project (Members Total)
9. Frequency of meetings (Frequency meet)
10. How many attendees at average meetings (Attendees Meet)
11. How often do you email? (Email)
12. How often do you teleconference? (Teleconference)
13. How often do you telephone? (Telephone)
14. How often do you hold small group meetings? (Small Meet)
15. How often do you hold whole group meetings? (Full Meet)
16. BoundednessMeasure (Boundedness)
17. StabilityMeasure (Stability)
18. InterdependenceMeasure (Interdependence)
19. RealTeamMeasure (Real Team)
20. PsychologicalSafetyMeasure (Psychological Safety)
21. CreativityMeasure (Creativity)
22. IntrinsicMotivationMeasure (IM)
23. TeamSatisfactionMeasure (TS)
24. ProjectProgressMeasure (Progress)
25. AlliancePerformanceSubEffectivenessMeasure (Performance Effectiveness)
26. AlliancePerformanceSubEfficiencyMeasure (Performance Efficiency)
27. AlliancePerformanceSubResponsivenessMeasure (Performance Responsiveness)
28. AlliancePerformanceMeasure (Alliance Performance)
29. Coded Reported State of Project at time of questionnaire (State)
30. Gender
31. Ethnic Background (Ethnicity)

Appendix 4

| Pearson's Correlation | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|-------------------------------------|---|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. Agreement Objective | 1 | -.021 | .116 | .137 | -.201 | .034 | -.237 | -.097 | .048 | -.003 | -.046 | -.316 | -.098 | -.125 | .212 | .010 | -.077 | .055 | .009 | -.021 | .032 | -.156 | -.248 | -.016 | -.206 | -.188 | -.088 | -.159 | -.033 | -.114 | .023 |
| 2. TimePWG | | 1 | .830 | .090 | -.060 | -.280 | .046 | -.078 | -.125 | .530 | -.048 | .213 | .004 | -.446 | .197 | -.348 | -.227 | -.129 | -.302 | -.188 | -.039 | .295 | .133 | -.087 | -.062 | -.030 | -.035 | -.043 | -.011 | .208 | -.009 |
| 3. TimeNDIV | | | 1 | -.033 | .007 | -.236 | -.092 | -.234 | -.096 | .501 | -.087 | .171 | .037 | -.461 | .176 | -.360 | -.173 | -.140 | -.300 | -.132 | .040 | .263 | .091 | -.034 | -.212 | -.179 | -.093 | -.160 | -.054 | .339 | .010 |
| 4. MembersHome | | | | 1 | -.457 | .319 | -.356 | .624 | -.177 | -.432 | -.099 | -.278 | .054 | .334 | -.039 | .246 | .259 | .289 | .325 | -.076 | .005 | -.089 | -.088 | .087 | -.055 | -.050 | .043 | -.011 | .177 | .352 | -.083 |
| 5. Members commercial | | | | | 1 | -.065 | .438 | .194 | -.161 | .060 | -.246 | .143 | -.020 | .078 | -.350 | -.226 | .105 | .148 | -.030 | .396 | -.304 | -.234 | .249 | .094 | .463 | .495 | .401 | .476 | .015 | -.063 | .115 |
| 6. Members from a NHS Collaborating | | | | | | 1 | -.550 | .446 | -.203 | -.727 | .025 | -.044 | -.117 | .659 | -.415 | .195 | .113 | .103 | .179 | .052 | .103 | -.235 | .064 | .294 | -.181 | -.275 | -.257 | -.260 | .070 | .110 | .061 |
| 7. Members Other | | | | | | | 1 | .227 | -.151 | .399 | -.048 | -.033 | .103 | -.286 | .063 | -.131 | -.155 | -.224 | -.208 | -.063 | -.133 | .269 | -.166 | -.417 | .402 | .439 | .305 | .396 | -.262 | -.234 | -.001 |
| 8. Members Total | | | | | | | | 1 | -.180 | -.485 | -.173 | -.237 | .043 | .486 | -.337 | .158 | .200 | .182 | .216 | .039 | -.119 | -.089 | -.081 | -.025 | .271 | .255 | .219 | .260 | .003 | .169 | .001 |
