

Imperial College London  
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# **The Evolution of Knowledge Transfer Boundary Networks in Healthcare**

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A thesis submitted to Imperial College London for the Degree of Doctor of Philosophy

# ABSTRACT

A particular concern within healthcare is the issue of research-informed practice. Failure to translate knowledge efficiently from research into practice potentially has consequences in terms of the quality of care or wasted resources, leading to an inefficient and unproductive health system. Effective techniques and approaches to address this knowledge gap (often called the 'second translational gap') are required. Literature suggests there is no 'magic bullet' to move healthcare research into improved clinical practice. This difficulty is linked, at least in part, to the organisational complexity of health systems including the National Health Service; there are multiple stakeholders, networks and professional and organisational silos.

This study draws on data collection and analysis of a healthcare intervention borne from policy aimed specifically at addressing the second translational gap, i.e. moving research into clinical practice effectively and efficiently. The intervention was entitled the 'Collaboration and Leadership in Applied Health Research and Care' (CLAHRC), of which nine examples have been deployed in local health systems. North West London CLAHRC is an appropriate case study as its approach is consciously designed to create collaboration by establishing new networks that span different local health organisations and professions. The study is longitudinal and therefore enables a dynamic perspective that explores the impact of this carefully managed programme of activities on knowledge network evolution within this local context. Using a range of mixed methods, including semi-structured interviews, observation and Social Network Analysis I aimed to uncover how knowledge networks are instigated, how they are successfully developed and also how they are sustained over time, to deliver evidence-based medicine.

The findings demonstrate and discuss the process through which a knowledge boundary network evolves and ultimately attains sustainability. It highlights how a mandated, structured inception and continued facilitation leads to increased interaction, a reduction in hierarchy and collaboration across boundaries. The findings are analysed with reference to extant literature and ultimately they contribute to the body of knowledge with regard to boundary network and community development. Finally, this study outlines the implications to future research and in particular the importance of the study to both healthcare practice and policy.

# DECLARATION

I declare that this thesis submitted for the degree of Doctor of Philosophy is my own composition and that, unless otherwise referenced, the material presented herein is my own original work.

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# DEDICATION

*'.....strong in will to strive, to seek, to find, and not to yield. Knowing the steps to your dreams doesn't make the climb any less of a challenge.'* A. Tennyson/ R Goodrich.

From Regents Park to the North Pole and Cambfix. It has not been easy.

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# **CHAPTER 1: INTRODUCTION**

## **1.1 Background of Study**

The overriding objective of this thesis is to examine the development of knowledge transfer networks in healthcare. There has been substantial interest within the United Kingdom (UK) in the movement of evidence-based medicine into clinical practice effectively and efficiently. This has been termed the 'second translational gap' by policymakers and has resulted in substantial investment into nine organisations whose primary objective is to address this gap (Cooksey, 2006). These bodies are called 'Collaborations for Leadership in Applied Health Research and Care' (CLAHRC). Drawing on literature a large part of the focus to date with regard to closing the second translational gap is through improved knowledge transfer (KT). Alongside this move towards improved KT, the National Health Service (NHS) has also moved toward a more networked form of organising, supported by government policy, as literature indicates that networks improve knowledge transfer (Ferlie et al, 2010).

To date, despite this effort there are few longitudinal studies that focus on the development and evolution of networks set up to stimulate the uptake of evidence-based medicine. The thesis aims to address this deficit. It explores the antecedents, the process and the outcomes of a knowledge transfer boundary network (KTBN) as it develops and ultimately becomes functionally sustaining. The study utilises a mixed method approach that enables a comprehensive analysis of the developmental process, including a quantification of the network characteristics, alongside an understanding of the context and emerging community. It presents a framework of findings that demonstrate the developmental process and the outcomes at various stages that both informs and progresses the literature in this area. This chapter offers a brief overview of the thesis.

## **1.2 Research Problem**

Within healthcare there is a particular issue of research informing practice, as often a substantial time lag exists between research being conducted and research being taken up and utilised in a reliable or consistent fashion (Seddon et al, 2001). This

problem has been the subject of debate since the 1950s and still continues today (Lomas, 2000, Lomas, 2007, Niccolini et al, 2008, Kontos and Poland 2009, Oborn et al, 2010). The failure to translate knowledge from research into practice has consequences, both in terms of clinical and healthcare quality outcomes and in terms of potentially wasted resources leading to an inefficient and unproductive health system. A requirement remains for effective techniques and approaches to address this knowledge gap (defined in policy as the 'second translational gap') (Cooksey, 2006, Darzi, 2007). Extant literature suggests that there is no a single 'magic bullet' to move research into clinical practice efficiently and effectively (Greenhalgh, 2004). Knowledge mobilisation is generally viewed as a key ingredient for resolving this issue, alongside a network based structure of organisations, professions and individuals. However, the NHS is a complex system and does not form a homogenous structure. There are multiple networks and therefore multiple network boundaries. Research demonstrates that knowledge mobilisation 'sticks' at boundaries and also suggests mechanisms that can create more fluidity such as boundary bridging mechanisms - interactions, people (skills and brokerage) and boundary objects (Wenger, 2000). Finally, literature highlights the concept of a boundary network (Karafillidis, 2008) and discusses the concept of a group coming together to create a learning network i.e. a community of practice (Wenger, 2000). In other words there is interplay between networks and social structure.

The matter, which is highlighted above, is discussed within the health services research literature, but there are gaps resulting from the approach to research, quality of reporting, the empirical nature of the work and the specific challenges which studies in the context of healthcare have to negotiate. There have been calls for reporting of implementation research to be clear on the theory and concepts from which it draws, a requirement for the exploration of multi-faceted interventions, the importance of context and the need for longitudinal research (Rycroft-Malone et al, 2013, Robertson and Jochelson, 2006, Su et al, 2010). These factors are important because, for example, drawing on different theories enables a different focus on the healthcare context, which could lead to a better understanding of the impact of an intervention and the impact over time. Also, the nature of the healthcare environment to some extent renders single, static views obsolete as the environment is dynamic and constantly changing.

This thesis builds upon the concepts briefly outlined above, e.g. knowledge and boundary networks alongside communities of practice. It, however, specifically addresses these concepts in a longitudinal fashion and through investigation of a multi-faceted intervention specifically designed to improve knowledge mobilisation.

### **1.3 Research Question and Objective**

Following on from the background to the study and more specifically the research problem there is clearly a requirement to understand further the development of a knowledge network that crosses boundaries and creates a shared community that essentially learns together and interacts regularly. There has been limited, if any, research that takes a longitudinal approach and that combines network development, community development and the process through which these combine. The overriding aim of my research is therefore to investigate these developmental processes and their respective outcomes, and more specifically to create a conceptual framework that explains the stages and processes by which a knowledge transfer boundary becomes sustainable.

As a result, my overarching research question is:

***'How do knowledge transfer boundary networks develop over time and how do they become self-sustaining?'***

This is investigated through the following sub-questions:

***RQ1. What were the developmental processes underlying network inception?***

***RQ2. How do knowledge transfer boundary networks evolve from inception to sustainability?***

***RQ3. What factors are needed to create sustainability?***

A key aspect of this study was the iteration between the different methods in order to understand the complexities of these questions more fully. Different aspects of the mixed methods utilised inform these. Specifically, quantitative data and social network analysis enable a characterisation of the network structure throughout the

evolution process, the fieldwork data enable a characterisation of these processes, and the qualitative data helped to socially embed and explain outcomes.

## **1.4 Research Methods and Analyses**

As highlighted above, in order to effectively conduct the proposed research and investigate the research questions fully both qualitative and quantitative approaches were utilised. The methods used were field observation and participation, interviews and social network analysis. Whilst all of the methods were blended together across the research questions the specific methods were purposively chosen to elucidate specific aspects of the research questions.

These are described in chapter 3 in full. The combined approach enabled triangulation with regard to the empirical evidence and therefore offers a richer, more nuanced understanding. The fundamental approach was inductive due to the novel nature of the intervention being investigated and due to the lack of theoretically based longitudinal studies within the literature.

## **1.5 Scope of Study**

The proposed study compares the empirical quantitative and qualitative findings (Chapters 4 to 8) with the theoretical considerations and gaps of the healthcare literature (Chapter 2), to conceptualise a developmental process framework for knowledge boundary networks.

The study compares the various knowledge transfer boundary networks that are instigated, evolve and sustain as a result of a policy driven initiative – Collaboration in Leadership of Applied Health Research and Care (CLAHRC). CLAHRC utilises a number of different approaches to convene a group of individuals who each represent a different aspect of a care pathway. The group go through the CLARHC process being subject to facilitated interaction, utilising web reporting tools, learning improvement methodologies and implementing a change within their care pathway. The CLAHRC which I focused on was based in North West London.

## **1.6 Major Areas of Contribution**

The main contributions of the thesis are to the health services literature in general and specifically to the knowledge networks, boundaries and communities of practice literatures. Fundamentally it offers a perspective on the evolution of boundary networks whose aim is to improve the mobilisation of knowledge. The thesis essentially makes a contribution on four aspects – theory, methodology, practice and policy.

Literature discusses at length the need to mobilise knowledge into practice. One method of achieving this is through improved dissemination of knowledge across networks (Ferlie, 2010). This knowledge can ‘stick’ at boundaries and it is in here where this study’s first contribution lies. The study delineates a framework of the inception, evolution and sustainability of knowledge boundary networks. This builds on theory as it focuses on the evolution of the network, which is not often approached in the literature and continues to sustainability. It also characterises the various antecedents and consequences of the mechanisms used throughout the process. Again, this contributes to literature as these aspects have not been well characterised both in terms of their use and impact.

The study also contributes to specific theoretical areas within the literature. It develops the nomenclature surrounding communities of practice. The community of practice literature is predominantly based within a discussion around a static definition of a community of practice. This study suggests that there are forms that have a similar core definition but alter in some way to that of a community of practice. These forms are transient across the process as the knowledge transfer boundary network develops.

Another theoretical area the study contributes toward is that of knowledge transfer, boundary relations and the complexity of relational ties. This study demonstrates that there are more than one type of knowledge exchange process that can achieve the inception, evolution and sustainability of a knowledge boundary network. This is as opposed to the usual stance of literature that there is one optimum process model to be characterised or used.

The study also highlights how boundary relations change throughout the evolution of the network and can go through different stages of strain or neglect and evolve to supportive and cooperative. Finally, with regard to relational ties the study delineates a more granular concept to the definition and characterisation of a relational tie. Literature discusses ties, in the main, in terms of strength or presence. This study indicates that there are more granularities needed to define a tie in terms of level of contact and value gained. This level of complexity around boundary crossing and tie formation is not covered within the literature.

The study was undertaken utilising mixed methods. It was conducted in a manner of methodological blending, which offers a new and interesting approach to healthcare studies. As the quantitative and qualitative were both inductive it was possible to blend the methods to create a model of change in a manner that enabled more of the complexities to be accounted for. This is a useful contribution to approaches in healthcare research as it can offer benefits when there are time and access constraints, incorporates more of the complexities, which is important due to the nature of the healthcare environment, and it enables process and structure to be investigated at the same time.

From a practice and policy perspective this study contributes in a number of important ways. It offers an evaluation of a government borne policy and highlights insights into how the approach taken worked. It also highlights lessons learnt in terms of mechanisms used to create the knowledge boundary networks, how to apply them and how to ensure they combine to create a sustainable change. A key lesson regarding practice and policy is the concept that the development through inception, evolution and sustainability there are a number of transient forms, from a structural and community perspective that are achieved. This study therefore suggests that it is important that an organisation attempting to create knowledge boundary networks allows the capacity for this to happen.

Finally, the study draws together the importance of applying new theories to healthcare, the requirement for a blending of methods and to conduct analysis over a period of time. This will enrich healthcare studies and will offer a better understanding of the complexities involved. By doing this good, informed healthcare

decisions can be made at the policy level and ultimately the practice of healthcare can be improved alongside the requirement for efficiency.

## **1.7 Thesis Structure**

Within this section I briefly outline the structure of the thesis. In chapter 2 I review the literatures that combine to form the background to this study. To date, there have been limited longitudinal studies relating to the development of knowledge networks based around boundaries. As a result aspects such as boundary crossing and communities of practice within this context remain poorly understood. Drawing on the overview of the literature and the gaps identified I outline my research questions within this chapter.

Chapter 3 addresses the stance of the research paradigm and the research methodology. Within this chapter the process conducted for data collection and data analysis are described – in-depth semi-structured interviews, sociometric questionnaires and collection of fieldwork data. Finally, I discuss how reliability, validity and trustworthiness in the study were ensured.

Chapters 4, 5, 6, 7 and 8 outline the findings. Chapter 4 provides an overview of the conceptual framework of the developmental process through which a knowledge boundary network travels. It also, for clarity, provides a guide to the structure of the subsequent findings chapters. Chapter 5 delineates the contextual analysis. The overview of the case study CLAHRC and the mechanisms and methodologies it uses throughout the process.

Chapters 6, 7 and 8 each deal with a specific aspect of the research question. They present the empirical results resulting from the qualitative data and the quantitative data. It delineates the process framework of the development of the knowledge transfer boundary network (KTBN) from inception through to sustainability.

Chapter 6 outlines the developmental processes that create inception of the knowledge boundary network. Chapter 7 discusses the evolution of the knowledge boundary network and chapter 8 focuses on the sustainability of the knowledge boundary network.

Chapter 9 focuses on a discussion of the main findings with reference to extant literature. It examines the findings of this study and highlights where appropriate their implication to the relevant theoretical areas within the literature.

Chapter 10 concludes the thesis. It concludes with the implications and suggestions with regard to future research and the importance of the study to theory development and healthcare practice and policy.



# **CHAPTER 2: LITERATURE REVIEW**

## **2.1 Chapter Overview**

Within this chapter I outline the narrative literature review that was undertaken and that ultimately led to the identification of the gaps within the literature and the research questions that this study seeks to address. The chapter initially provides an outline of how the narrative literature review was undertaken, for example, the approach taken, the structure and the reasons for this. I then move on to review the actual literature providing the theoretical framing to this study.

There is an extensive literature from a number of different research disciplines that to varying extents have relevance to this study. Within this chapter I specifically review the literature that most closely frames the study being undertaken, with a view to identifying the gaps in the literature that led me to the research questions this study empirically interrogates. The study draws upon two main areas of the literature: knowledge management and networks and, within these, literatures on boundaries and communities of practice (CoP). I examine these areas with reference to their characterisation, development and process, including aspects such as network boundaries, boundary crossing mechanisms, communities of practice (CoP) and knowledge transfer. Finally, throughout the chapter I examine the literature from these areas with specific reference to healthcare, the empirical focus of this study.

## **2.2 Narrative Literature Review Approach**

Systematic literature reviews are an established means of outlining the theoretical and empirical background of available research. There are a number of approaches available and the approach employed depends on a number of factors. In particular, the aims and nature of the evidence to be explored (Popay et al, 2006, Aveyard, 2010). In previous reviews where the literature to be summarised centres around being of a 'diffuse, emergent and contested nature' and where the primary and initial stance was to 'describe, interpret and synthesise key findings and important contours of debate' and therefore hone in on any relevant gaps a narrative review was undertaken in a systematic manner.

The literature review undertaken here was initiated from extensive browsing in journals, libraries, healthcare policy documents and peer related discussion in order to get a feel for the overall research field. Fundamentally, the narrative literature review was undertaken via four methods; Overall setting up of the research field, knowledge and understanding, initiated via protocol driven to include hand and electronic journal search, 'snowballing' to enable the story to emerge and personal knowledge to include peers, contacts, conference networking and serendipitous discovery (Greenhalgh, 2005). The process remained iterative throughout the course of the study.

During the overall understanding of the research field a prominent and high quality comprehensive systematic review by Greenhalgh, 2004 emerged as a seminal paper from which the literature review stemmed initially. This review was identified to initiate the process as it specifically related to the original broad research topic identified - diffusion of innovations and healthcare. It was also well known to have been undertaken in a rigorous, comprehensive and systematic manner. At this stage in the process the approach was to read as widely as possible in order to develop thoughts and ideas and the wider reading was directed via reference snowballing and from many discussions with various peers, healthcare professionals and tutors. This enabled a clarification and focus.

At this point a research question was formulated that directed the searching and mapping of the available literature and specifically identifying studies for inclusion (Greenhalgh, 2005). In order to do this there was a broadly defined inclusion and exclusion criteria. This at the top level related to including papers that were in the English language, dated after the systematic review, primary research only after that date (where possible) and healthcare related. The literature broadly fell into theoretical, research, practice and policy.

A snowballing technique was used to augment papers for review. This was done manually by searching references of included papers and electronically, by using citation-tracking software that cited already included papers.

The searching was undertaken in subject specific databases and utilised key terms that had been drawn up from the initial wider reading and discussion with peers with experience in the relevant field. This discussion also included identification and

highlights of seminal works and key authors that were useful to review and deem relevant and therefore to be used in the ongoing literature review process or excluded as non-relevant for this study's focus.

Throughout the searching titles and abstracts of articles were reviewed for relevance and if there was doubt as to a paper's relevance the full article was reviewed. Each article was appraised in terms of relevance, used to hone the research question and identify any gaps, evaluate the contextual political backdrop to the proposed study and to ensure critical appraisal of the extant literature to the study.

Throughout the literature review the searches were adapted iteratively and it became clear that a central tenet of interest related to the movement of knowledge across networks in order to achieve the movement of evidence based medicine into clinical practice. From this I identified two main story lines – that networks do not exist in isolation and it is at the boundaries that knowledge 'sticks' and that practice within a community was deemed to foster multi-disciplinary collaboration and knowledge sharing aka communities of practice. For each area a brief historical account of the growth of the field was undertaken and then an examination of each story line and outlined in a narrative synthesis in the literature review ultimately, highlighting what there is in the literature, what the gaps are and the question this study seeks to address.

The narrative review undertaken is not without its limitations. One of the cautions that must be considered is that of reviewer bias. A systematic review attempts to reduce reviewer bias through the use of objective, reproducible criteria in order to select publications for inclusion. The key strength of the systematic review is that it enables a narrow focus of the question, explicit, transparent methods. However, this can also be a weakness in that the narrow focus and prescribed methods do not allow for comprehensive coverage and it requires knowledge and focus to be in place when initiated. A narrative review enables a wider scope and a development of knowledge within an area of literature. It also according to Greenhalgh, 2005 allows for a greater yield as it incorporates informal approaches such as browsing and enables the incorporation of 'serendipitous' discovery. It particularly highlights the usefulness of 'snowball methods' and those systematic literature reviews of 'complex

and heterogeneous evidence such as those undertaken for management and policymaking questions' can fail to identify important evidence.

As a result of this debate regarding the relative strengths of systematic and narrative literature reviews the approach undertaken was narrative but incorporated a suitable systematically related approach as outlined above.

## **2.3 Introduction**

Research in healthcare is deemed as fundamental to delivering best practice in the clinic. This, however, is not always achieved (Rycroft-Malone et al, 2012). The Cooksey report in 2006 highlights two gaps that limit the progress of innovation or interventions through the translational pathway and ultimately impacting the deliverance of best practice. The first gap results from the translation of basic and clinical research into product/practice and the second relates to bringing the products/practice into clinical practice. The focus of this study is the second translational gap. The depiction of the translational pathway and the respective gaps are shown in fig 2.1 below.

Literature suggests there is no 'magic bullet' to move healthcare research into improved clinical practice i.e. addressing the second translational gap. This difficulty is linked to NHS structures and organisational complexity; there are multiple stakeholders, networks and silos. Literature also indicates that knowledge 'sticks' at many of these professional and organisational junctions (Ferlie et al, 2010).

The requirement to implement evidence-based practice in a timely and efficient manner is clear (see chapter 1); the complexities of doing so have often been examined within the literature (Rycroft-Malone et al, 2002; Dopson and Fitzgerald 2005). Literature has moved from a focus on implementation being based on an individual's response and activity to the perspective that implementation is influenced by many factors and that taking evidence in to practice is 'complex and multi-factorial' (Rycroft-Malone and Burton, 2010). Literature highlights that at least a part of the complexity stems from the interplay of the specific piece of research or intervention, the people involved and the context. It is therefore suggested that it is important to adopt a longitudinal perspective, i.e. investigating how it 'plays out' (Rycroft-Malone and Burton, 2011). As a result it is suggested that investigating a

process evaluation is a useful approach principally because using evidence in practice is not a one-off event. Or at least the objective at a policy level is for it to be a sustainable event. As such, there is a focus on understanding what occurs across the translational gap through the use and development of theory (Rycroft-Malone and Bucknall, 2010, Bhattacharyya et al. 2006).

A current focus within healthcare is the facilitation of the translation/mobilisation of research findings into practice via the implementation of large-scale interventions. These large scale interventions are deemed a key mechanism for delivering health benefits. Implementing evidence based practice is difficult as it involves being aware of the evidence, interpreting the evidence and when and how to apply it (Tsoukas, 1996). This is essentially the second translational gap – the gap between taking the ‘knowledge’ from clinical research and health services research and utilising and implementing it.

As a result of this current focus in healthcare the theoretical and empirical area within literature that relates to this is the mobilisation of knowledge i.e. moving the ‘knowledge’ from research and using it (or making an informed decision not to) and specifically the mobilisation of knowledge across a network. To structure the study it is clear, therefore that I first need to address the concept of knowledge itself and the mobilisation of knowledge.

In order to do this it is important to provide a brief introduction to the background of ‘knowledge’ related enquiry within the literature. In order to do this I start with the very broad and encompassing term of knowledge management. Knowledge management has been a rapidly expanding area of study in the field of management (Oborn et al, 2010, Ferlie et al, 2010, Mitton, 2007). This expansion has cut across a number of separate business and management disciplines, including strategy, international business, network theory, human resource management, information systems and organisation science (Foss, 2006, French et al, 2009, Alavi and Leidner, 2001). Examples of this expansion include identification of the critical role of knowledge for developing a firm’s competitive advantage (Kogut and Zander 1992, Spender and Grant, 1996, Spender, 1996), increasing innovation (Nonaka, 1994), inter firm alliances and networks (Tsai, 2001, Powell et al, 1996) and enabling organisational learning (Argote and Ingram, 2000, Brown and Duguid, 2001). Whilst

undoubtedly these fields have impacted on healthcare research, there are fundamental differences. For example, the management literature has sought, in general, to develop more extensive taxonomies and conceptual definitions of knowledge whereas in healthcare it has largely been defined in terms of levels of hierarchy (Alavi and Leidner, 2001, Nutley et al, 2003, Oborn et al, 2010). It should be noted, however, that even in the healthcare literature discussion about terminology and conceptual definitions has started to ensue (Greenhalgh and Wieringa, 2011). Another distinction is that the management literature tends to focus at the organisational or field level of analysis, whereas healthcare literature tends to be more focused on individual, or group level practice communities (Rynes et al, 2001, Greenhalgh, 2004, Oborn et al, 2010).

Knowledge management is viewed as increasingly essential to modern healthcare systems intent on delivering quality whilst maintaining efficiency (Williams and Dickinson, 2008, Lavis et al, 2003). The term knowledge management broadly encompasses 'the creation and subsequent management of an environment that encourages knowledge to be created, shared, learnt, enhanced and organised for the benefit of the organisation and its customers' (Turner et al, 2002). This process has attracted a great deal of attention, probably due to the lack of a 'one size fits all' approach (Grimshaw et al, 2004, Haines et al, 2004).

In the literature review outlined below I begin with knowledge mobilisation including the terminology used, the concepts and the processes. I utilise the term knowledge mobilisation in a similar manner to that of its use in recent literature reviews where generic management literature and specific healthcare literature are highlighted enabling a broader overall theme under which to discuss the various elements relevant to this study i.e. to encompass the aspects of knowledge itself and the process of transfer/mobilisation (Crilly et al, 2013). This study is not focused on resolving the differences in terminology. Rather, I take the stance that whilst there are many terms used in the literature 'the specific words are not important per se – what is important is how these terms are operationalised'. Therefore, I specifically define the terms used in the respective section and the reasons for this whilst acknowledging there are other terminologies and taxonomies available (Tetroe, 2007). Knowledge mobilisation was the initial term chosen as part of the literature review as in the early stages of the literature review it was acknowledged to be a

broader, looser term than for example, management. This indicated and highlighted the potential of outcomes that are not planned i.e. it acknowledges there is an unknown to some extent (Crilly et al, 2013).

The structure of the literature review continues to the acknowledgement of other definitions and concepts and where appropriate highlights the specific ones used within this study and the reasons for this.

Following on from the concepts of knowledge mobilisation is the next central tenet of the study - the mobilisation of knowledge specifically across networks. Again, I acknowledge that within the literature there are a number of different models and concepts regarding the process of knowledge mobilisation, however of specific interest here is it being across networks. I therefore, following on from knowledge mobilisation as described in the previous paragraph, move onto outlining pertinent literature relating to networks.

Following on from the broader discussion of the knowledge mobilisation and networks literature I then focus on the specific areas of these literatures that frame this study and inform the research questions. These include network boundaries (where the transfer of knowledge is known to 'stick'), how these boundaries are bridged to enable knowledge flow, and the community that animates the network found located at the knowledge network boundaries.

To aid understanding of the logic and flow of the literature review the diagram below outlines the process undertaken and references the relevant section below where each aspect is discussed.

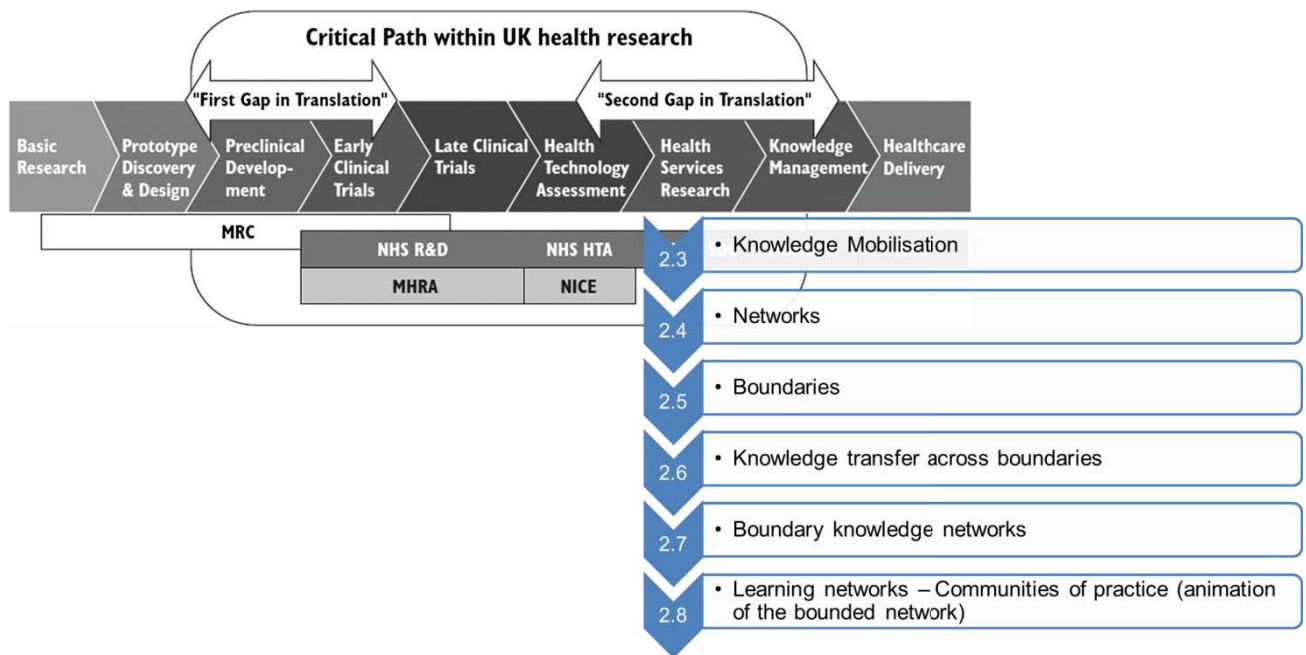


Fig: 2.1 Outline of the focus of the study – second translational gap (Cooksey, 2006) and the flow of the literature reviewed below.

## 2.4 Knowledge Mobilisation

A dominant theme in a lot of literature relating to knowledge includes ‘what is knowledge?’ and ‘how do we know what we know?’ This broad area of enquiry is not settled and of particular note is the vast number of terminologies and concepts. For example, within the healthcare literature terms such as ‘knowledge’, ‘research’ and ‘evidence’ are utilised. In the management field, however, ‘knowledge’ is often used as a noun whilst acknowledging that attempts to make simple distinctions is complex (Alvesson and Karreman, 2001, Crilly et al, 2013).

The various attempts to create distinctions include dualist classifications such as tacit-explicit, process-object, covert-overt (Crilly et al, 2013), hierarchies of knowledge and embedded capabilities (Crilly et al, 2013). A strong focus, to date, has been the distinction between tacit and explicit knowledge (Crilly et al, 2013).

Equally, over time a number of different process definitions have emerged (Tetroe et al, 2008). For example, terms that are often used interchangeably include knowledge transfer, knowledge sharing, knowledge management, knowledge mobilisation, dissemination, research use and implementation research. (Graham et al, 2006, Johnson, 2005, Jacobson et al, 2003, Landry et al, 2006 and Sudsawad, 2007).



Others attempt to resolve the differences between the terms (Sudsawad, 2007). However, regardless of the precise definition the underlying concept is fundamentally the same – to transfer, apply and spread knowledge generated from research.

As the literature review created this commonality across the underlying concept the definition used within this study evolved. Knowledge mobilisation, chosen as described above for its broader theme and looser definition at the inception of the literature review, evolved to knowledge transfer.

It is worth highlighting that there are also many definitions relating to knowledge transfer and an often used definition for knowledge transfer in reference to healthcare is that employed by the Canadian Institutes of Health Research (CIHR). It is defined as ‘the exchange, synthesis and ethically-solved application of knowledge – within a complex system of interactions among researchers and users – to accelerate the capture of the benefits of research for Canadians through improved health, more effective services and producers, and a strengthened healthcare system’ (CIHR, 2003, Sudsawad, 2007).

Knowledge transfer is a term that emerged in the 1990’s as a process by which research was ‘pushed’ to users (Lavis et al, 2003). This definition evolved to knowledge exchange to indicate interaction in a multi-directional communication and as highlighted previously to many other terms and definitions. Knowledge transfer is specifically defined as a ‘process’ and is the term commonly used when referring to the transfer of knowledge into action (Ward et al, 2009). It is broadly understood to ‘encompass the exchange, synthesis and application of research results and other evidence’ which is the central tenet here (Ward et al, 2009).

As a result of this the literature review moves to focus on knowledge, the process of knowledge transfer and its use. Each of these aspects is discussed below relating to themes arising from the literature.

#### ***2.4.1 Explicit and tacit knowledge***

Knowledge is described from a number of different angles within the healthcare literature and the broader literature. Alavi and Leidner, 2001 provide a taxonomy of a wide variety of knowledge types. A well-known focus of the literature discusses

predominantly the distinction between explicit and tacit knowledge, which has been quoted as having 'paradigmatic status' (Crilly et al, 2013).

Explicit knowledge is objective and rational knowledge, whereas tacit is subjective, experiential and difficult to formalise. Explicit knowledge can be codified into, for example, materials, databases, or policies whereas tacit knowledge is difficult to codify and therefore share (Nonaka, 1994). Greenhalgh et al, 2004 indicate that tacit knowledge does not exist in a written form; it is predominantly the experience and expertise of an individual and the meaning of the knowledge depends on its context in terms of sense-making and the ability to share. Therefore, explicit knowledge is transferred and tacit knowledge is shared. Knowledge transfer and knowledge sharing are distinct concepts, although often used interchangeably. Knowledge sharing is quoted as:

'a more subtle concept, and is seen as a dual process of enquiring and contributing to knowledge through activities such as learning-by-observation, listening and asking, sharing ideas, giving advice, recognizing cues, and adopting patterns of behaviour' (Bosua and Scheepers, 2007).

The knowledge of an organisation is purported to expand and diffuse through social interaction via the interplay necessary between tacit and explicit knowledge (Williams and Dickinson, 2008). In 2006 Soderquist highlights that knowledge transfer and sharing are reciprocally supportive processes and are of equal importance in respect of effective knowledge management.

This suggestion of equal importance is interesting when viewed in relation to the backdrop of healthcare. The Evidence Based Movement (EBM) highlights the tension between tacit and explicit knowledge. This approach relies on the view that evidence based knowledge is hierarchical. For example, systematic reviews and randomised controlled trials are perceived a higher form of evidence than personal experience (Crilly et al, 2013). This hierarchy of evidence has moved in the healthcare literature to a more interactive approach, for example, the mind lines created by GPs as described by Gabbay and le May in 2004.

### **2.4.2 Knowledge transfer process**

The knowledge transfer process is well acknowledged to be a complex process that goes far beyond the initially purported one-way push model of information from researchers to decision makers, and vice versa the pull model (Sudsawad, 2007, Oborn, 2010). It is generally agreed to involve a series of interactions between the producers and users of research, whilst also taking into account the presentation of knowledge and how it interacts with other knowledge that is in constant play in day to day decisions and processes (Graham et al, 2006). Much knowledge transfer research has focused on the implementation of specific pieces of research knowledge rather than a broader view of knowledge transfer via ongoing interactions (Belkhdja et al, 2007, Innvaer, et al, 2002, Elliott and Popay, 2000, Sudsawad, 2007). For example, the healthcare literature recognises the interactive nature and reciprocal exchange, however the models employed to evaluate knowledge transfer often focus on linear approaches (Logan and Graham, 1998, Kontos and Poland, 2009).

The importance of knowledge transfer i.e. the movement of knowledge into action is widely viewed as important, however, literature has generally focused on theories, models and frameworks of the process of knowledge transfer. A 2009 review aimed at creating a conceptual framework of translating knowledge into action states that there are '63 different theories or models of knowledge transfer across fields as diverse as healthcare, social care and management' (Ward et al, 2009). There are, however, few reported studies specifically reporting knowledge transfer interventions (Ward et al, 2009).

### **2.4.3 Absorptive and disseminative capacity**

Another relevant aspect of the broader management literature to this study stems from the widely cited article by Cohen and Levinthal (1990) which introduced the concept of 'absorptive capacity'. This is an organisation's ability to 'identify, capture, interpret, share, reframe, and recodify new knowledge; to link it with its own existing knowledge base; and to put it to appropriate use' (Greenhalgh, 2004). This, in essence, means that an organisation requires the capacity to recognise the value of new information, assimilate and apply it. It is also argued that the concept includes culture in terms of style and utilisation of shared memory, vocabularies and tacit

understandings and explicit disciplines. It includes the systems by which knowledge is transferred in the organisation across geographies, boundaries, grade and department (Greenhalgh, 2004). Overall, an organisation with the ability to deliver absorptive capacity, it is suggested, can handle diffusion and dissemination better (Ferlie et al, 2005, Zahara and George, 2002). Cohen and Levinthal (1990) postulated that an organisation with strong absorptive capacity is more pro-active in utilising its networks to secure new and useable knowledge.