| 9. Frequency meet | | | | | | | | | 1 | -.095 | -.141 | -.153 | .137 | .052 | .042 | -.160 | .046 | .154 | -.007 | .096 | -.046 | .001 | -.052 | -.082 | .323 | .338 | .248 | .314 | -.075 | -.103 | .244 |
| 10. Attendees meetings | | | | | | | | | | 1 | .007 | .202 | .037 | -.923 | .492 | -.485 | -.200 | -.330 | -.456 | -.190 | -.112 | .360 | .033 | -.266 | -.076 | -.035 | -.014 | -.039 | -.203 | -.047 | -.025 |
| 11. Email | | | | | | | | | | | 1 | .162 | -.041 | -.051 | .013 | .016 | -.170 | -.212 | -.127 | -.099 | .100 | -.005 | -.122 | -.118 | -.062 | -.106 | -.157 | -.125 | -.134 | -.091 | -.179 |
| 12. Teleconference | | | | | | | | | | | | 1 | .045 | -.143 | -.138 | -.140 | -.096 | .002 | -.100 | .155 | -.114 | .078 | .302 | .225 | -.021 | .045 | .057 | .036 | .176 | -.020 | -.152 |
| 13. Telephone | | | | | | | | | | | | | 1 | -.035 | -.059 | .139 | -.037 | .012 | .070 | .039 | -.023 | .002 | -.144 | -.127 | .019 | -.011 | .048 | .024 | -.010 | -.038 | .037 |
| 14. Small Meet | | | | | | | | | | | | | | 1 | -.603 | .495 | .350 | .377 | .521 | .343 | -.012 | -.394 | .194 | .343 | .279 | .217 | .155 | .219 | .330 | .007 | .019 |
| 15. Full Meet | | | | | | | | | | | | | | | 1 | -.200 | -.229 | -.256 | -.278 | -.337 | .234 | .327 | -.344 | -.316 | -.373 | -.352 | -.263 | -.340 | -.263 | .022 | -.053 |
| 16. Boundedness | | | | | | | | | | | | | | | | 1 | .284 | .562 | .854 | .436 | -.181 | -.478 | .064 | .482 | .163 | .151 | .283 | .226 | .627 | .112 | .012 |
| 17. Stability | | | | | | | | | | | | | | | | | 1 | .509 | .636 | .574 | -.363 | -.430 | .456 | .465 | .399 | .348 | .449 | .432 | .579 | .224 | -.077 |
| 18. Interdependence | | | | | | | | | | | | | | | | | | 1 | .867 | .747 | -.536 | -.614 | .430 | .765 | .475 | .520 | .850 | .603 | .811 | .237 | -.109 |
| 19. Real Team | | | | | | | | | | | | | | | | | | | 1 | .707 | -.424 | -.635 | .340 | .711 | .398 | .397 | .550 | .495 | .839 | .221 | .033 |
| 20. Psychological Safety | | | | | | | | | | | | | | | | | | | | 1 | -.570 | -.661 | .570 | .756 | .580 | .554 | .688 | .661 | .783 | .067 | .083 |
| 21. Creativity | | | | | | | | | | | | | | | | | | | | | 1 | .346 | -.462 | -.507 | -.506 | -.525 | -.591 | -.586 | -.546 | -.049 | -.019 |
| 22. IM | | | | | | | | | | | | | | | | | | | | | | 1 | -.283 | -.649 | -.292 | -.275 | -.413 | -.362 | -.641 | -.156 | -.057 |
| 23. TS | | | | | | | | | | | | | | | | | | | | | | | 1 | .571 | .424 | .361 | .401 | .421 | .532 | .062 | -.031 |
| 24. Progress | | | | | | | | | | | | | | | | | | | | | | | | 1 | .305 | .466 | .399 | .857 | .218 | -.142 | |
| 25. Performance Effectiveness | | | | | | | | | | | | | | | | | | | | | | | | | 1 | .889 | .725 | .901 | .446 | -.134 | -.166 |
| 26. Performance Efficiency | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | .839 | .962 | .466 | -.113 | .130 |
| 27. Performance Responsiveness | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | .940 | .611 | .098 | .052 |
| 28. Alliance Performance | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | .559 | -.028 | .112 |
| 29. State | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | .207 | -.105 |
| 30. Gender | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | -.084 |
| 31. Ethnic Background | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |

** .Correlation is significant at the 0.01 level (2-tailed); * .Correlation is significant at the 0.05 level (2-tailed).

Appendix 4

| Speaman's RHO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | |
|------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. Agreement Objective | 1.000 | -.026 | .078 | .105 | -.208 | .025 | -.357 | -.115 | .041 | .011 | -.041 | -.311 | -.100 | -.123 | .215 | .018 | -.089 | .047 | -.012 | -.053 | .064 | -.127 | -.253 | -.047 | -.188 | -.180 | -.112 | -.149 | -.068 | .125 | -.041 | |
| 2. TimePWG | | 1.000 | .841 | .093 | -.105 | -.210 | -.036 | -.111 | -.168 | .503 | -.032 | .217 | -.022 | -.412 | .159 | -.284 | -.147 | -.139 | -.287 | -.152 | -.050 | .314 | .123 | -.038 | -.027 | -.025 | -.044 | -.046 | .059 | .227 | .053 | |
| 3. TimeINDIV | | | 1.000 | -.079 | .039 | -.277 | -.113 | -.246 | -.120 | .570 | -.097 | .194 | .028 | -.523 | .153 | -.394 | -.141 | -.171 | -.361 | -.145 | -.016 | .319 | .064 | -.058 | -.145 | -.127 | -.057 | -.104 | -.069 | .313 | -.041 | |
| 4. MembersHome | | | | 1.000 | -.484 | .401 | -.332 | .638 | .125 | -.410 | -.068 | -.268 | .050 | .316 | -.057 | .315 | .293 | .232 | .353 | -.070 | .039 | -.117 | -.019 | .113 | .019 | -.012 | -.046 | -.030 | .157 | .350 | 0.000 | |
| 5. Members | | | | | 1.000 | -.106 | .456 | .160 | .156 | -.010 | -.246 | .143 | -.020 | .150 | -.350 | -.261 | .142 | .182 | -.063 | .394 | -.321 | -.211 | .266 | .069 | .383 | .476 | .442 | .495 | -.001 | -.063 | -.046 | |
| 6. Members from a | | | | | | 1.000 | -.362 | .524 | -.164 | -.745 | .018 | -.070 | -.113 | .664 | -.402 | .278 | .052 | .186 | .286 | .009 | .143 | -.259 | .071 | .303 | -.177 | -.232 | -.229 | -.247 | .137 | .099 | .088 | |
| 7. Members Other | | | | | | | 1.000 | .218 | .095 | .047 | -.001 | -.011 | .085 | .113 | -.152 | -.003 | -.042 | -.121 | -.055 | .094 | -.171 | .216 | -.105 | -.296 | .447 | .490 | .437 | .472 | -.104 | -.224 | .030 | |
| 8. Members Total | | | | | | | | 1.000 | .139 | -.555 | -.167 | -.187 | .053 | .538 | -.337 | .205 | .195 | .207 | .257 | .035 | -.109 | -.106 | -.026 | .019 | .217 | .257 | .181 | .221 | .018 | .177 | .035 | |
| 9. Frequency meet | | | | | | | | | 1.000 | -.117 | -.140 | -.153 | .140 | .067 | .044 | -.173 | .026 | .132 | -.050 | .063 | -.023 | .042 | -.013 | -.134 | .337 | .314 | .262 | .318 | -.146 | -.099 | .107 | |
| 10. Attendees meetings | | | | | | | | | | 1.000 | .008 | .207 | .021 | -.938 | .510 | -.487 | -.178 | -.350 | -.509 | -.163 | -.109 | .352 | .001 | -.240 | -.115 | -.076 | -.036 | -.058 | -.183 | -.017 | -.030 | |
| 11. Email | | | | | | | | | | | 1.000 | .162 | -.041 | -.031 | .013 | .031 | -.168 | -.151 | -.059 | -.070 | .069 | -.047 | -.160 | -.105 | -.102 | -.158 | -.141 | -.164 | -.085 | -.091 | -.158 | |
| 12. Teleconference | | | | | | | | | | | | 1.000 | .045 | -.142 | -.138 | -.115 | -.119 | .023 | -.092 | .168 | -.139 | .072 | .281 | .231 | -.024 | .037 | .058 | .030 | .210 | -.020 | -.174 | |
| 13. Telephone | | | | | | | | | | | | | 1.000 | -.028 | -.059 | .145 | -.047 | -.035 | .055 | .066 | -.050 | .035 | -.182 | -.124 | -.014 | -.020 | .069 | .027 | -.018 | -.038 | .153 | |