The general form of optimal absorptive capacity was originally stated to consist of a series of internal units possessing partially overlapping knowledge underpinned by non-overlapping distinct bodies of knowledge, enabling effective communication (Cohen and Levinthal, 1990). This relates to another generalised classification of knowledge - component and architectural knowledge (Balogun and Jenkins, 2003, Henderson and Clark, 1990). Component knowledge is specific, professionally-defined knowledge and is well structured and understood in healthcare, for example by doctors, nurses and other specialist professions. Conversely, architectural knowledge can be characterised as organisation-wide routines and schemas for co-ordinating knowledge. In essence, this results in distinct knowledge domains co-existing but without architectural knowledge to unify them (Balogun and Jenkins, 2003, Henderson and Clark, 1990).

The link, however, between absorptive capacity and a particular knowledge domain as viewed by Cohen and Levinthal, is believed to be more specific than this by Lane and Lubatkin (1998). They state that absorptive capacity varies with each tie within the network of interest. They also found that learning levels are higher in ties with high similarity in basic knowledge and lower management formalisation.

The composition of an organisation is another aspect that has been highlighted as having an impact on absorptive capacity (Greenhalgh et al, 2004). For example, it has been suggested that an organisation, which focuses on exploration would have a more open, fluid structure than a bounded network (Greenhalgh et al, 2004). Whilst there are views in the literature which offer some discussion on this area it is not well developed. For example, a large number of empirical studies reported in the literature focus on an in-house R&D group, which Cohen and Levinthal stress as inadequate (Goodwin et al, 2004).

I have discussed here the capacity to receive knowledge across ties. It is also argued there is equally the need to be able to organise and present the knowledge (Goodwin et al, 2004). This concept has been termed 'disseminative capacity'. When both concepts are viewed together it is suggested that you have the underpinning of knowledge transfer itself (Goodwin et al, 2004). The existence and need of disseminative capacity has been discussed to some extent within the literature, however, there is little empirical research supporting use (Goodwin et al, 2004, Greenhalgh, 2004).

#### **2.4.4 Knowledge Use**

Once knowledge has been transferred and shared there is the concept of knowledge into practice, i.e. making use of the knowledge received or at the very least making a conscious, informed decision not.

The concept of knowledge into practice can be broadly defined as 'a variety of interventions aimed at increasing the use of knowledge to solve human problems' (Backer, 1993). Backer indicated that knowledge utilisation is broadly related to a number of topics. These are highlighted as technology transfer, information dissemination and utilisation, research utilisation, innovation diffusion, sociology of knowledge, organisational change, policy research and interpersonal and mass communication.

There are three main types of defined knowledge use: instrumental, conceptual and symbolic. Estabrooks (1999) characterises these as applying research results specifically, using it for general enlightenment and using it to confirm an approach/position respectively. In a piece of empirical research investigating conceptual knowledge use across 600 nurses, Estabrooks (1999) highlighted how each type of knowledge use influenced overall research utilisation.

The literature continues along this theme, indicating that each type of knowledge use needs to be considered and each type of use can be associated with different predictive factors. For example, a survey conducted by Amara et al (2004), highlighted that whilst all three types of knowledge use were commonly associated with the same set of factors, some were specifically associated with each type. These included: qualitative research and individuals educated to a graduate level

being significantly associated with a high conceptual use, adaptation of research to a user's needs and scholarly advancement associated with high instrumental use, and adaptation combined with a more provincial location with high symbolic use. It has been highlighted that there is a need for further studies into this area (Sudsawad, 2007).

Historically, within the literature, utilisation is viewed as having occurred when all research recommendations are implemented (Landry et al, 2001). However, it is argued that knowledge use is more complicated and multi-faceted than this view. Knowledge can be and is, by its very nature, modified, partially used, or used in a different way, i.e. to meet a user's circumstance or not used at all but for a good reason. This is particularly apparent when knowledge is adapted to meet a user's needs and circumstances (Landry et al, 2001). This has led the discussion on the inclusion of the term 'effective use' of knowledge. A final aspect is essentially the consideration of context. It is highlighted in healthcare literature that context is a key factor in the implementation of evidence into healthcare practice (Cammer et al, 2013). Literature has highlighted a number of different contextual factors as important ranging from resources, culture, support, social networks and receptivity (Cammer et al, 2013).

#### **2.4.5 Summary**

In the preceding paragraphs I have provided a review of the literature with regard to the categorisation of knowledge type, the process by which it is transferred and the actual use or otherwise (effective knowledge use). This overriding process, whilst often defined and labelled in different ways has a fundamental important implication in healthcare. There have been a number of high profile reports that acknowledge the failure to translate research into action, which ultimately plays a part in health inequities and wastes resources (Ward et al, 2009). This gap not only creates a resource problem but also one of quality. It can lead to a lack of use of effective treatments and ultimately a substandard outcome for the patient (Ward et al, 2009). This broad realisation in healthcare has created a focus on transferring knowledge into action. Alongside the interest surrounding knowledge transfer within the healthcare literature there is also an interest in the move toward a networked form of

an organisation within the health service and also the implication that knowledge diffuses better across networks (Ferlie et al, 2010).

## **2.5 Networks**

Alongside the identification of knowledge transfer as a key approach to closing the second translational gap the literature also highlights the increasing use of the network form of organisation within the National Health Service (NHS) (Currie et al, 2010, Ferlie et al, 2010). There is a range of theoretical perspectives, originating in a number of different social science disciplines, which offer explanatory theories for the move to network based forms (Ferlie et al, 2010). One interesting rationale offered for the importance and rise of network based organisations is their superior ability to accelerate organisational learning and the diffusion of knowledge (Ferlie et al, 2010). In essence the healthcare system is focused on providing a parallel coordinated integrated service, i.e. service coordination has moved from a hierarchical and sequential approach to horizontal, parallel (networks) (Ferlie et al, 2010). With this systems approach the importance of architectural knowledge outlined above becomes increasingly evident. There is, however, a gap within the healthcare literature as there are few empirical studies that focus on how the network form is instigated, evolves and ultimately sustains. Without this knowledge it is difficult for practitioners and policy makers to take steps to create horizontal networks that have shared architectural knowledge.

There are a number of definitions and aspects to 'networks' resulting from a variety of disciplines within the literature (Goodwin et al, 2004). In brief, these differences can be structural, characteristic, relating to type of management and/or form (Goodwin et al, 2004). For example, sociometric accounts define it as 'any system of linkages between nodes', whereas others may define it with an exclusion of hierarchical forms or very weakly tied nodes (White and Harary, 2001, Powell, 1990, Bradach and Robert, 1989).

It is also worth highlighting that the 'linkages between nodes' have been discussed in terms of their level of strength i.e. are they weakly or strongly connected. The literature also debates the relative benefit of each of these types of links with regard

to for example an organisation's ability to innovate (Granovetter, 1973, Marsden, 1984 and Burt, 2009). This is discussed in more detail below.

It is beyond the scope of this study to discuss all aspects of the network literature. Instead I hone in on the specific area this study draws upon – knowledge networks.

### **2.5.1 Knowledge networks**

There is a stance in the literature that research that focuses upon characteristics of social relationships, their networks and the influence of this to various aspects of knowledge transfer (transfer, sharing and use) – collectively termed 'knowledge networks' research. Knowledge networks are defined as 'a set of nodes - individuals or higher level collectives that serve as heterogeneously distributed repositories of knowledge and agents that search for, transmit, and create knowledge—interconnected by social relationships that enable and constrain nodes' efforts to acquire, transfer, and create knowledge' (Phelps 2012).

As I outlined above there is a vast amount of literature relating to knowledge transfer (Argote and Ingram, 2000). There is, however limited research on knowledge networks, despite it spanning multiple fields and levels of analysis (Su et al, 2010). Research to date has focused on aspects such as network centrality and the strength of network ties on organisational transfer (Tsai, 2001, Krackhardt, 1992, Levin and Cross 2004). Also seen as important are inter-unit knowledge networks (Hansen, 2002; Tsai, 2001), information seeking through knowledge networks (Cross and Sproull, 2004), roles of managers (Zupan and Kaše, 2007), influence of social network structure on diffusion of innovations (Bothner, 2003) and how they exchange, combine and create knowledge (Reagans and McEvily, 2003; Reagans and Zuckerman, 2001). There is, however, concern that a number of the network studies are primarily method-driven and atheoretical and essentially lack empirical validation (Granovetter, 1979; Salancik, 1995, Dimovski et al, 2008).

A recent systematic review of knowledge networks organises the extant literature into a typology of three dimensions: knowledge outcomes, knowledge network properties and level of analysis (Phelps et al, 2012). I provide a brief descriptive overview of each dimension below and then focus on the specific aspects that frame this study.



Knowledge related outcomes include knowledge creation, knowledge transfer and knowledge adoption. These are the generation of new knowledge, effort to share information between a receiver and acquirer and decision and ability to use respectively. These outcomes are conceptually distinct but clearly related.

The second aspect, knowledge network properties, includes properties of network structure, relations, nodes and knowledge and can be split in broad terms into network composition and properties of knowledge. From a network composition perspective research has focused on relationships and patterns of relations, i.e. structure of the network and the impact on knowledge outcomes. There are broadly three structural aspects discussed in the literature including network position – the location of a node relative to another, ego-network structure (a node's pattern of ties) and whole network structure (pattern of ties among all nodes).

The final aspect, the level of analysis, includes interpersonal, intraorganisational and interorganisational. These focus on the individuals and the relationships between them, organisations and ties between them and on relationships within a team and relationships between that team and another within the same organisation respectively (Phelps et al, 2012).

As the central tenet of this study is centred round the second translational gap and the transfer of knowledge based on the above categorisations, this study centres on the knowledge outcomes (transfer and adoption), whole network composition and the properties of knowledge and the interpersonal level of analysis.

Studies focused at the whole network level focus on structural aspects such as the level of connectivity (density). For example, Singh in 2005 demonstrate that the more connected i.e. dense a network is the rate and extent of information diffusion increases and conversely that knowledge transfer declines as the density decreases i.e. the path length between individuals increase.

Interestingly, however, studies are 'rare' of whole knowledge networks despite their delineated influence on knowledge transfer (Phelps, 2012, Schilling and Phelps, 2012). It is the whole network structure that this study specifically focuses upon. With regard to 'properties of knowledge' research has focused on how aspects such as

type of knowledge (tacit or explicit) influence the knowledge outcomes (creation, transfer and adoption) (Phelps et al, 2012).

The composition of the network is more complex and there is more comprehensive research in this area at the interpersonal level. It predominantly has reported on the influence of the strength of interpersonal ties and the similarity of actors involved on knowledge outcomes including transfer and adoption.

A strong body of research has demonstrated that strong interpersonal ties e.g. high frequency of communication and long duration is highly effective in promoting knowledge transfer and learning. More so than weak ties (Marsden and Campbell, 1984, Phelps, 2012)

Also, tie strength has been related to having an impact on the transfer of specific types of knowledge and in times of change or uncertainty. For example, Centola and Macy in 2007 demonstrated that tie strength increases the ease and efficacy of transferring tacit knowledge by demonstrating the importance of competence-based trust across dyadic knowledge exchange. Equally, Krackhardt in 1994 highlighted that strong ties were important when there was change or uncertainty. Strong ties have also been associated with helping to overcome the impact of geographic distance, differences in technology capabilities and competition (Tsai, 2001, Phelps, 2012).

Weak ties, however, are deemed useful for codified knowledge transfer i.e. explicit knowledge (Crilly et al, 2013, Krackhardt, 1994). There is, however, a well-known opposing theory that was proposed by Granovetter in 1973 indicating that weak ties were more important i.e. there was more strength inherent within weak ties than in strong ties. The view was generally held that strong ties were between those who were similar and closely connected, whereas weak ties were between disconnected parts of a network and therefore able to bring access to new information (Krackhardt, 1994). The proposal was that very weak ties were of no use, weak ties gave the maximum benefit and with strong ties the usefulness starts to diminish again. This perspective of value from the type of tie has led to ambiguity around the definition of a weak and strong tie (Krackhardt, 1994).

Literature discusses tie strength in a number of different ways. For example, Granovetter utilised frequency of interaction. Granovetter states a weak tie is a 'nodding acquaintance' and in more detail considers more often a tie that was once strong and had become weak. In other studies tie strength has been determined by the 'closeness' of a relationship i.e. a close friend is a strong tie, an acquaintance a weak tie. There are other suggestions such as source of a relationship (relative a strong tie, neighbour a weak tie), reciprocal perspective (strong tie acknowledged both sides of the dyad), support, and memberships (Marsden, 1984). As a result it has led to some proposed terminology regarding ties and their strengths or characterisation. For example, acquaintance ties, philos ties, simmelian ties (Marsden, 1984, Krackhardt, 1994, Tortoriello and Krackhardt, 2010).

So, leading on from the discussion surrounding how a tie is defined as strong or weak and the inherent value of that or otherwise the next step is to consider the development of a relational tie – its inception, evolution and sustainability. Here, however, the literature is weak. There is research that focuses on the characteristics of ties and their influence on knowledge transfer however there are limited studies that consider time in reference to any influence. Literature does suggest that the duration of a tie influences knowledge transfer and it also indicates that strong and weak ties can complement each other over time as one form moves to another. It remains however an area where further enquiry is needed (Crilly et al, 2013 Phelps, 2012).

It is worth highlighting that there is an important area of neglect that underpins a number of the publications in this area – the majority of studies are cross-sectional, i.e. static and from one point in time. This has been recognised and it has been highlighted that future research should utilise a longitudinal approach in order to capture the evolutionary properties of knowledge networks (Phelps, 2012). This lack of longitudinal studies also leads to the fact that as research tends to focus on a snapshot in time there is limited evidence on how a knowledge network sustains or otherwise.

The requirement for longitudinal studies is particularly relevant to healthcare (Robertson and Jochelson, 2006). Healthcare is a dynamic, constantly changing context. It is therefore important for empirical studies to incorporate a longitudinal aspect in order to capture the complexities involved. The result of a longitudinal

study can offer insight into how the point in question evolves or otherwise, sustains or indeed is instigated.

This perspective of instigation, evolution and sustainability is interesting as not only are there few studies that take a longitudinal view and therefore these different aspects are not currently so readily described but also it highlights a gap within the literature surrounding sustainability. Whilst there are a number of different facets to it from the perspective of this study the interesting tenet is what exactly is meant by 'sustainability'. In the broader literature it is acknowledged that there is a requirement for a clearer definition and further characterisation (Banerjee, 2011 and Stirman et al. 2012). From a recent review of the sustainability in healthcare with regard to new programs and innovations it indicates that the most common use of the term 'sustainability' related to what happened after the initial implementation. However, working definitions of the term was lacking (Banerjee, 2011 and Stirman et al. 2012). According to the Stirman et al, 2012 review the majority of sustainability related studies focuses on a broad definition of 'the continuation of the programs and practices that were implemented within organizations, systems, or communities after initial implementation efforts or funding ended'. This is the definition of sustainability used within this study. The study specifically focuses on whether the core element i.e. the network and relational ties continue when support is no longer necessary or available. It should be noted that there are additional, more detailed sustainability definitions such as specifying each aspect of the factors inherent in sustainability. The most suitable one for this study, however, is the broad definition outlined above alongside the point that it is the continuation of the network and relational ties and not the enacted project itself I am interested in.

### **2.5.2 Summary**

The literature review has established that there is a large and growing body of research that demonstrates that social relationships and the resulting networks these create have an influence on the processes of knowledge creation, diffusion, absorption and use. This body of research has been termed knowledge networks and it spans many research fields ranging from economists to sociologists, psychologists and organisational scholars. (Phelps, 2012). There are few studies, however, that have this focus within the context of healthcare despite a growing view

of the importance of networks and the empirical study of them in the field (Currie and White, 2012). Alongside, this it is clear that this area of literature does not delve into the instigation, evolution or sustainability of a network and the resulting knowledge outcomes.

Moving forward in the literature review I highlight the consideration of multiple networks. Networks do not exist in isolation and therefore there is a need to consider network boundaries and ultimately the impact on knowledge transfer at these boundaries.

## **2.6 Boundaries**

Another feature of the literature relating to knowledge networks essentially draws upon the concept that networks do not exist in isolation. There are boundaries to a network (Ferlie et al, 2005, Karafillidis, 2008, Guthrie et al, 2010). These boundaries vary in their fluidity as they arise in a number of different ways, for example via different methods of engaging, incentivising and communicating, as well as by capabilities (Wenger, 2000). Ferlie et al (2005) clearly highlights that 'The presence of strong professional roles and identities makes it even less likely that knowledge will flow across social boundaries'. This causes knowledge to 'stick'. In fact, epistemic 'communities of practice (CoP - defined and outlined below), according to Ferlie et al (2010), specifically help to explain the problems and failures of evidence-based medicine (EBM) diffusing within the NHS. The CoP studies demonstrate how knowledge 'sticks' at the boundaries (Greenhalgh et al, 2004, Ferlie, 2005).

Boundaries of specific interest to this study broadly fall into two camps – professional and organisational (contextual). Both are constructed and heavily influenced by the individuals involved, and the social contexts in particular social networks they encompass (Guthrie et al, 2010, Ferlie et al, 2010). This implies the need for formal knowledge transfer systems in conjunction with the facilitation of social relationships and broader organisational cultures (Ferlie et al, 2010).

Central to the many discussions relating to professional boundaries is the inhibition of knowledge exchange (Currie and Suhomlinova, 2006). For example, specialist knowledge is considerably more difficult to exchange outside silos, whereas generalist and generic knowledge is more able to permeate across boundaries

(Martin et al, 2009). This difference fuels, for example, the dominance of doctors, power differentials between doctors and nurses, the management challenge of doctors and intra-professional hierarchies and power relationships, e.g. doctors in secondary care vs primary care (Currie et al, 2010). All reportedly inhibit knowledge exchange across boundaries (Ferlie et al, 2005). There are many aspects to this issue. For example, collaboration within networks impinges on long established jurisdictions and divergent education; training, socialisation and career structures also establish cultural differences (Currie et al, 2010).