| 14. Small Meet | | | | | | | | | | | | | | 1.000 | -.617 | .494 | .336 | .392 | .564 | .328 | -.036 | -.374 | .177 | .313 | .297 | .249 | .182 | .230 | .327 | -.024 | .041 | |
| 15. Full Meet | | | | | | | | | | | | | | | 1.000 | -.201 | -.264 | -.294 | -.317 | -.328 | .257 | .312 | -.353 | -.332 | -.335 | -.327 | -.274 | -.321 | -.303 | .022 | -.157 | |
| 16. Boundedness | | | | | | | | | | | | | | | | 1.000 | .256 | .504 | .878 | .425 | -.139 | -.485 | .087 | .520 | .153 | .145 | .195 | .177 | .652 | .109 | .115 | |
| 17. Stability | | | | | | | | | | | | | | | | | 1.000 | .449 | .583 | .531 | -.314 | -.425 | .432 | .427 | .376 | .356 | .366 | .400 | .521 | .215 | .042 | |
| 18. Interdependence | | | | | | | | | | | | | | | | | | 1.000 | .788 | .692 | -.458 | -.552 | .482 | .726 | .495 | .508 | .540 | .557 | .717 | .188 | .104 | |
| 19. Real Team | | | | | | | | | | | | | | | | | | | 1.000 | .645 | -.301 | -.614 | .322 | .698 | .356 | .332 | .383 | .385 | .798 | .187 | .128 | |
| 20. Psychological | | | | | | | | | | | | | | | | | | | | 1.000 | -.564 | -.601 | .557 | .699 | .514 | .539 | .649 | .645 | .740 | .051 | .012 | |
| 21. Creativity | | | | | | | | | | | | | | | | | | | | | 1.000 | .262 | -.462 | -.464 | -.529 | -.539 | -.560 | -.583 | -.482 | -.027 | -.014 | |
| 22. IM | | | | | | | | | | | | | | | | | | | | | | 1.000 | -.307 | -.631 | -.240 | -.239 | -.321 | -.312 | -.595 | -.153 | -.031 | |
| 23. TS | | | | | | | | | | | | | | | | | | | | | | | 1.000 | .581 | .397 | .362 | .377 | .405 | .551 | .068 | .007 | |
| 24. Progress | | | | | | | | | | | | | | | | | | | | | | | | 1.000 | .267 | .286 | .380 | .350 | .839 | .189 | .131 | |
| 25. Performance | | | | | | | | | | | | | | | | | | | | | | | | | 1.000 | .856 | .720 | .862 | .432 | -.109 | .137 | |
| 26. Performance | | | | | | | | | | | | | | | | | | | | | | | | | | 1.000 | .857 | .959 | .437 | -.046 | .035 | |
| 27. Performance | | | | | | | | | | | | | | | | | | | | | | | | | | | 1.000 | .953 | .457 | .055 | -.033 | |
| 28. Alliance | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1.000 | .476 | -.012 | .026 | |
| 29. State | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1.000 | .152 | .125 | |
| 30. Gender | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1.000 | -.027 | |
| 31. Ethnic Background | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1.000 |

Team Level Correlations**Variables Key:**

1. Agreement Objective
2. TimePWG
3. TimeINDIV
4. MembersHome
5. Members commercial
6. Members from a NHS Collaborating Organisation
7. Members Other
8. Members Total
9. Frequency meet
10. Attendees meetings
11. Email
12. Teleconference
13. Telephone
14. Small Meet
15. Full Meet
16. Leadership Clarity
17. Boundedness
18. Stability
19. Interdependence
20. Real Team
21. Psychological Safety
22. Creativity
23. IM
24. TS
25. Progress
26. Performance Effectiveness
27. Performance Efficiency
28. Performance Responsiveness
29. Alliance Performance
30. State
31. Gender
32. Ethnic Background

Appendix 4

| Pearson's | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 |
|--|---|------|--------|-------|-------|-------|-------|--------|-------|---------|-------|---------|-------|---------|---------|--------|-------|-------|--------|--------|--------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------|-------|
| 1. Agreement Objective | 1 | .084 | .143 | .196 | -.271 | .155 | -.288 | -.008 | .012 | .001 | -.046 | -.420 | .199 | -.112 | .200 | .474 | .039 | -.216 | -.046 | -.054 | -.137 | -.095 | -.166 | -.321 | -.058 | -.428 | -.364 | -.283 | -.357 | -.135 | .244 | -.078 |
| 2. TimePWG | | 1 | .932** | .085 | -.098 | -.142 | .037 | -.019 | -.301 | .496 | .007 | .314 | .043 | -.436 | .252 | -.173 | -.380 | -.394 | -.269 | -.394 | -.298 | .049 | .410 | .012 | -.188 | -.236 | -.202 | -.185 | -.211 | -.149 | .388 | -.077 |
| 3. TimeINDIV | | | 1 | -.052 | -.046 | -.165 | -.102 | -.199 | -.345 | .547** | .006 | .357 | -.037 | -.523** | .350 | -.278 | -.437 | -.418 | -.308 | -.444 | -.264 | .147 | .351 | -.008 | -.161 | -.395 | -.353 | -.257 | -.333 | -.196 | .452 | -.158 |
| 4. MembersHome | | | | 1 | -.415 | .282 | -.283 | .626** | .263 | -.385 | -.269 | -.546** | .177 | .303 | -.024 | .142 | .279 | .341 | .315 | .351 | -.032 | -.073 | -.129 | -.089 | .098 | .012 | .011 | .115 | .059 | .192 | .550** | -.264 |
| 5. Members commercial | | | | | 1 | .082 | .461 | .266 | .195 | -.135 | -.424 | .148 | -.074 | .274 | -.602** | -.083 | -.186 | .082 | .121 | -.019 | .361 | -.303 | -.296 | .301 | .072 | .479 | .481 | .326 | .427 | -.025 | -.102 | .259 |
| 6. Members from a NHS Collaborating Organisation | | | | | | 1 | -.382 | .554* | -.265 | -.675** | -.052 | -.181 | -.355 | .624* | -.566** | .000 | .100 | .003 | -.016 | .042 | -.043 | .075 | -.202 | .007 | .156 | -.158 | -.251 | -.290 | -.254 | -.072 | .181 | -.151 |
| 7. Members Other | | | | | | | 1 | .281 | .197 | .223 | -.103 | -.112 | .310 | -.110 | -.081 | .123 | -.107 | -.167 | -.197 | -.176 | -.053 | -.131 | .240 | -.203 | -.395 | .401 | .422 | .251 | .354 | -.238 | -.298 | -.006 |
| 8. Members Total | | | | | | | | 1 | .218 | -.560** | -.401 | -.531** | .099 | .573** | -.531** | .155 | .152 | .181 | .145 | .179 | .018 | -.170 | -.146 | -.100 | -.051 | .282 | .244 | .160 | .224 | -.039 | .310 | -.050 |
| 9. Frequency meet | | | | | | | | | 1 | -.253 | -.285 | -.465 | .265 | .227 | -.092 | .356 | -.049 | .299 | .375 | .208 | .287 | -.131 | -.258 | .031 | .008 | .532* | .564* | .478 | .537* | .079 | -.300 | .075 |
| 10. Attendees meetings | | | | | | | | | | 1 | .187 | .440 | .113 | -.950** | .697** | -.013 | -.480 | -.241 | -.353 | -.439 | -.228 | -.046 | .464 | .000 | -.239 | -.239 | -.191 | -.103 | -.170 | -.179 | -.017 | -.075 |
| 11. Email | | | | | | | | | | | 1 | .124 | .249 | -.246 | .126 | .091 | -.178 | -.330 | -.444 | -.353 | -.256 | .233 | .412 | -.179 | -.227 | -.216 | -.322 | -.391 | -.339 | -.330 | -.340 | -.054 |
| 12. Teleconference | | | | | | | | | | | | 1 | -.171 | -.356 | .072 | -.368 | -.084 | -.117 | .079 | -.037 | .193 | -.133 | .032 | .424 | .344 | -.009 | .033 | .081 | .045 | .280 | -.092 | .501 |