There has been a strong policy drive to enable patients to be involved in service development in terms of their experiences and preferences (NHS plan, 2003). However, there is little evidence reported in the literature of widespread patient engagement or the focus of patients impacting professional and managerial practices (Crawford et al, 2002). Equally, it has been highlighted that collaboration is particularly difficult across both professional and organisational boundaries in networks involving patients and other stakeholders (Kumpers et al, 2006, Burnett et al, 2005). It has been suggested that where patient self-management and engagement is important, a means to ensure success is to conduct the network as a facilitated community of practice (Winkleman and Choo 2003, Demeris, 2006).

### **2.6.1 Knowledge Boundaries**

Carlile (2004) outlined three kinds of knowledge boundary – syntactic, semantic and pragmatic. Ferlie et al (2005) developed this further, highlighting that boundaries from professional behaviour are built either upon specific cognitive knowledge, technical competences and social behaviour. An overview of each of these is outlined below:

#### **Cognitive boundaries**

- Knowledge and skills
- Scientific foundation
- Specialised Expertise
- Patient-view

## **Technical boundaries**

- Specific methods
- Clinical guidelines/standards
- Competences

## **Social boundaries**

- Day-to-day interaction
- Professional associations
- Codes of conduct
- Education and post-educational training

The cognitive dimension comprises the possession of specific knowledge and skills to solve practical problems and often has a strong ideological grounding. Scientific knowledge that is accepted and therefore legitimised is important, e.g. EBM (Sanders and Harrison, 2008). However, the definition of legitimised knowledge is dependent on the community of practice a professional is in. For example, Ferlie et al. (2005) state: "Professions display different research cultures, agendas and questions". In other words the professional identity is grounded in its scientific foundation. This means that a professional network could be characterised on the basis of a cognitive dimension e.g. orthopaedics, vascular, or diabetes.

The second, technical dimension focuses on the application of knowledge and skills. This can include guidelines, techniques and procedures (Epstein and Hundert, 2002). It is related to the previous dimension (cognitive) as practices are also grounded in a knowledge base.

Finally, the social dimension, the most difficult type to define. It is influenced partly by formal codes of conduct and also tacit knowledge of social behaviour. It is suggested that the social boundaries are 'taught' during the education phase. Hafferty and Franks (1994) refer to this as the 'hidden curriculum', i.e. there is an intensive socialisation process resulting from the high workload and the necessity for practical experience in medicine. Within this dimension aspects such as loyalty to peers and

peer references are important. It is suggested that this dimension is triangulated with both cognitive and technical boundaries, because when knowledge and skills are not shared with others this is a barrier to establishing social relationships (Ferlie et al, 2005). In fact, these authors state “The presence of strong professional roles and identities makes it even less likely that knowledge will flow across social boundaries”.

From the perspective of boundaries, outlined above, it is argued that boundaries are actively constituted to establish an exclusive field of knowledge and authority. In essence, they are the consequence of individual action. However, boundaries are not only individually constructed, but also institutionalised in education systems, professional associations, organisational and financial structures (Fleming and Waguespack, 2005). Child and Heavens (2001) highlighted that an institution itself can constrain collaborative action, such as knowledge exchange (cf. Currie et al, 2010). The institutional boundary can be delivered by an organisational structure or a specific set of events and actions that are meaningful by a specific set of actors, i.e. the individuals construct the context (Smircich and Stubbart, 1985). Traditionally, the literature highlights that organisational boundaries are difficult to change (Currie et al, 2010). In particular, within healthcare, extant literature highlights the divisions between primary care and secondary care and more broadly between health and social care professions as the organisational backdrops of particular concern which are commonly viewed as significant boundaries (Guthrie et al, 2010, Greenhalgh, 2010).

## **2.7 Knowledge transfer across boundaries**

As outlined above studies have demonstrated how knowledge ‘sticks’ at boundaries. It is, therefore, suggested there is a need to form connections and methods of spanning a boundary (Wenger, 2000, Carlile, 2002, Ferlie et al, 2005). This can be difficult when professionalism, particularly within healthcare, is focused on what makes them special rather than what is shared (Ferlie et al, 2005).

The approaches toward spanning a boundary are known as ‘boundary processes’: “activities that weave systems more tightly together” (Wenger, 2000). These include various methods proposed that enables ‘bridges’ to be formed across boundaries (Wenger, 2000). These can be classified as interactions between different



Communities of Practice, people acting as 'brokers' and/or 'boundary spanners', and boundary objects, which include artefacts such as tools, terms or processes, (Wenger, 2000). Much of the literature surrounding these boundary processes has reported on skill sets, characteristics and experiences as opposed to the organisational structures and individual practices that might enable them (Ferlie et al, 2010).

As outlined previously literature abounds with generic transfer models of knowledge management (Sudsawad, 2007). I can draw on the literature surrounding these boundary spanning mechanisms, and critiques of policy and practice interventions, to outline approaches specifically aimed at improving knowledge exchange (Wenger, 2000, Williams and Dickinson, 2008, Greenhalgh, 2004, Guthrie et al 2010, DoH, 2007, Wensing et al, 2006). Here I characterise and discuss each aspect under each of the three types of boundary bridges highlighted above. It is a useful typology with which to outline the discussions, however it should be noted that in reality they are not distinct or mutually exclusive areas and there are other typologies outlined within the literature (Williams and Dickinson, 2008).

### ***2.7.1 Interactions***

The fundamental constituents of a network are the individuals and the relationship between them (Goodwin et al, 2004). As such there are two important theoretical stances that are relevant to both collaborative interaction and the following section on people. These are human capital and social capital. Human capital describes the skills and capabilities an individual possesses, whereas social capital is concerned with the relations between individuals (Coleman, 1988, Krebs, 2000). Human capital is created through changes in an individual that bring about new skills and capabilities that create new action; social capital surrounds changes in the relations between individuals that concurrently facilitate action (Coleman, 1988). In essence, social capital is what connects other forms of human capital in a symbiotic way, i.e. social capital can create human capital and vice versa (Coleman, 1988, Krebs, 2000). From an organisational perspective it has been suggested that it is the unique interconnectivity of human capital within and outside an organisation that creates an advantage. Indeed, it has been postulated that managing social capital will become

core in knowledge-based organisations and this is a view firmly held within healthcare (Burt, 1992, Williams and Dickinson, 2008).

Social interaction has been highlighted by a number of reviews and studies as essential to best practice dissemination (Greenhalgh, 2004). For example, Innvaer et al (2002) conducted a systematic review of the use of evidence by policy makers. The conclusions outlined that the most influential aspect of research uptake within policy resulted from direct interaction. The use and focus of social interaction has been proposed to enable the 'predisposing, enabling and reinforcing' necessary for consistent and continual uptake of best practice (Williams and Dickinson, 2008).

Direct interaction is deemed to be particularly successful as it enables 'exchange' alongside 'transfer' of knowledge, both explicit and tacit. It also enables the envelopment of a number of boundary spanning mechanisms at any one time. For example, when interaction was facilitated between implementers and other stakeholders the use of ICT systems was found to be encouraged (Williams and Dickinson, 2008). Taking this a step further in reference specifically to healthcare, a study of managed care networks in Scotland found that they increased interaction and enhanced the sharing of information and this ultimately led to improvements in healthcare delivery (Burnett et al, 2005).

There are other aspects to the benefits achieved through social interaction which, whilst there is not a vast evidence base, intuitively makes sense. For example, interaction with peers and experts can provide reassurance and ultimately reduce the level of perceived risk (Williams and Dickinson, 2008).

Interaction is clearly a useful approach towards overcoming the barrier presented by boundaries (Greenhalgh, 2004, Wenger, 2000, Ferlie et al, 2005). Informal interaction is probably most useful, but not always possible, particularly if attempting to make a system wide and cultural change. Facilitated interaction is therefore an approach that has been suggested as a solution, although it is significantly under researched (Williams and Dickinson, 2008). Alongside this it is also clearly important to look at the socially embedded characteristics of knowledge exchange. It has been suggested that taking this approach enables a more nuanced understanding of the processes involved, including learning and capacity development alongside

constraining and enabling features of social and environment contexts (Lomas, 2000, 2007).

### **2.7.2 People – brokerage and skills**

Much of the knowledge brokering literature has focused specifically on positioning within boundaries in private sector firms. It also indicates that relations across boundaries can increase access to external knowledge and that a centralised position can achieve the relations across boundaries and therefore external knowledge can be used beneficially (Oborn, 2010). It is this centralised position that is believed to be held by actors acting as a knowledge broker and thereby enabling the exchange of knowledge within a social network (Burt, 1992). In addition, both the closeness of a relationship between different actors, i.e. tie strength, and the building of trust are important in effective knowledge transfer (Lane et al, 2001). Motivational and cognitive aspects are deemed relevant (Szulanski, 1996).

I have above discussed social capital and its importance with regard to interactions and communities of practice. The importance of social capital regarding brokers was illustrated by Burt (1992). He demonstrated that structural holes can be bridged by brokers; individuals who connect otherwise disconnected actors. Prior to this theory, data was reported demonstrating widespread correlation between ability, ties across multiple organisations and leadership (Fleming and Waguespack, 2005). At this stage the term used was 'boundary spanners' and they were identified as the bridge within and across engineering firms.

Within the literature the concepts of brokerage and boundary spanning are empirically correlated, yet theoretically distinct. However, it should be noted that this distinction is not always adhered to and has led to a confusing substitutable approach to the use of the terms. The distinction, as described in Fleming and Waguespack (2005), is that brokers can span boundaries, but not all boundary spanners can broker. A predominant difference between the two is how they were initially characterised. Burt's early description characterised brokers as 'calculating and politically savvy', as opposed to Allen et al, 1979, who characterised boundary spanners as 'respected guardians'. This leads us to a predominant aspect of the literature, trust. This is often cited as important but that a broker is less likely to be afforded this sentiment (Coleman, 1988, Currie et al, 2010).

Current literature that discusses effective intervention in the management of knowledge exchange has recently emphasised the concept and practice of knowledge brokering across organisational and professional boundaries (Currie et al, 2010). This refers to individuals or groups of individuals who act as brokers between communities (Wenger, 2000, Hildreth and Kimble, 2002). These are often people, which have significant social ties inside and outside the organisation. Organisational literature indicates that this enables an organisation to capture and simulate innovations more quickly (Rogers, 1995, Greenhalgh, 2004). Whilst brokering is often discussed in a positive light it should be remembered that the value afforded depends on whether the individuals act as a facilitator or as a bottleneck (Goodwin et al, 2004).

Brokerage is essentially the use of multiple memberships, for example, to connect a number of organisations where the individual can transfer some element of one practice into another. The role of brokering can be complex as it involves a process of translation, coordination and alignment and incorporates aspects such as the use of incentives (Currie et al, 2010). In order for an individual to be successful at brokering they need to be able to offer enough legitimacy in order to influence the development of practice, attract attention and address any conflicting interests present. In addition, it requires the ability to link practices, usually through the facilitation of transactions and to enable learning (Currie et al, 2010).

Knowledge brokering occurs at different levels – individual, group and organisational (Currie et al, 2010). At an individual level a key employee may act in boundary-spanning work across organisational and occupational boundaries to enable knowledge exchange. For example, a senior nurse may broker knowledge between different professionals involved in a particular pathway of care. There is some confusion within the literature as to when an individual is a broker as opposed to a boundary spanner (Fleming and Waguespack, 2005). These concepts are purported to be two related but distinct social positions. In essence an individual acts as a broker if they are the only link between two areas. If, however they are one of a number of links between the two areas they are a boundary spanner. A distinction between an individual acting as a broker or a boundary spanner that is often cited in the literature is that of trust. There is an inherent lack of trust associated with

brokerage positions that it is suggested can be overcome through physical interaction (Currie et al, 2010, Fleming and Waguespack, 2005).

At a group level brokering is deemed to be achieved through 'social capital' (Nahapiet and Ghoshal, 1998). For example, at a group level, interaction is developed and a level of trust is built alongside situated learning (Long et al, 2013). This establishes the foundations for knowledge exchange.

At an organisational level the literature defines it as a boundary spanning organisation. This is an organisation distinct from either of the two or more organisations being brought together to share knowledge (Currie et al, 2010). This type of organisation can offer mediation, training and enable other interactions and knowledge exchange between the two organisations it is distinct from. The majority of the literature on knowledge brokering relates to the individual level. In healthcare literature, however, it has been suggested that much of this analysis could be applicable to both group and organisational level brokering (Currie et al, 2010).

Knowledge brokers facilitate knowledge exchange via a positional point of 'in between' to connect, recombine, mediate and transfer ideas that would otherwise remain disconnected (Long et al, 2013, Hargadon and Sutton, 2000, Verona et al, 2006, Burt, 1992). The individual brokerage role has been defined into a number of different roles (Fernandez and Gould, 1994). These are outlined below:

<b>Role</b>	<b>Description</b>
<b>Liaison</b>	Between different groups, neither of which they are a member
<b>Representative</b>	Senior member of a group delegates the brokering role of external knowledge to someone else in the group
<b>Gatekeeper</b>	Screens external knowledge to distribute within their own group
<b>Co-ordinator</b>	All the actors are in the same group
<b>Itinerant</b>	Mediates between actors in the same group, however, the broker is not part of the group

Table 2.1: Table to show the different brokering roles (Fernandez and Gould, 1994)

The role of knowledge brokering can be substituted by another individual if it relates to structure or a role specifically. If, however, it relates to a specific person it is not easily substitutable and this highlights again the importance of social capital and that

it often underpins the ability to conduct knowledge brokering (Lin, 1999). This is important with regard to healthcare interventions. If the goal of an intervention is to create sustainable change then creating brokerage that can be achieved by any individual is important. Alternatively, it could be that brokerage occurs through an intervention in order to create different types of brokers within the healthcare system. If this could be achieved it could lead to sustainable system wide change and importantly enable it to adapt organically.

Social capital has clearly been highlighted as potentially important in the group knowledge brokering role (Nahapiet and Ghoshal, 1998). This includes the organisational structures and processes that link knowledge domains and actors laterally (Currie et al, 2010), the structural dimension. It also includes co-location and interaction leading to high trust relationships and has been highlighted as necessary for effective brokering in healthcare (Bowen et al, 2005, Waring and Currie, 2009, Dobbins et al, 2009) i.e. relational dimension. Finally it includes the possession of knowledge related specifically to the various knowledge domains being brokered (Dobbins et al, 2009), i.e. the cognitive dimension.

Social capital produces a cycle of affect, i.e. it both affects, and is an effect of, situated interaction between actors. In other words, social capital can develop as actors engage in day to day practice where knowledge is exchanged, and this interaction may depend on social capital initially (Currie et al, 2010). Equally, social capital has been described as the 'glue' for brokerage to overcome any 'stickiness' of tacit knowledge across boundaries (Currie et al, 2010, Hargadon, 2002, Ferlie et al, 2005). Situated interaction allows tacit knowledge to be more easily exchanged as it is embedded in practice itself.

Current literature has also looked at the role of the boundary-spanning organisation in the brokering of knowledge (Hargadon and Sutton, 2000). The majority of research has focused on competitive situations and innovation gains from R&D sharing across private sector organisations (Currie et al, 2010). In these cases, boundary spanning organisations are deemed as 'trusted intermediaries' that mediate, facilitate co-operation between parties and maintain this co-ordination role over time. Interestingly, brokerage at this level often focuses on organisational mechanisms and processes, i.e. architectural knowledge (Currie et al, 2010). In

doing this it can perform a social-integrative function and mediate divergent interests to produce collective action and co-operation within a network (O'Mahony and Bechky, 2008, Currie et al, 2010). There is a consequence, however, of this approach. Shi et al (2009) indicate that whilst the role of a knowledge broker can enhance organisational performance there may be a need to be affiliated with the group that they are brokering to in order to have a positive impact; thus legitimacy is considered important.

As a result of this postulation literature emphasises the potential importance of social capital and relationship quality for effective knowledge brokering in healthcare whether at the individual, group or organisational level.

There is a section of brokerage literature specifically on health and social care. (Canadian Health Research Foundation, 2003, Lomas, 2007, Verona et al, 2006, Dobbins et al, 2009, Burgess and Currie, 2013). However, the majority of this focuses on the brokering of external evidence into practice with little empirical evaluation of the use of brokering to effectively deliver healthcare (Dobbins et al, 2009). In addition to this gap little consideration given to the interaction of social structures and knowledge exchange, along with how institutional barriers to knowledge exchange is mediated and how effective any approach undertaken actually is (Greenhalgh et al, 2004, Hargadon, 2002, Currie et al, 2010). Other gaps within the brokerage literature include the effectiveness of brokers in different settings and amongst different groups of healthcare professionals, and the personal characteristics and the combination of these on outcomes (Greenhalgh, 2004, Dobbins et al, 2009).

Finally, it is important to highlight the significance of individual skills in relation to boundary bridging. I discussed human capital above, i.e. an individual's skill set and capability. To some extent this fits broadly across the three categories – interaction, brokerage and boundary objects. For an individual to be able to use a boundary object, build a relationship and/or act as broker certain skills are required, including leadership skills. Literature on leadership is extensive and it is beyond the scope of this study.

Other issues described within the literature that are seen as important include the need for the involvement of people at different levels of the organisation in order for

a network to flourish and move away from a hierarchy (Williams and Dickinson, 2008). It is suggested that networks are also more effective when they engage a range of staff members at all levels through a process of collective leadership, defined as multiple members with different responsibilities combining to lead. (Ferlie and Shortell, 2001, Denis et al, 2001). This is supported by research into high performing units within organisations where there are two or three co-leaders as opposed to a single leader (Williams and Dickinson, 2008).

This is an interesting aspect as it highlights the interplay of hierarchy within a network and their effectiveness. Alongside the paucity of literature in general and healthcare specifically is that of the evolution of a knowledge network. A part of understanding the evolution and its effectiveness it appears would be to look at various structural and relational compositions.

### **2.7.3 Boundary Objects (*artefacts*)**

Boundary objects are artefacts, documents, guidelines, conferences or meetings that enable the spanning of established boundaries. In essence, they provide a shared framework for action (Wenger, 2000, Carlile, 2002, Star and Griesemer, 1989). There is a great deal of literature focused on boundary objects, their form, meaning and influence. It is beyond the scope of this study to discuss each aspect in detail. It is, however appropriate to highlight their use, a prominent issue with regard tacit knowledge and their influence on relations and enacted practices in healthcare.

A criticism levelled at the use of boundary objects to cross boundaries surrounds the capture and dissemination of tacit knowledge. Tacit knowledge is embedded in work practice, which is difficult to capture effectively in a knowledge repository, and as such it is important to contextualise the knowledge from experience (Currie et al, 2010). In addition, trust between individuals is key for effective sharing of knowledge through a virtual means (Currie et al, 2010). Social and organisational influences on the use of tacit knowledge are therefore very important in professionalised organisations such as health and social care networks, the more so if the network is geographically dispersed (Ferlie, 2010, Currie et al, 2010).

The final aspect covered here is the interest within the literature in the meaning attached to a boundary object by different communities. Constantinides and Barrett



(2006) outline how boundary objects influence relations and enacted practices in healthcare. They demonstrate how a telemedicine system was engaged at different sites, with different perspectives and ultimately no shared meanings giving rise to a 'collaboration with resistance'. Equally, not all objects employed as a boundary object actually fulfil this designated function. It is therefore suggested that it is important to explore how objects are actually used in practice to span various boundaries (Levina and Vaast, 2005). An aspect of this is the impact of point within a collaboration process that a boundary object is utilised on its effectiveness. For example, a study of software development teams demonstrated that objects were useful at an early stage of the collaborative process however they may create impedance at a later point (Oborn et al, 2010). This highlights the need to study not only the ability of an object to enable knowledge transfer but also the influence to practice (Carlile, 2002).

The inherent problem with regard to the capturing of tacit knowledge and the need to understand its influence on practice lends itself to the requirement of multi-faceted interventions within healthcare in order to cross boundaries for both explicit transfer and tacit sharing and ultimately to create practice.

## **2.8 Boundary knowledge network**

There is a suggestion in the literature that a boundary forms a network itself, raising questions such as what a boundary network looks like and how it functions (Karafillidis, 2008, Newman, 2003). Literature discusses aspects that I have highlighted above such as interaction, a brokerage role or a boundary object but this tends to be focused on a single relationship, for example between firm 'a' and firm 'b'. It is rare to find knowledge network research that looks at more than one type of relationship and therefore more than one type of network boundary (Hustad and Bechina, 2012).

There is, however, research on 'public sector knowledge networks' (PSKN), which address multiple relationships and are focused on knowledge sharing across organisational boundaries (Dawes et al, 2009). PSKNs involve networks formed to cross network boundaries, effectively an extension of the three boundary bridging processes outlined above. In other words, they are not just an interaction between

two organisations, or someone brokering across the boundary, but a network formed to specifically share knowledge across boundaries. The interplay between boundary bridging processes and the formation of a cross boundary network is not raised within the literature. The reason for this may come from the fact that in the majority of studies these aspects are not investigated longitudinally. Research has shown that, for example, the duration of a tie has a significant influence on the transfer of knowledge, however structural network studies do not consider how different durations of ties impacts knowledge outcomes (Phelps et al, 2012).

Another branch of research that touches on the concept of multiple representatives coming together in a boundary network is that of a distributed network of knowledge (DNoK). This essentially constitutes an 'inter-community' where participants are a part of a community and a distributed network (Hustad and Bechina, 2012). DNoK typically demonstrates weaker ties between geographically dispersed participants, where they are for example working together on a project or a similar task (Granovetter, 1973).

With specific regard to the context of healthcare it has been highlighted in a recent systematic literature review that healthcare research focuses on groups and group behaviour rather than group boundaries (Braithwaite, 2010). It also suggests that there are gains to be had to focus studies on this area as it is across these spaces that knowledge is exchanged and practice can disseminate (Braithwaite, 2010).

### **2.8.1 Summary**

The literature highlights the concept of network boundaries and that the transfer of knowledge can 'stick' at them. There is also, limited, suggestion and focus on networks situated specifically at these boundaries. This appears, however, to be a limited strand of literature with the majority of studies highlighting the possibility of such a definition of a network as opposed to studies specifically focused on it as a characterisation or in terms of how to create and sustain if necessary such a proposition.

If I draw together the main areas of literature discussed above – knowledge transfer, knowledge networks and boundaries – the synthesis of a knowledge transfer boundary network is possible in a similar vein to a PSKN or DNoK. It is difficult to

distinguish between the different labels for this type of network from the literature due to the lack of publications targeting this area. Equally, whilst public sector could have a relevance to healthcare neither concepts (PSKN or DNoK) have been viewed within the healthcare setting. The PSKN literature does, however, highlight that for public managers to deal with complex problems it is useful to create networked forms of engagement and action. Importantly, it is not focused on the delivering of a particular project rather it is about the creation of cross-boundary knowledge sharing.

One approach outlined in the cross-boundary related literature is that of supporting and facilitating communities of practice. The suggestion being that as a network develops it becomes a place of situated learning and sharing and effectively creates a community of practice.

## **2.9 Learning networks – Communities of Practice (CoP)**

The literature suggests that networks and ‘communities of practice’ could play a role in the movement of knowledge into practice (Swan et al, 2002, Rycroft-Malone, 2011, Dopson et al, 2002). This is an important aspect to this study as the primary motivation is that of understanding movement of knowledge into clinical practice. Those communities that are multi-disciplinary have been shown to offer benefits with regard to this movement of knowledge into practice.

As I have described above this study is focused on the ability to move knowledge into clinical practice across networks that are situated at various boundaries. There is a requirement to understand not just the structural element of the network but also the aspects that ‘animate’ the network. A multi-disciplinary community is essentially the knowledge boundary network I discuss above, alongside an animating community of practice, i.e. a group of people who engage in a process of collective learning. There is little evidence within the healthcare literature for the increase or otherwise in knowledge uptake via a community of practice (Rycroft-Malone, 2011, Gabbay et al, 2003).

The aspect of literature that I draw upon with regard to the ‘animation’ of the network is communities of practice. The definition of a CoP is ‘groups of people who share a concern or a passion for something they do and learn and how to do it better as they interact regularly’ (Wenger, 1998).

In order to discuss the literature on communities of practice it is firstly worth highlighting relevant aspects from the broader organisational learning literature and its impact to healthcare knowledge transfer literature. Central to the organisational learning concept is the need to facilitate knowledge transfer (Oborn, 2010). This large volume of literature highlights the difficulty in achieving this in practice, the benefits of doing so and has suggested methods of supporting the process e.g. training, patents, personnel movement (Szulanski, 1996, Oborn, 2010). Empirical studies within this area have found that an 'interconnected organisational form' may demonstrate enhanced performance as a result of learning to transfer knowledge across the constituent parts (Argote et al, 2000). Here I note an important difference between the organisational literature and healthcare literature – by focusing on processes rather than engaging with individuals, this ability can persist regardless of individuals and therefore it becomes an organisational practice. There have been some attempts to bring the key idea of focusing on process into the healthcare literature, but there is little use of these concepts in the knowledge transfer and exchange literature (Nutley et al, 2003). This is an important aspect of this study as I seek to address to some extent this lack of focus on process.

A predominant aspect of healthcare knowledge transfer literature views it as embedded in a situated social learning process, as discussed briefly above. An important concept within this is social networks. A social network is defined as 'the pattern of friendship, advice, communication and support which exists among members of a social system' (Valente 1996) and is viewed as a vital mechanism for diffusion of knowledge. Different groups have different types of social networks. Doctors, for example, tend to operate in informal, horizontal networks and nurses more often have formal, vertical networks (West et al, 1999). Different social networks also have different uses for different types of influence; for example, horizontal networks are more effective for spreading peer influence and supporting the construction and reframing of meaning; vertical networks are more effective for cascading codified information and passing on authoritative decisions (Greenhalgh et al, 2004). The constituents of social capital – understanding, trust and reciprocity – are regarded as crucial to the development of CoP and these aspects effectively underpin knowledge exchange (Nahapiet and Ghoshal, 1998). As a result of this it is often implied that CoP operate optimally when co-located (Greenhalgh, 2004).

The social network approach highlights that knowledge cannot be divorced from its context and therefore knowledge exchange is best embedded in work practices i.e. 'situated' as opposed to, a planned mechanistic process of cognitive learning (Lave and Wenger, 1991). This situated process is generally termed 'communities of practice' (CoP) and stems from seminal pieces of work by Lave and Wenger in 1991 where the concept was outlined. This, in essence, is an interpretive framework that describes learning as inherent in situated activity, rather than compartmentalised to the mind (Wenger, 1998). Through participating in a CoP learning is enabled and social relations and identity can be transformed (Lave and Wenger, 1991, Wenger, 1998). The example Lave and Wenger use is through description of a novice who over time gains knowledge and develops practice and identity within a community. In order for this to occur the person is legitimised and can eventually become masters if full participation is enabled (Wenger, 1998).

'Communities of practice' was initiated as a theory of learning and has progressed as a substantial part of the field of knowledge management. Within the literature the concept is predominantly discussed in the business and development sectors with a more recent shift toward healthcare.

A community of practice (CoP) can be intentionally formed for learning or an incidental outcome resulting from the interactions (Wenger, 1998). The implication, therefore, is that CoPs are everywhere and as an individual or organisation we are involved in any number of them (Wenger 2000). However, it should be noted that the application of the term 'community' is not the same in all cases. Indeed, Wenger's definition of the characteristics of a CoP has altered over time. Initially, Lave and Wenger focused on knowledge acquisition by a newcomer to the community – a process they termed 'legitimate peripheral participation'. This concept essentially states that a newcomer would move from peripheral to full participation in the group. For example, as a newcomer joins they would initially start by observing and performing simple tasks. It is through this that they learn how the group works and how and when they can participate.

Wenger moved on from this concept and identified three elements that distinguish a community of practice from other groups and communities (Wenger, 2011). They constitute i) a domain, i.e. the identity of the community defined by a shared interest,

ii) a community, i.e. the members interact and learn and iii) practice, i.e. a focus around which it develops. Equally, he describes that these elements are animated via the tensions created within and between four fundamental dualities. These are; participation-reification, designed-emergent, identification-negotiability and local-global.

A well-known example of a successful CoP was outlined by Brown and Duguid, 2001. In their study the Xerox customer service representatives exchanged tips from their work in the field to fix the machines. This information was shared at informal meetings. Xerox recognised there was a value to this and developed a database, called Eureka, in order to share the knowledge on a global scale. It was estimated to have saved the corporation approximately \$100m (Brown and Duguid, 2001).

CoPs have been purported to promote the management of knowledge and learning and provide the structure necessary to support it. It would appear, therefore, that the concept is particularly relevant to the healthcare sector where learning, practice and peer review play an important role in the success of an individual and ultimately the organisation. For example, a physician's knowledge is embedded in practice, which is born from a body of evidence based research. This continually evolves through additional research and peer reviews, enabling the process of change to filter through to the practice (Parboosingh 2002). Gabbay and Le May (2004) looked at CoPs within the primary health care trusts. They found that clinicians usually worked with "knowledge in practice" as opposed to explicit codified knowledge. The clinicians involved were found to instinctively employ knowledge through constantly comparing knowledge with each other. It therefore suggests that a CoP's success and value is placed on the ability of the members to be skilled at appraising and integrating into practice various forms of knowledge, which can be wide-ranging and influenced by a number of factors including medical, economic, political and socio-cultural (Bentley et al, 2010). This skill can relate to the concept of absorptive and disseminative capacity, discussed earlier, and highlights how interlinked these concepts could be in practice.

Lesser and Storck (2001) argue that the social capital within the CoP affects a behavioural change. This change can result in improved knowledge sharing, which can lead to improved performance e.g. a competitive advantage, higher productivity,

a decreased learning curve, quicker response, preventing rework and encouraging new ideas. This is important as a network evolves across time it is likely the CoP structure and composition will change.

Additional positive aspects of CoPs within the literature in healthcare result from the collaborations being organised around knowledge domains as opposed to a specific technology or service (Bentley et al, 2010). They are said to enable both research evidence and knowledge from experience to be utilised and can therefore bridge disciplines and job roles. Equally, collaborative learning moves the ownership away from management and the traditional hierarchy. Research has indicated that as a result it provides a sense of ownership, autonomy and improved job satisfaction - the impact is a positive one on an organisation (Bentley et al, 2010). Equally, these aspects feed into improving and increasing collaboration, which perpetuates its success.

When reviewing the literature surrounding CoPs, however, it is clear that the views are mixed. Essentially, a large body of literature remains concerned with whether or not CoPs enable effective collaboration. The literature criticisms range from the ambiguity of terms through to the failure to recognise the complexity of interactions, power relations and the formation of CoPs (Bentley et al, 2010, Omrod, 2007, Hildreth and Kimble 2004, Ardichvili et al, 2003). Both the terms “community” and “practice” are ambiguous. Cox suggests that the term community is generally understood to mean “a large, self-conscious, externally recognised, all encompassing, tight knit, friendly, geographically situated group.” However, within the definitions offered for CoPs few of these aspects are necessary for it to be a community. ‘Practice’ is equally ambiguous – does it mean the same or a similar venture? For example, Cox suggests a common enterprise to mean building a boat together or anyone building a boat. Equally, a practice can relate to a specific item, e.g. a particular work or very broad e.g. the practice of engineering (Lesser and Storck, 2001).

Another aspect of the debate is the extremely broad nature of what it includes. Wenger states that CoPs are everywhere, small or large, public and private domains. The question remains how are CoP defined? The difficulty of achieving this can be demonstrated within organisations where other ‘groups’ such as formal work groups,

project teams and informal networks can be found. In 2000 Wenger and Snyder offer a snapshot comparison of these groups:

	<b>What is the purpose?</b>	<b>Who belongs?</b>	<b>What holds it together?</b>	<b>How long does it last?</b>
<b>Community of practice</b>	To develop members' capabilities; to build and exchange knowledge	Members who select themselves	Passion, commitment, and identification with the group's expertise	As long as there is interest in maintaining the group
<b>Formal work group</b>	To deliver a product or service	Everyone who reports to the group's manager	Job requirements and common goals	Until the next reorganisation
<b>Project team</b>	To accomplish a specified task	Employees assigned by senior management	The project's milestones and goals	Until the project has been completed
<b>Informal network</b>	To collect and pass on business information	Friends and business acquaintances	Mutual needs	As long as people have a reason to connect

Table 2.2: A snapshot comparison (Wenger and Snyder, 2000)

Li et al (2009), argue that the distinction between these 'groups' is vague and contradictory. It is due to this lack of clarity concerning the CoP concept that a number of criticisms are levelled.

There is also discussion within the literature as to whether or not a community of practice is correct term and definition. Other suggestions have been a community of purpose i.e. a group with a shared agenda and interest in a particular project (Barab et al, 2004). Equally, Brown and Duguid (2000) proposed a related but distinct concept termed networks of practice (NoPs) (cf. Andriani et al, 2004). They propose that a network of practice is distinct from a community of practice due to the constituents being more loosely coupled in the former. A NoP is also distinct from



other networks due to the relationships being around information exchange in order to create practice (Andriani et al, 2004).

It is not clear from the literature how any of these forms evolve as opposed to any of the others. It also argues that each form that is proposed is 'the' form it rarely discusses them in terms of context or antecedents.

A central tenet of the communities of practice concept is that they are self-organising and sustaining. They essentially sustain as long as necessary. However, literature offers an extension to this aspect of the theory as a group can demonstrate the characteristics of a CoP but be facilitated by an entity or be epistemic i.e. there is some kind of authority creating the procedures within the CoP. This is of interest to this study situated in healthcare as it is of interest to understand how a CoP can be created. For example, does facilitation create a CoP and can it assist in its evolution. Finally, the aspect around sustainability is of interest within healthcare. Within healthcare the requirement is for it to sustain in terms of sharing and using knowledge. Is it possible to create and evolve an epistemic CoP, for example, that can sustain within the healthcare context?

In addition to the criticisms surrounding definition of a CoP there are others including the lack of studies focused on power within a CoP, comparisons to natural phenomena and the lack of focus on how they are created and supported (Bentley et al, 2010). Various studies have supported these criticisms by confirming that work-based collaborations can require additional support in order for them to function, for example financial support, purposely co-ordinated groups and identification of specific leaders (Bentley et al, 2010). One example, Ardichvili et al, (2003) describes how an organisation working toward creating vibrant knowledge sharing needs to create a supportive environment, specifically highlighting the need for a set of institutional norms, multiple face to face meetings and clearly communicated norms and standards.

The issue of power and its general neglect in terms of studies based on the CoP literature is a recurrent one. There are many aspects discussed as to what is not covered in terms of power, however, of particular interest to this study is the power within a network and its associated community that exists in terms of healthcare

professions and organisations. This includes aspects such as attitudes and traditional hierarchy within the medical professions. These are briefly outlined below.

Conflicts can result from reluctance of CoP members to adopt innovations from other CoPs particularly if the innovation is deemed to reduce sovereignty over the domain (Omrod et al, 2007). This relates to an aspect of power peculiar to healthcare organisations, i.e. the power wielded from the traditionally dominant medical profession that conducts itself alongside other healthcare professions that are less powerful. For example, there is a perceived knowledge and skill imbalance between different types of health professionals. The Department of Health, NHS, GMC, Royal Colleges and expert advisors all have restricted membership, which serves to add weight to the power and domination of such a network (Bentley et al, 2010).