| 13. Telephone | | | | | | | | | | | | | 1 | -.181 | .039 | .582** | -.198 | -.100 | .116 | .119 | .100 | -.189 | -.081 | -.258 | -.067 | .108 | .122 | .070 | .099 | .002 | .111 | -.075 |
| 14. Small Meet | | | | | | | | | | | | | | 1 | -.802** | -.074 | .491 | .385 | .410 | .504 | .361 | -.113 | -.517** | .226 | .305 | .431 | .365 | .234 | .335 | .288 | -.040 | .067 |
| 15. Full Meet | | | | | | | | | | | | | | | 1 | .031 | -.229 | -.246 | -.332 | -.311 | -.403 | .371 | .477 | -.383 | -.326 | -.574* | -.487 | -.267 | -.426 | -.212 | .022 | -.322 |
| 16. Leadership Clarity | | | | | | | | | | | | | | | | 1 | -.146 | -.167 | -.146 | -.173 | -.214 | .010 | .050 | -.335 | -.306 | -.079 | -.102 | -.302 | -.192 | -.300 | -.262 | .038 |
| 17. Boundedness | | | | | | | | | | | | | | | | | 1 | .452 | .681** | .880** | .549* | -.336 | -.661** | .170 | .611* | .249 | .285 | .419 | .348 | .733** | .219 | .037 |
| 18. Stability | | | | | | | | | | | | | | | | | | 1 | .707** | .763** | .738** | -.575* | -.645** | .726** | .629* | .606* | .550* | .646** | .629* | .711** | .087 | -.111 |
| 19. Interdependence | | | | | | | | | | | | | | | | | | | 1 | .922** | .855** | -.682** | -.868** | .596* | .875** | .617** | .677** | .810** | .748** | .918** | .209 | .375 |
| 20. Real Team | | | | | | | | | | | | | | | | | | | | 1 | .806** | -.590* | -.842** | .512 | .817** | .529* | .557** | .701** | .637** | .914** | .215 | .146 |
| 21. Psychological Safety | | | | | | | | | | | | | | | | | | | | | 1 | -.724** | -.876** | .751** | .850** | .689** | .688** | .788** | .759** | .820** | .018 | .285 |
| 22. Creativity | | | | | | | | | | | | | | | | | | | | | | 1 | .624* | -.641** | -.643** | -.659** | -.697** | -.745** | -.735** | -.647** | -.144 | -.417 |
| 23. IM | | | | | | | | | | | | | | | | | | | | | | | 1 | -.556** | -.851** | -.483 | -.491 | -.591* | -.553* | -.780** | -.203 | -.263 |
| 24. TS | | | | | | | | | | | | | | | | | | | | | | | | 1 | .726** | .631* | .563* | .564* | .602* | .706** | -.021 | .236 |
| 25. Progress | | | | | | | | | | | | | | | | | | | | | | | | | 1 | .440 | .443 | .612* | .536* | .919** | .230 | .432 |
| 26. Performance Effectiveness | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | .966** | .822** | .945** | .529* | -.273 | .320 |
| 27. Performance Efficiency | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | .904** | .984** | .560* | -.232 | .405 |
| 28. Performance Responsiveness | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | .961** | .712** | .002 | .359 |
| 29. Alliance Performance | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | .642** | -.144 | .377 |
| 30. State | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | .206 | .293 |
| 31. Gender | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | -.276 |
| 32. Ethnic Background | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 |

** . Correlation is significant at the 0.01 level (2-tailed). * . Correlation is significant at the 0.05 level (2-tailed).