There are other subtleties arising in this power imbalance regarding the role of 'reputation'. Reputation within the network is deemed extremely valuable and as such a professional identifies more with the college of peers, i.e. the Royal Colleges, as opposed to the organisation that employs them, the hospital/NHS (Goodwin et al, 2004). In short, the management is often disregarded as important and control is therefore more complicated than in other settings.

The discussion above primarily relates to a single CoP. Within healthcare it is suggested that a CoP can be characterised via professional groupings termed uniprofessional communities of practice (Ferlie et al, 2005). It was originally purported that knowledge would diffuse rapidly through such networks (Ferlie et al, 2005). However, there has been a growing body of literature that subscribes to an alternate theory – that high professionalism and the resultant boundaries between professions retard transfer and diffusion. This is equated to the importance of the structure and quality of an individual's social network (Valente, 1996 and West et al, 1999). It has been demonstrated that symbolic and formal connections may increase the permeability of boundaries between CoPs (Ferlie et al, 2005).

Research on collaborative learning generally focuses on the actions within a group rather than between groups (Stahl, 2009). The lens of 'between groups' is particularly important within healthcare and for this study, as it can be necessary and desirable for multiple communities within healthcare to harmonize practice. However, the character of practice-based knowing varies between CoPs. In other words the

knowledge from one CoP does not readily fit the 'reality' of another CoP (Yanow, 2004). There have been studies that demonstrate that multiple CoPs working together often hinder learning and create conflict (Ferlie et al, 2005, Currie and Suhomlinova, 2006, Bate, 2000, Gabbay et al, 2003). Potential explanations for this are offered by Gherardi and Nicolini (2002), where they indicate that in a multidisciplinary setting advocacy and comparison are more likely to be the focus than integration. Conversely, there is a considerable amount of literature that highlights that benefits can be had from interaction between diverse CoP, although this has predominantly come from the organisational literature and not healthcare (Oborn, 2010). Aspects highlighted within the literature with regards future research include examination of changes in identity formation and levels of participation as previously separate CoPs are brought together (Oborn, 2010).

The concept of CoPs has been discussed for approximately a decade and whilst it has been emphasised as an important field it remains significantly underdeveloped (Hislop, 2003). Research to date has been predominantly based on qualitative case studies (Gherardi et al, 1998, Gongla and Rizzuto, 2001; Kimble and Hildreth, 2005). Importance has been placed on aspects such as motivation, management and leadership in the context of knowledge exchange (Zboralski et al, 2009), however little is known about the antecedents of a CoP, the interactions and the implication on knowledge sharing and ultimately the knowledge network (Zboralski, 2009). It has been suggested that CoPs can become cliques and develop strong ties which can create a barrier (Bentley et al, 2010). However, literature does not discuss or address how to prevent a clique forming via process and whether or not strong ties are necessary for a CoP to be formed in the first place. There is, in general, limited research on the evolution and sustainability of CoPs (Li et al, 2009). The studies that do investigate the evolution of a CoP demonstrate a process through which it develops. It begins loosely connected and matures into a more developed set of stronger connections. They indicate that there are varying stages and that these can take differing levels of time to reach. A recent systematic review on CoPs indicates the requirement for the development of a framework to guide the establishment and facilitation of CoPs in healthcare (Ranmuthugala et al, 2011).

## 2.10 Conclusion

This study generally takes the view that extant literature suggests that there is not a single 'magic bullet' to move research into clinical practice efficiently and effectively (Greenhalgh, 2004). However, it is equally clear that there is an urgent requirement for this movement to occur consistently and widely within healthcare (Cooksey, 2006). Knowledge mobilisation is generally viewed as a key ingredient for resolving this issue, alongside network structure. However, the NHS is a complex system and does not form a homogenous structure. There are a number of networks present, and each is characterised in different ways depending primarily on the knowledge itself and/or the organisational context (Ferlie et al, 2010).

The literature relating to knowledge from the broader management literature delineates a number of different key concepts relating to knowledge. In particular different knowledge 'processes'. For example, knowledge sharing, knowledge transfer, knowledge exchange etc. A predominant issue is the need for the inherent knowledge in one group to be available to a different group. Knowledge is learned within a social context according to the conceptualisation of Lave and Wenger in 1991 – communities of practice. This need to share knowledge and inform practice is of particular importance to healthcare due to the constant need to do more for less whilst maintaining quality. It remains, however, difficult to integrate or transfer knowledge across different domains.

The literature highlights that these multiple domains or professions or expertise essentially represents multiple networks and therefore multiple boundaries. Boundaries, like networks, can be characterised by different methods (Ferlie et al, 2005, Karafillidis, 2008, Guthrie et al, 2010). Predominant boundaries discussed within the healthcare literature are those that arise from the knowledge demarcation, i.e. professional boundaries and those from the organisational context (Ferlie et al, 2010). Research demonstrates that knowledge mobilisation 'sticks' at boundaries and equally also suggests mechanisms that can create more fluidity such as boundary bridging mechanisms - interactions, people (skills and brokerage) and boundary objects - with a clear view that a multi-faceted approach is probably required (Wenger, 2000, Williams and Dickinson, 2008). Finally, I note that the literature highlights the concept of a boundary network and discusses the concept of

a group coming together to create a learning network i.e. a community of practice. In other words there is interplay between networks and social structure.

These areas of literature – knowledge, networks, boundaries and CoP - combine to provide this study a focus on knowledge transfer boundary networks. This is a concept synthesised from the literature and one that has not been directly introduced.

Throughout the review above, as and when appropriate, various gaps within the specific theme were highlighted. The areas of particular focus within this study were: the limited research on knowledge networks despite their proposed influence on knowledge transfer (Su et al, 2010, Schilling and Phelps, 2012); the growing realisation of the importance of networks in healthcare and the need for further studies to focus on them (Currie and White, 2012); network duration (time inception including varying strengths and duration) and impact on knowledge outcomes (Phelps, 2012); definition of various groupings in relation to the CoP definition (Li et al, 2009); CoP research being predominantly based on qualitative case studies (Kimble and Hildreth, 2005); limited research on the creation, evolution and sustainability of networks and CoPs; and the suggestion that facilitated interaction could prove useful with regard to the creation, evolution and sustainability but is significantly under researched (Williams and Dickinson, 2008 Li et al, 2009).

There are two aspects underlying all of the above. Firstly, the reporting of healthcare interventions within the literature. There are many publications relating to healthcare interventions, although less that report on a multi-faceted approach. Also, it is suggested in the literature that few studies specifically report knowledge transfer interventions (Ward et al, 2009).

Secondly, the issue of applied relevance. In the review above I have described the issues facing healthcare at the current time i.e. the requirement to do more for less whilst maintaining quality. There has been and continues to be increased investment in networks, which leads to the need to understand their effectiveness in terms of addressing the second translational gap and the transfer of knowledge. As a result there is a requirement to address the gaps outlined above in order to understand the ingredients of creating the required network which ultimately can lead to sound and

informed decisions to be made about interventions relating to networks, healthcare and knowledge transfer.

From the above delineation of important gaps for this study it is clear that the focus is on knowledge transfer boundary networks. There is an overarching gap with regard to each area of the literature discussed above. That is how are these knowledge networks located at the boundaries created, how do they evolve and ultimately sustain? There is, for example, limited discussion relating to the evolution of knowledge networks (Phelps et al, 2012). Equally, there is limited discussion relating to the evolution of CoP (Li et al, 2009). One reason for this is the paucity of longitudinal studies, a key aspect this study seeks to address. To study over time is important as it can enable the inclusion of perspectives and actions past the start-up phase, for example, when it is novel and engagement is possibly less arduous as a result. The ability to maintain that over time is very important when attempting to achieve change whether resulting from an intervention or otherwise. A final gap to highlight is the suggestion of the need for the development of a framework to guide the establishment and facilitation of CoPs in healthcare (Ranmuthugala et al, 2011).

With these gaps in mind from the extant literature, this study intends to explore in more detail the evolution of a knowledge boundary network, the antecedents and consequences. I will therefore examine the following research questions:

***'How do knowledge transfer boundary networks develop over time and how do they become self-sustaining?'***

***RQ1. What were the developmental processes underlying network inception?***

***RQ2. How do knowledge transfer boundary networks evolve from inception to sustainability?***

***RQ3. What factors are needed to create sustainability?***

From a sustainability perspective I relate back to the relevant discussions in the literature review. The use of the term sustainability in this study does not relate to the sustainability of an intervention in terms of a new set of guidelines implemented or a

new tool to be used rather it is focused on the organisational relationships and processes which include the relational ties that develop or otherwise via an intervention aimed at creating these knowledge networks.

Alongside the theoretical contribution arising from these research questions, this study has an important applied contribution to both practice and policy. From a practice perspective it will inform future approaches for accelerating research knowledge into clinical practice, thereby delivering benefits more efficiently and effectively. As the case study is a policy initiative, its evaluation could have a number of implications on future policy evaluation and direction within healthcare.

The following chapter describes the mixed-methods research methodology utilised within this thesis in order to answer the research questions.

## **CHAPTER 3 - RESEARCH METHODOLOGY AND DESIGN**

In the previous section I reviewed the literature and identified the gaps in knowledge and relevant research questions. This section outlines the research approach, methods and overall design employed to study the research question.

The process of research is based upon differing sets of philosophical assumptions and as a result of the particular stance taken the engagement of specific research methods appropriate for development of knowledge. It is necessary, therefore, to initially outline the research stance and the assumptions through which lens the research was conducted and evaluated. This chapter outlines the philosophical assumptions, the design of the study, the case study chosen and the embedded units of analysis (UoA). This, more specifically, includes a review of the philosophical assumptions i.e. the interpretive paradigm for the study, a discussion of the research methodologies, the stages and process involved and an outline of the case study and UoA including their suitability. Alongside this I outline the strategies, instruments and data collection and method of analyses employed.

### **3.1 Research Stance/Paradigm**

The first step in understanding the rationale behind the research process employed stems from assumptions about social reality and about how we can gain knowledge about reality i.e. the interpretive paradigm. A paradigm is a broad framework of perception, understanding and belief within which theories and practices operate.

According to Guba (1990) research paradigms can be characterised across three aspects – ontology (what is reality?), epistemology (how do you know something?) and methodology (how to go about finding out?).

In more common parlance the ontological and epistemological approach of a study can be described as an individual's 'worldview' which has a significant impact on the importance of differing aspects of reality.

The stance of this study retained that of an ontological realism alongside epistemological constructivism and relativism. In other words there is a real world that exists independently of our perceptions, theories and constructions, however, our understanding of this world stems from our construction of it i.e. from our own



perspectives and standpoint (Zachariadis et al, 2013). This is essentially a critical realist stance which was largely characterised by Bhaskar (1975) (cf. Zachariadis et al, 2013). A fundamental part of this approach is the importance of the perceptions and values of the participants, which forms a predominant tenet of this study (Grix, 2002, Saunders, 1959).

## **3.2 Research Methodology**

Critical realism does not commit to a single type of research. It is open to a variety of research methods which are chosen according to the research and the aims of the study. The benefit of this mixed method approach is that they mutually inform one another whilst unpacking the relationships between local practices and changes that can be found at another level of analysis. Whilst a number of studies have been conducted based on one approach alone there has been increased attention within methodological debates in the social sciences and a groundswell of support for a mixed method approach has ensued. The mixed method approach is deemed as complementary and enables a more complete understanding (Jack 2010, Edwards, 2010, Edwards and Crossley, 2009, Bechky, 2006).

As a result an inductive 'mixed method' (quantitative and qualitative) methodology was chosen. An inductive approach was chosen due to the level of complexity inherent with this study and as such made a direct causal hypothesis redundant. The specific research methods were purposively chosen to fully elucidate the different facets of the research question. These were in-depth semi-structured interviews, field observation and participation and Social Network Analysis (SNA).

These were chosen because each method provided an added dimension to the study, which when blended together could offer a more complete and robust picture. In the section below I highlight the rationale behind each method chosen and in table 3.1 outline which method was utilised for each facet of the research question.

### **3.2.1 Methods rationale**

The research questions of this study were centred on process and essentially how a group of individuals brought together within that process evolved into a network or otherwise. Therefore, the focus was on the network, its inception, evolution and

sustainability. Crucially, to this study networks are ‘both structure and process *at the same time*’ (Edwards, 2010). As a result it is suggested that they should not be categorised as either quantitative or qualitative alone.

The qualitative approaches enabled the consideration of the reasons behind the network relations, the reproducibility, variability and particularly important to this study the dynamics of the network relations. The stance of my qualitative research was that of a process researcher. The qualitative approach was via interpretive methods that were well suited to addressing questions of process (Ferlie et al, 2005, Bechky, 2006). Interpretive methods are adapted to the description, interpretation and explanation phenomenon (Ferlie et al, 2005). Process research is the dynamic study of behaviour in reference to organisations and particularly focusing on organisational context, activity, and actions that unfold over time (Pettigrew, 1997). The research undertook a narrative strategy of qualitative process research with the expectation that this would produce chronology, concepts and theory relating to data (Langley, 1999, Ferlie et al, 2005).

Qualitative methods are well suited to the study as they typically examine issues from the perspective of the participant and they are particularly appropriate and frequently used in the study of organisation members’ constructions and accounts (Maitlis, 2005). Field observation, participation and interviews were specifically chosen as they enable the impact and characterisation of context, practice and process to be elucidated and a deeper investigation into specific aspects that arise during the course of the study respectively.

From the quantitative perspective I utilised Social Network Analysis (SNA), which is particularly suited to the study of patterns of interaction in health and social care organisations as it is inherently relational and provides methods for analysing both vertical and lateral relations within a network (Balkundi and Kilduff, 2006, Scott, 2000). Social Network Analysis is a quantitative approach that enables the mapping and measurement of a set of network relations. It is a methodology that enables the characterising of a network from a structural and form perspective and also the content and processes of a network (Edwards, 2010). It is also a quantitative approach that can be utilised inductively or deductively (Prell, 2011).

This, combined with the qualitative aspects, enabled an investigation into the complex phenomena surrounding each aspect of my research questions. The figure below outlines which method specifically addresses each facet of the research question.

For clarity, in understanding the table below, the overarching research question is:

***‘How do knowledge boundary networks develop over time and how do they become self-sustaining?’***

As discussed in chapter 2 this was investigated within this study through three sub-questions:

***RQ1. What were the developmental processes underlying network inception?***

***RQ2. How do knowledge boundary networks evolve from inception to sustainability?***

***RQ3. What factors are needed to create sustainability?***

Each of these sub-questions was investigated by a blending of all three methods, although each method was purposively chosen to address each sub-question. The table below delineates the primary method for each sub-question, the secondary method used to describe and add context and finally, the specific reason each method was chosen for that sub-question.

Sub-question	Method	Reason chosen
1	<ul style="list-style-type: none"> <li>Contextual historical analysis</li> <li>Field observation and participation</li> <li>Early exploratory interviews</li> </ul>	<ul style="list-style-type: none"> <li>Develop an understanding of the contextual environment</li> <li>Understand the specifics of the process</li> <li>Understand the practice of 'inception' i.e. what creates it</li> </ul>
2	<ul style="list-style-type: none"> <li>SNA</li> <li>Interviews</li> </ul>	<ul style="list-style-type: none"> <li>Measure the network structurally as it evolves along the process (SNA)</li> <li>Composition of the network in terms of content and process (Interviews and SNA)</li> </ul>
3	<ul style="list-style-type: none"> <li>Interviews</li> <li>SNA</li> </ul>	<ul style="list-style-type: none"> <li>Understanding the requisite factors that drove the networks to sustainability</li> <li>Composition of the network in terms of content and process</li> <li>Measure the network structurally</li> </ul>

Table 3.1: A table to show the method chosen for each research question

### 3.3 Research Design

A cross-sectional approach with a longitudinal element was adopted for data collection (Saunders, 1959). In other words the study over a period of time made a series of observations on a cross-section of the case study. I have specifically termed the research design as including a longitudinal element to honour the 'over a period of time' element. According to the BMJ introduction to epidemiology a longitudinal study follows subjects over time with continuous or repeated monitoring. It also states that these studies can vary considerably in size from very large (across decades) to very small (across a few days) (Coggon and Barker, 4<sup>th</sup> edition). The longitudinal nature is relevant depending on the case under study. In the case of this study the units of analyses (the different funded CLAHRC projects) were funded by the CLAHRC for an 18 month period. The study, followed these projects for the majority of this time (12 months) in addition to the 6 months early data collection, hence their lifespan.

I purposively chose the overall case study, i.e. I chose it based on the knowledge of the case study and the purpose of the study and within that a number of units of analysis in a similar manner.

For clarity, purposeful sampling is a non-random method of sampling where the researcher selects 'information-rich' cases for study in depth (Patton, 2002). Purposeful sampling takes place when the researcher selects a sample from which the most can be learned (Merriam, 2002). It is a common approach in qualitative research and its benefit can be described as 'Any common patterns that emerge from great variation are of particular interest and value in capturing the core experience and central shared dimensions of a setting or phenomenon' (Patton, 2002). It should be noted that whilst each network was conducting differing projects the data collected relate to the group's network and development of knowledge transfer or otherwise. The varying projects were a part of the 'great variation' – data was not collected with regard to the impact of the projects itself. Any data captured in relation to the projects was based on the individual's perception of it.