Appendix 4

| Spearmen's RHO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | |
|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. Agreement Objective | 1.000 | .064 | .103 | .082 | -.284 | .065 | -.507 | -.112 | .017 | .047 | -.165 | -.232 | .277 | -.181 | .351 | .509 | .020 | -.297 | -.092 | -.113 | -.213 | -.030 | -.063 | -.269 | -.025 | -.390 | -.410 | -.388 | -.372 | -.180 | .495 | -.055 | |
| 2. TimePWG | | 1.000 | .906 | .078 | -.117 | -.047 | -.018 | -.026 | -.327 | .448 | -.029 | .310 | -.045 | -.371 | .164 | -.211 | -.325 | -.331 | -.311 | -.388 | -.324 | .006 | .432 | -.098 | -.150 | -.181 | -.211 | -.171 | -.199 | -.098 | .374 | .191 | |
| 3. TimeNDIV | | | 1.000 | -.121 | -.032 | -.213 | -.135 | -.244 | -.337 | .621 | -.015 | .410 | -.078 | -.575 | .324 | -.236 | -.526 | -.379 | -.488 | -.572 | -.360 | .125 | .490 | -.131 | -.248 | -.377 | -.360 | -.274 | -.312 | -.278 | .352 | -.002 | |
| 4. MembersHome | | | | 1.000 | -.446 | .352 | -.289 | .623 | .252 | -.339 | -.192 | -.413 | .023 | .269 | .046 | .074 | .342 | .443 | .284 | .410 | .006 | .006 | -.152 | .144 | .118 | .214 | .140 | .039 | .073 | .196 | .514 | -.022 | |
| 5. Members commercial | | | | | 1.000 | .034 | .541 | .239 | .112 | -.207 | -.337 | .064 | -.016 | .323 | .674 | -.080 | -.283 | .094 | .174 | -.063 | .346 | -.346 | -.316 | .222 | .063 | .316 | .378 | .441 | .441 | -.016 | -.359 | 0.000 | |
| 6. Members from a NHS Collaborating Organisation | | | | | | 1.000 | -.177 | .599 | -.174 | -.712 | -.062 | -.195 | -.392 | .654 | -.483 | -.053 | .171 | 0.000 | .134 | .203 | -.093 | .164 | -.266 | .098 | .170 | -.137 | -.201 | -.239 | -.201 | .021 | .243 | .192 | |
| 7. Members Other | | | | | | | 1.000 | .304 | .138 | -.160 | .061 | -.235 | .279 | .285 | -.437 | -.057 | -.012 | -.065 | -.007 | -.085 | .113 | -.129 | .117 | -.260 | -.236 | .379 | .425 | .463 | .426 | -.096 | .525 | -.091 | |
| 8. Members Total | | | | | | | | 1.000 | .208 | -.607 | -.331 | -.488 | .083 | .596 | -.483 | .173 | .154 | .239 | .205 | .230 | .029 | -.114 | -.172 | -.029 | -.023 | .263 | .264 | .197 | .221 | -.014 | .165 | .019 | |
| 9. Frequency meet | | | | | | | | | 1.000 | -.234 | -.188 | -.475 | .165 | .184 | .043 | .305 | -.024 | .206 | .458 | .129 | .291 | -.038 | -.192 | .088 | -.049 | .508 | .533 | .524 | .564 | .034 | -.383 | .082 | |
| 10. Attendees meetings | | | | | | | | | | 1.000 | .042 | .480 | .107 | -.959 | .650 | -.045 | -.423 | -.265 | -.451 | -.459 | -.194 | -.076 | .496 | -.136 | -.209 | -.277 | -.176 | -.147 | -.177 | -.166 | .094 | 0.000 | |
| 11. Email | | | | | | | | | | | 1.000 | .055 | .268 | -.087 | .013 | .029 | -.106 | -.281 | -.237 | -.202 | -.171 | .208 | .347 | -.195 | -.232 | -.243 | -.277 | -.273 | -.299 | -.230 | -.194 | .189 | |
| 12. Teleconference | | | | | | | | | | | | 1.000 | -.188 | -.413 | .080 | -.363 | -.047 | -.140 | .032 | .011 | .185 | -.220 | .029 | .355 | .434 | -.119 | -.034 | .011 | -.017 | .361 | -.009 | .374 | |