A case study approach is deemed as the optimum approach for studying complex phenomena (Yin, 1994). Also, case studies are deemed as particularly well suited for constructing, adapting, extending and refining theory. Yin (1994) stated that case studies were appropriate when the research question was 'how' or 'why'. This study focuses on explaining the 'how' of the development of knowledge transfer boundary networks (KTBN). It should, however, be noted that case study research is strong on internal validity but weak on external validity. Yin (1994) also highlighted that multiple case studies should have a replication logic i.e. each case serves a specific purpose. By using several different units of analysis, the study offers replication logic and enables a compare and contrast approach which adds to external validity and is also useful in theory development (Gummesson, 2006, Eisenhardt and Graebner, 2007).

As outlined above a purposive approach to case study selection was employed. I specifically chose a policy initiated intervention entitled "Collaboration for Leadership in Applied Health Research and Care" (CLAHRC). This was developed to address the "second translational gap", i.e. the well-known gap between research evidence and mainstream clinical practice. As discussed in chapter 1 there are various approaches to addressing this gap. I was specifically interested in looking at an approach that focused on mobilising knowledge through the development of networks. The North West London CLAHRC took an approach that specifically incorporated a focus on this and therefore it was an appropriate choice as a case study.

Within the case study itself I chose embedded units of analysis or mini case studies. These were chosen via purposive, maximum variation sampling and the boundary was defined via a nominalist approach i.e. it was set from my theoretical interest (Marsden, 1990, Doreian, 1994). Specifically, the units of analyses were chosen to incorporate a wide range of variation, for example, different disease indications, locations, participants, projects and time within CLAHRC. The principle behind this was to achieve greater insights by enabling the identification of common themes that are evident from across the sample. As stated above 'Any common patterns that emerge from great variation are of particular interest and value in capturing the core experience and central shared dimensions of a setting or phenomenon' (Patton, 2002). To ensure appropriate selection, before data gathering commenced, attendance at events and meetings was conducted along with document review.

In the following section I outline the overall case study – North West London CLAHRC. Following this I outline an overview of data collection and analysis and finally conclude with comment relating to the trustworthiness of this study.

### **3.4 Study Context – Case study Collaborations of Leadership in Applied Health Research and Care (CLAHRC)**

In order to investigate the overall research question I was specifically interested in looking at knowledge mobilisation (explicit transfer of knowledge, tacit sharing of knowledge, knowledge use and spread) within networks, including how these networks develop and sustain. As highlighted above within North West London there was a government initiative that was focused on transferring knowledge i.e. evidence-based medicine into use, and to spread it to a wider audience. It does this through creating and building groups (networks) and taking them through a process.

Within chapter 1 I have outlined the 'top level' funding/delivery of care issue surrounding healthcare and the resulting need to address the 'translational gap' between research and clinical uptake. At a policy level in order to address the second translational gap it has been suggested that there is as a need to establish a new approach to a) the adoption of technologies, interventions and processes in the NHS b) the improved mobilisation of research-based knowledge and c) the

increased capacity within the NHS to make use of that knowledge (Cooksey, 2006, Darzi, 2007).

In April 2009, a briefing document outlining the new innovation landscape in the UK was produced. It outlines the organisational structures that have been developed in order to create a landscape that stimulates and disseminates innovation and increases research capacity through a series of interactive networks (HSRN, 2009).

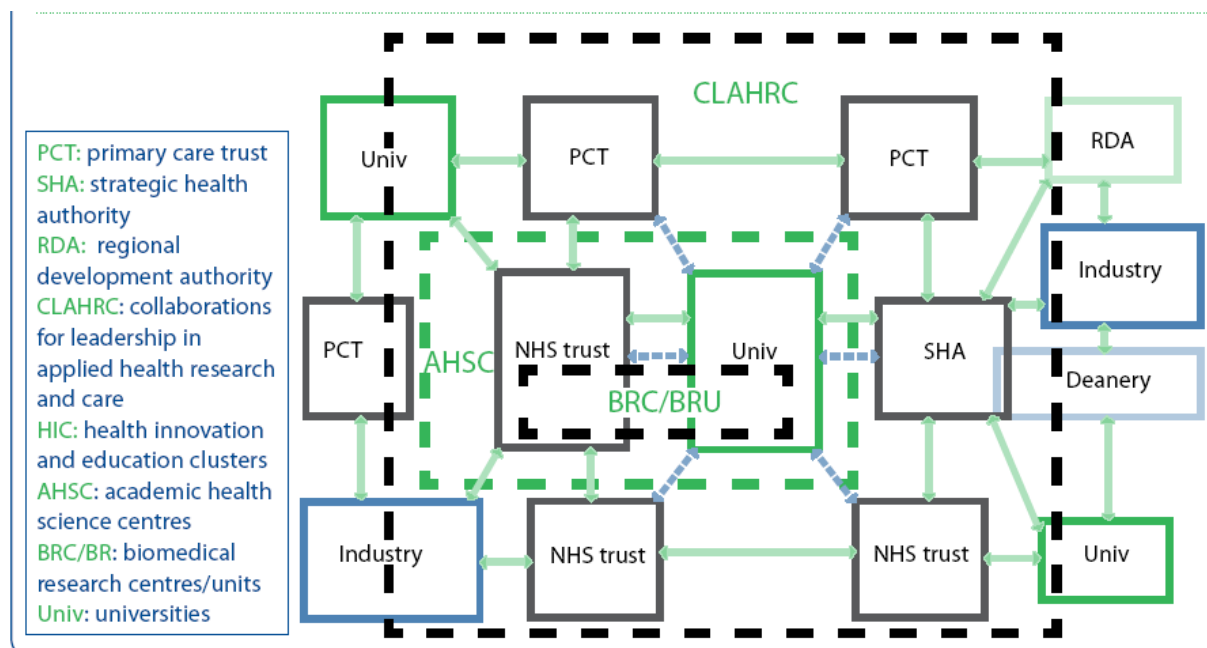


Figure 3.1: CLAHR in its wider context (HSRN, 2009)

Nine Collaborations of Leadership in Applied Health Research and Care were set up in 2008, with funding for five years from the National Institute for Health Research. The nine CLAHR's were:

- NIHR CLAHR for Birmingham and Black Country
- NIHR CLAHR for Cambridgeshire and Peterborough
- NIHR CLAHR for Greater Manchester
- NIHR CLAHR for Leeds, York and Bradford
- NIHR CLAHR for Leicestershire, Northamptonshire and Rutland
- **NIHR CLAHR for North West London**
- NIHR CLAHR for Nottinghamshire, Derbyshire and Lincolnshire
- NIHR CLAHR for South West Peninsula
- NIHR CLAHR for South Yorkshire

All nine shared a set of broad purposes and aims. However they adopted their own approaches according to the local context and research interests. In essence, the aim was to move research evidence into practice more efficiently, thereby facilitating improvements to patient care faster than would have otherwise been the case. My case study CLAHRC did this by facilitating interaction between patients, carers, healthcare staff and researchers and then evaluating how this alternative approach translates into actual benefits along with how far these benefits reach.

### **3.4.1 Case study suitability**

NW London CLAHRC defines itself as ‘an alliance of academic and healthcare organisations working to develop and promote a more efficient, accelerated and sustainable uptake of clinically innovative and cost-effective research interventions into patient care.’ This was to be achieved by the following four mechanisms:

- Patient public involvement i.e. actively incorporating and engaging patient opinion and perspectives into the design and development of care
- Move research into practice quicker i.e. employ rapid-cycle research, improvement methodologies and relevant evaluations
- Improve quality i.e. evidence based practice
- Create a seamless care pathway i.e. skill up staff to implement change across professional and organisational boundaries

### **3.4.2 Units of Analyses (UoAs)**

The units of analysis for this thesis outlined in the table below were chosen in order to enable us to capture a range of variables. I purposively selected cases so that common patterns and associations could be perceived and therefore enable the identification of common themes that are evident from across the sample. The cases that were selected varied in terms of medical indication i.e. stroke, programme (project and fellows), the organisational setting and professional groupings.



<b>Units of Analysis (No.)</b>	<b>Indication</b>	<b>Programme</b>	<b>Location</b>	<b>Boundaries crossed</b>
1	COPD	Project	Hospital & Community	Professional & Organisational
2	IMPE H	Project	Hospital	Professional
3	Anaes	Project	Hospital	Professional
4	Halc	Project	Hospital & Community	Professional & Organisational
5	Stroke	Project	Hospital	Professional
6	Alcohol	Project	Hospital & Community	Professional & Organisational
7	Various	Fellows Yr. 1	Various	Professional & Organisational
8	Various	Fellows Yr. 2	Various	Professional & Organisational
9	Jaundice	Project	Hospital & Community	Professional & Organisational
10	IMPE	Project	Hospital & Community	Professional & Organisational

Table 3.2: A table to outline the purposively selected Units of Analyses

### **3.5 Data Collection**

The main data collection techniques used in the research was semi structured interviews, field observation and participation and sociometric questionnaires.

#### **3.5.1 Interviews**

Interviews were conducted on a semi-structured basis, i.e. I used a combination of closed and open questions. In order for a level of consistency we had a set of pre-planned core questions for guidance that enabled the same areas to be covered broadly across all participants. Throughout the interview, the interviewee was able to elaborate if they felt necessary. Using semi-structured interviews enabled me (as

interviewer) to pursue specific areas alongside being able to react to interesting and enlightening information elucidated throughout the interview itself.

### ***3.5.2 Field observation and participation***

I became involved with the CLAHRC process to differing levels. In general, I conducted an observational methodology at, for example, CLAHRC events or project meetings. It was on occasion appropriate for the approach to include actual participation i.e. join in a workshop as a contributing member. This would depend on the content of the event being attended and on occasion dependent on the participant's requirements. For example, there may have been a wish to discuss something they wanted to garner a wider viewpoint on, for example, the changing context within the NHS.

Researchers taking an interpretive stance often seek to derive their data through direct interaction with the phenomenon being studied. It is an important aspect of the qualitative work within this study to search for meaning through direct interpretation of what was actually observed by the researcher alongside that which was experienced and reported by the subjects.

### ***3.5.3 Sociometric Questionnaire***

A sociometric questionnaire is a quantitative study of interpersonal relationships. As my research design has a longitudinal aspect to it I asked questions relating to appropriate time points depending on how far through the CLAHRC process they were. For example, if the participant had already completed the process I could ask them questions relating to before, during and after the process. However, if they were still within the process I could ask them questions relating to before and during (current) time points. I asked questions in order to 'measure' relational contact between members of each UoA and between them and CLAHRC, frequency, level of knowledge transfer (explicit knowledge), level of knowledge sharing (tacit knowledge) and the three types of knowledge use (conceptual, instrumental and symbolic) as described by Estabrook, 1999.

These were measured using a roster method, i.e. all members of a community were interviewed and given a list of everyone who was defined as being part of that community, and asked several questions about their network (Valente, 2010). For

each of the pre-listed actors in the roster, a set of questions on a relational level was asked. These included level of interaction, the split of that interaction between explicit (knowledge transfer) and tacit (knowledge sharing) knowledge exchange and use of explicit and tacit knowledge exchange (knowledge into practice). This was possible within this study as the units of analysis were a manageable size and it was possible to obtain a full list of actors. There was also an opportunity for individuals to be added to the roster, which enabled us to capture any additional members not initially identified. This approach was consistent with sociometric work on network interactions (Balkundi and Kilduff, 2006) and is deemed to provide reliable data which avoids mono-source bias (Friedkin, 1981). Furthermore, the data can generate measures at the individual level of analysis (e.g. the centrality of each individual) or at the network level of analysis (e.g. the extent to which the network is centralised around a few actors) (Valente, 2010). Within this study I focus on the network level of analysis.

For each relation the respondent was asked to assign a value to the level of exchange e.g. I interact with 'x' twice a week, which related to 'x' on a pre-defined Likert scale. Then for each interaction the respondent was asked to split that into level of explicit knowledge transfer and tacit knowledge sharing. Finally, each respondent was asked to categorise the use of the knowledge received across each relational tie as instrumental, conceptual or symbolic. The definition of each of these was given according to Estabrook's (1999) definition of applying research results specifically (Instrumental), Using the knowledge for general enlightenment (Conceptual) and to confirm an approach or position (Symbolic). It should be noted that there are other measures within the literature regarding research utilisation. There are, however, few measures that have been used more than once and as stated by Estabrooks and Wallin in 2004 the most common approach is to develop one's own measure. The 1999 Estabrook definition of research utilisation was chosen here because it initially verified the definitions empirically, the typology has been replicated and used a number of times and it enabled the concept of utilising knowledge in a manner that was not necessarily action related (Estabrooks and Wallin, 2004). To ensure clarity for each aspect of the questionnaire the respondents were given guiding descriptions of the various kinds of knowledge use relating to

each definition to clarify specifically what was being questioned. This was the case for the definition of knowledge transfer, knowledge sharing and knowledge use.

In addition, the respondents were asked to recall any other actors they felt were missing from the list and I was able to add them. This type of SNA data collection is termed primary data and is often used to empirically assess questions relating to networks. I chose this method because it is deemed as the most statistically robust when comparing different types of relationships between the same set of actors. It is easier to ask about more than one kind of relationship tie via this method, e.g. frequency, advice, friendship ties.

The use of a ranked scale to measure knowledge is often quoted within the literature, although differing approaches are often employed (Sudsawad, 2007, Amara et al, 2004). I used a Likert ranked scale via questionnaire addressing each of the knowledge measures in relation to each of the mechanisms identified. A Likert scale was chosen as it is a well-established and tested ranked methodology and it removes the middle option, deemed important in this type of study. Content validity was measured via peer review (Garland, 1991, Likert, 1932).

Alongside the interrogation of the actual relational network, I also undertook data collection with regard to perception of the networks investigated. . This type of data collection is termed cognitive social structure (CSS) (Krackhardt, 1990). This approach was utilised in order to account for any missing data. It essentially included asking each respondent their perception of the level of interaction between each of the other network members. For example, if the respondent was person A, I would ask them how often they thought person B and C interacted on a weekly basis.

It should be noted that within the literature this practice of asking a single sociometric question to measure a relationship is sometimes challenged due to the potential of mono-source bias. However, Marsden (2003) has suggested that these measures are reliable when participants are assisted in the understanding of the measures, with pre-testing the questionnaire and honing the questions to ensure specificity. As a result I pre-tested the questionnaire and made some alterations and also decided to conduct the sociometric questionnaire within the interview, therefore enabling a discussion if required to ensure understanding and clarity.

### **3.5.4 Ethical Considerations**

A central tenet of this study is qualitative research and quantitative research conducted through extensive interaction with the participants. As a result the researcher 'enters' the personal domain of the participants. There is a requirement, therefore, for various ethical issues to be considered. Miles and Huberman (1994), for example suggest that a researcher considers and addresses issues such as informed consent, honesty and trust, privacy, confidentiality and anonymity. Within this study I addressed each of these in the following way:

#### *Informed consent*

Participants were sent prior to meeting the details of the study being conducted including the purpose, nature, data collection methods, right to withdraw from the study at any time and contact details for supervisors. In addition to this at the beginning of every meeting informed consent including the details of the study were discussed and the participant was given time to ask any questions and highlight any concerns. Prior to starting the data collection the participant was asked to give their informed consent in writing.

#### *Honesty and trust*

The study was undertaken within and under the realms of ethical approval reference 09/H0718/35. Ethical guidelines outlined within the ethical approval i.e. informed consent, were adhered to, which is indicative of the trustworthiness of the data collection and analysis.

#### *Privacy, confidentiality and anonymity*

Each participant was assigned a code and data transcription was made anonymous. As part of the study I have ensured that confidentiality and anonymity of the participants have been maintained throughout by the removal of any identifying characteristics. It was made clear that participants' names would not be used for any other purposes and that information would not be shared that could reveal their identity.

### *Voluntary participation*

It was made clear that participants were agreeing to be a part of the study for academic purposes and that participants' involvement was voluntary.

## **3.6 Data Analysis**

Data collection was through secure electronic and paper documents, which were entered into Microsoft Word and Excel (Microsoft Inc., USA). The data included numerical scales, yes / no responses, transcribed qualitative response and open text as well as fieldwork observations. The analysis was principally carried out using UCInet (Borgatti et al, 2002) and thematic analysis of interviews and fieldwork reports.

### ***3.6.1 Coding and analysis***

Transcripts of each interview were kept anonymous and a code number assigned to each for identification purposes. Following transcription the process of analysis began with the categorisation and organisation of the data in order to establish patterns, critical themes and meanings that become evident within the data. The process used was that of 'open coding' (Strauss and Corbin, 1990). In essence I identified via an iterative process of reading, coding and categorising the conceptual categories that emerged. The iterative process enabled a more robust development of conceptual categories and enabled a more complete understanding through immersion within the data.

Data analysis was conducted in both an inductive and thematic manner, using the constant comparative method of Grounded Theory (Glaser and Strauss, 1967, Strauss and Corbin, 1990, Strauss, 1987). As data was collected and analysed I was able to continually compare it with other data already collected and its coding, and in so doing allowed the emerging theoretical categories to be honed and refined. This enabled the identification of emergent relationships across the process and how the emerging concepts unfolded over time. Each individual interview was analysed in isolation and then at the end of the data collection a cross-case analysis of the interviews was carried out.

During the analysis a framework approach was used for ordering and summarising the data (Ritchie et al, 2003). Within the analysis the key themes and related subtopics were summarised within a thematic framework. This framework was compiled as matrices, i.e. one matrix per theme. The columns represented a subtopic and the rows represented the interviewee. This enabled the amalgamation of relevant quotes per theme, the compaction of the data and providing a basis for a systematic and structured constant-comparative analysis.

### 3.6.2 Social Network Analysis

Following data collection in the manner outlined above a number of matrices were built in Excel from the completed SNA questionnaires.

There is, however, an important limitation with the whole network data that relates to response rate and missing data. For optimum social network analysis complete network data should be available. In other words, all measures assume that all relationships for all actors of the population are included. Whilst I did not have a 100% response rate we do have an average response rate of 71% - Please see table below for the response rate for each unit of analysis.