| 13. Telephone | | | | | | | | | | | | | 1.000 | -.187 | .026 | .639 | .011 | -.258 | -.007 | -.079 | -.092 | -.257 | .178 | -.400 | -.215 | -.013 | .047 | .002 | .003 | -.168 | .047 | .139 | |
| 14. Small Meet | | | | | | | | | | | | | | 1.000 | -.759 | -.043 | .424 | .391 | .494 | .505 | .318 | -.061 | .550 | .279 | .269 | .421 | .295 | .281 | .296 | .279 | -.196 | 0.000 | |
| 15. Full Meet | | | | | | | | | | | | | | | 1.000 | .074 | -.076 | -.273 | -.429 | -.309 | -.362 | .400 | .475 | -.392 | -.255 | -.460 | -.384 | -.346 | -.371 | -.242 | .219 | -.297 | |
| 16. Leadership Clarity | | | | | | | | | | | | | | | | 1.000 | -.156 | -.205 | -.087 | -.167 | -.246 | -.089 | .131 | -.302 | -.340 | -.165 | -.187 | -.265 | -.238 | -.288 | -.130 | .181 | |
| 17. Boundedness | | | | | | | | | | | | | | | | | 1.000 | .411 | .597 | .875 | .482 | -.186 | -.599 | .250 | .692 | .280 | .257 | .268 | .259 | .737 | .164 | -.092 | |
| 18. Stability | | | | | | | | | | | | | | | | | | 1.000 | .547 | .700 | .679 | -.425 | -.652 | .749 | .481 | .616 | .525 | .511 | .506 | .590 | .000 | -.243 | |
| 19. Interdependence | | | | | | | | | | | | | | | | | | | 1.000 | .841 | .812 | -.576 | -.819 | .693 | .801 | .750 | .733 | .708 | .752 | .830 | -.082 | .399 | |
| 20. Real Team | | | | | | | | | | | | | | | | | | | | 1.000 | .746 | -.454 | -.835 | .640 | .845 | .541 | .504 | .486 | .502 | .890 | .107 | .083 | |
| 21. Psychological Safety | | | | | | | | | | | | | | | | | | | | | 1.000 | -.704 | -.810 | .774 | .801 | .699 | .736 | .807 | .795 | .784 | -.188 | .115 | |
| 22. Creativity | | | | | | | | | | | | | | | | | | | | | | 1.000 | .509 | -.562 | -.561 | -.627 | -.654 | -.629 | -.631 | -.572 | -.028 | -.399 | |
| 23. IM | | | | | | | | | | | | | | | | | | | | | | | 1.000 | -.723 | -.813 | -.475 | -.444 | -.480 | -.509 | -.736 | -.080 | -.023 | |
| 24. TS | | | | | | | | | | | | | | | | | | | | | | | | 1.000 | .739 | .559 | .487 | .494 | .508 | .759 | -.053 | .261 | |
| 25. Progress | | | | | | | | | | | | | | | | | | | | | | | | | 1.000 | .414 | .438 | .477 | .485 | .923 | .172 | .271 | |
| 26. Performance Effectiveness | | | | | | | | | | | | | | | | | | | | | | | | | | 1.000 | .957 | .907 | .922 | .581 | -.338 | .262 | |
| 27. Performance Efficiency | | | | | | | | | | | | | | | | | | | | | | | | | | | 1.000 | .968 | .981 | .551 | -.334 | .270 | |
| 28. Performance Responsiveness | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1.000 | .992 | .557 | -.357 | .156 | |
| 29. Alliance Performance | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1.000 | .561 | -.335 | .216 | |
| 30. State | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1.000 | .022 | .284 | |
| 31. Gender | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1.000 | -.133 | |
| 32. Ethnic Background | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1.000 |