UoA	No in core group	No reponses	%
1	14	5	36
2	10	10	100
3	3	3	100
4	5	3	60
5	8	5	63
6	4	4	100
7	9	6	67
8	13	11	85
9	10	4	40
10	11	11	100
<b>Overall</b>	<b>87</b>	<b>62</b>	<b>71</b>

Table 3.3: Table to show the response rate for each Unit of Analyses

In constructing the matrices I was able to deal with the missing data from the non-respondents in the following ways. For each reported tie I considered it as relational.

In other words, it was possible to suggest that if A interacts x times with B in a week then B must interact x times with A. Clearly, it is not as simple as this but as a general perspective this approach holds. In order to give some validity to the resultant matrices utilised in the SNA analysis I took a few steps to provide further support to the data used.

Firstly, I looked at the reciprocity of just the reported ties. In order to do this I also dichotomised the reported data. The reason for this is the reported data was based on a scale of 0 to 7. In order to test the reliability of the reported data I dichotomised it at greater than or equal to 4 = 1 and below a 0. The cut point was an interaction once or twice a month or less vs at least weekly. Reported reciprocity was high for the directly reported data – a range from 80 to 100%. Due to the high level of responses within the majority of the UoA the majority of the matrices integers could be completed. I did not calculate reciprocity between the UoAs and the CLAHRC organisation as there was no way of checking its validity in this manner.

Finally, where two sides of a tie were not reported for the interaction matrices I was able to use the CSS data, i.e. the perception of the level of interaction of that tie from all the other respondents (Casciaro et al, 1999). In order to check that this was a valid approach I ran a correlation between each of the reported matrices and each respondent's perception of those network ties. In other words I ran a correlation between each of the matrices. The output indicated that the respondents were, in the main, accurate regarding their view of others' interaction levels within the network. The table below outlines each unit of analysis and the relevant Cronbach alpha measure. If I use, the commonly accepted rule of thumb, all of the alpha results were acceptable and above, but UoA 6 and 7 were in the questionable range. These were both units that were interviewed after their involvement with CLAHRC and therefore this result is probably linked to the length of time over which they had to recall. Recall, however, was not an issue for UoA 6 in terms of missing data as there was a 100% response rate.



UoA	Alpha
1	0.8
2	0.8
3	0.9
4	1.0
5	0.9
6	0.6
7	0.6
8	0.7
9	0.9
10	0.9

Table 3.4: Cronbach alpha measure reliability measures

I was also able to sanity check the use of the missing data through the fieldwork data. This data resulted from a combination of discussions with those who responded, information I obtained from other members of the CLAHRC organisation, interview responses to questions about the history of the group and finally aspects that I knew were mandated, e.g. I knew that at least once a month there was an interaction as attendance was mandatory.

Finally, in cases where I was not able to base the missing data sufficiently on any of the above, I ran the measures twice to note the impact of the matrix having missing data and if necessary taking a modal approach to the incorporated integer. This would minimise any potential bias to the measures from an included number.

Other problems with this type of methodology relate to the length of time required to administer the survey, and the complexity for an individual not used to the SNA method to complete it; therefore it is often conducted within an interview. This is time consuming and if asking about multiple relations can be cognitively taxing for the respondent. This method is therefore most suited to small population sizes as is the case within this study.

A final criticism of this approach centres on recall. This was essentially negated within this study because the respondents were given an option to add additional people to the team that represented the units of analysis. However, this was rarely taken up probably due to the UoA being well-bounded and defined by CLAHRC as

the core team project team. If a respondent did wish to add someone to the core team I would include them. However, generally after discussion about what the core team represented they withdrew the name. Another aspect of recall surrounds the different time points for which I was requesting data. Few studies collect longitudinal data at multiple time points (Van der Valk, 2007) and it is also difficult to ask about relationships in the distant past. Whilst clearly this is true and there may be an impact of recall on the reported data, this was negated for two reasons. Firstly, there were very specific time points for respondents to identify with, i.e. before they were involved with CLAHRC, during CLAHRC and after CLAHRC involvement. The distinctions between these three time points were significant and therefore more likely to be clear in a respondent's mind. Also, the recall was not in the very remote past and I found that even with the respondents who had completed their CLAHRC involvement, and therefore had the longest time over which to recall, they were clear on the differences to their responses.

The alternative to this type of primary data collection is secondary data collection, for example, events attendance lists. This would not have been appropriate in this case as it would not have captured the group's interaction away from mandated CLAHRC events or indeed offered a more granular level in terms of type of knowledge and level of knowledge use.

Within social network analysis there are a number of different levels a researcher can focus on. For example, a researcher can examine ways in which individuals are connected. This analysis is at an individual level. Alternatively, a researcher may focus on a more 'macro' perspective or as it is often termed a 'top down' perspective. This, according to Hanneman and Riddle (2005), effectively 'seeks to understand and describe whole populations by the texture of the relations'. The kind of structures that provide the texture of the population can be viewed on a dyadic level through to wider structural aspects such as hierarchy. As outlined above, due to the complexity inherent within the study I took an inductive approach where direct causal hypotheses were not deemed the best method for unpacking and analysing the results. Rather, I outlined a number of research questions and then analysed the results in an inductive manner by specifically investigating it in two ways – Network composition and Knowledge mobilisation (include knowledge transfer, knowledge sharing and knowledge use).

In order to characterise the UoAs network appropriately over time I specifically chose appropriate measures in order to look at both the network composition and knowledge transfer. For network composition I used network connection (density and reciprocity), horizontal differentiation (E-I index) and vertical differentiation (centrality and Krackhardt's graph theory). I also analysed the connection between the UoA and the CLAHRC organisation in terms of network connection (density) and differentiation (centrality).

For knowledge transfer I analysed explicit knowledge transfer (EKT), tacit knowledge sharing (TKS) and knowledge use (KU). The measures used for EKT and TKS were network connection (density and reciprocity), horizontal differentiation (E-I index) and vertical differentiation (centrality). The measures used for KU were density, horizontal differentiation (E-I index) and vertical differentiation (centrality). I also analysed the connection between the UoA and the CLAHRC organisation in terms of knowledge transfer (density). Each of these measures were carried out using the software package UCINET (Borgatti et al, 2002) and are described in more detail below.

### *Density*

Density enables a comparison of populations in terms of degree of connection that I was able to compare over time and between units of analysis (Borgatti et al, 2002). Essentially, measuring density provides an index of the level or the degree of dyadic connection in the networks. Density for binary data is the ratio of the number of ties that are present divided by the number of pairs, i.e. 'what proportion of all possible dyadic connections are actually present' (Borgatti et al, 2002).

In other words for binary data density is the ratio of the number of adjacencies that are present divided by the number of pairs i.e. what proportion of the possible dyadic connection are actually present. For valued data density is defined as 'the sum of the values of all ties divided by the number of possible ties' (Borgatti et al, 2002).

The relational data collected was valued data, i.e. the level over a week of interaction across each dyadic connection. In order to test the data I dichotomised the data so the matrix simply showed whether there was an interaction or not. This was done for each stage, i.e. before, during and after where appropriate. I created two matrices on

this basis at different cut points. This was in order to be able to look in more depth at the interaction that was created. My cut points were chosen at level one and level three respectively. These represented any kind of interaction, albeit rare and fortnightly or above. Therefore, at cut point 1 – a simple creation of interaction or not, at cut point 3 – interaction created above that which was mandated within the process. I also utilised the valued matrix for data analysis.

### *Reciprocity*

Reciprocity is a measure used with directed data and is used to provide an understanding of the extent to which the ties are reciprocated. I utilised the dyad method as I was concerned with the ratio of the number of pairs with a reciprocated tie relative to the number of pairs with any tie (Borgatti et al, 2002).

### *Homophily*

This measure can be viewed as the extent to which a group (predefined) chooses itself. The predefined partitions I used were based on a number of different attributes including job role, career stage and where based. If the measure is -1 then the group interacts with only itself and conversely at +1 completely outside the group, i.e. heterophily. For valued data, as in this case, it is the sum of the tie strengths external to the groups minus the number of ties that are internal to the group divided by the total number of ties (Borgatti et al, 2002, Krackhardt and Stern, 1988).

### *Hierarchy*

The measures above enable horizontal analysis of a network, i.e. how the actors are embedded in the structure. It does not include any unequal rankings. The hierarchical measure analyses the level of 'vertical differentiation' – the degree of hierarchy. Krackhardt (1994) developed a definition of hierarchy to include four conditions – connectedness, hierarchy, efficiency and least upper bound. For each condition Krackhardt developed index numbers that enabled an assessment of to what extent each of the four conditions deviate from a pure hierarchy i.e. an out tree graph. It also lends itself to the fact that structures can be 'more or less' hierarchical. For each measure the calculated range is from 0 to 1, with one being hierarchical in structure. A more recent paper by Everett and Krackhardt (2012) suggests multiplying the measures together to obtain an overall value for hierarchy.

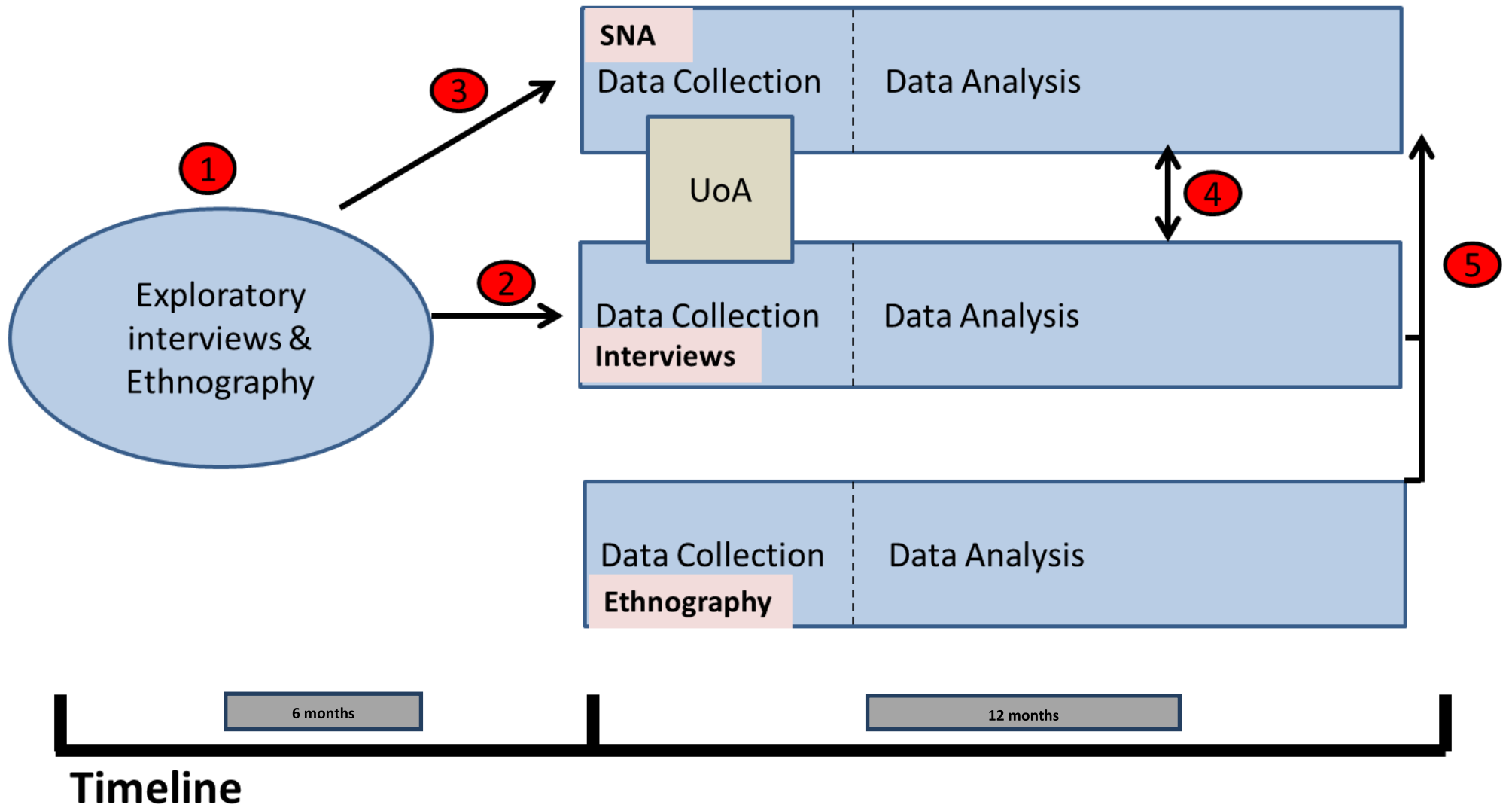
### *Centralisation*

This is another measure that can look at differentiation in the network in terms of hierarchy. In other words centrality is another measure that enables us to look at the texture of the network. I used Freeman's approach to degree centrality and specifically noted the overall centralisation of the graphs in line with my approach to analyse the network as a whole or on the macro level (Freeman, 1979).

### **3.7 Mixed Method Analysis**

During the course of the study the research methods outlined above were used in parallel. Both quantitative and qualitative methods were used with equivalent status within the research approach. (Tashakkori and Teddlie, 1998 and Zachariadis et al, 2013). The data collection and analysis from each approach provided feedback and context to each of the other approaches and therefore was mutually informing. In other words results were compared between methods, resulting in a set of outcomes that gave a greater, more nuanced understanding of the findings. Figure 3.2 below outlines the dynamic nature of the study with regard to the research methods. Key to figure 3.2 below.

- 1) Exploratory interviews and field observation and participation refine the research questions and decide on the appropriate methods to use
- 2) Initial results from the exploratory interviews and field observation and participation informed what to incorporate within the interviews
- 3) Initial results from the exploratory interviews and field observation and participation informed what to incorporate within the SNA questionnaire
- 2&3) Interviews and quantitative analysis provided insight into where and how to perform the study
- 4) The results from the data analysis were frequently compared
- 5) The fieldwork data informed and helped make sense of data gathered using other research methods



The main goal of my study was to understand the development of knowledge mobilisation networks and how they are sustained, with a particular focus on content, process and outcome. Initially, as outlined in the diagram above I conducted exploratory interviews and early fieldwork data collection (participation and observation) within the case study to immerse ourselves within the context – CLAHRC. I did this by participating and observing at CLAHRC organised events, project meetings, introductions, discussion groups etc. In addition, I conducted nine semi-structured interviews (Interview schedule in appendix 2) in order to gain an understanding of the various streams within CLAHRC, i.e. project vs fellows. Taking this approach at the start enabled me to:

- 1) Confirm I was using an appropriate case study for the research planned
- 2) Gain further, more comprehensive understanding of the case study in terms of approach, i.e. that there was a well-defined approach and process through which groups of individuals would pass and that there was a development of a network that was specifically aimed at mobilising knowledge.
- 3) As a result of understanding the case study further the research question was refined and appropriate methods chosen.
- 4) Conduct appropriate purposive sampling of the case study, i.e. it enabled me to choose appropriate units of analysis with which to conduct the study
- 5) Develop the interview schedules and sociometric questionnaire for the study

Following this I tested the interview schedule and sociometric questionnaire that had been constructed. The first part of this was through discussion with experienced peers. Having completed the schedules I then 'tested' them on the initial interviewees. This enabled a follow up with those already interviewed and also enabled me to test the approach to asking the SNA questions vs the interview questions, understand timing, order and consequently make alterations where appropriate. It should be noted that throughout I continued with the fieldwork data collection through participation and observation.

Finally, I conducted semi-structured interviews on all respondents from within the chosen units of analysis. Within the interview time slot I also conducted the sociometric questionnaire in a verbal fashion with the interviewer noting down the responses. This was found to be the most cognitively economical method of going

through approximately 20 minutes' worth of relational questioning. It also enabled explanation or discussion around any terms or concepts that were not initially understood. Alongside this I continued with the fieldwork data collection through participation and observation. The content of the various stages of the process was primarily investigated through the Social Network Analysis and some interview data, the process through the fieldwork data analysis and some interview data and the outcomes at each stage through the interview data analysis and some fieldwork data.

The different methods of data collection were undertaken simultaneously and across a period of 12 months (after the exploratory collection). As the data was collected longitudinally the data combined to provide a process 'map'. It essentially gave me an understanding of time and key concepts, allowing me to identify any change over time, and ultimately enabled a theoretical construct across the process to be proposed from the combination of the above data sources.

### **3.8 Trustworthiness of the Research**

In order to evaluate this study I will outline the trustworthiness of the research findings. It has been suggested by Denzin and Lincoln (1994) that 'the trustworthiness of qualitative research can be established by using four strategies: credibility, transferability, dependability and conformability'.

#### **3.8.1 Credibility**

The definition of credibility in qualitative research is the extent to which the data and data analysis are believable and trustworthy. It is analogous to internal validity from the quantitative approach, i.e. how findings match reality. From the qualitative perspective reality relates to the meaning that is given by individuals within social contexts. This leads us to the possibility of multiple realities (Denzin and Lincoln, 1994). I take the position from an interpretive perspective that understanding is co-created and that we cannot compare to an objective reality. As a result it is suggested by some that it is essential to increase credibility by including various strategies such as discussing the data, interpretations and conclusions with peers who also have an understanding of the context and appropriate experience.



Alongside this I utilised quantitative data that enables to some extent a reality with which to compare the results.

### ***3.8.2 Transferability***

In order for research findings to be generalisable they need to 'fit' into different contexts (Maxwell, 1992). It is analogous to external validity from the quantitative approach, i.e. the extent to which findings can be generalised. The subjectivity that is inherently involved in qualitative research creates a challenge here. It has been suggested that a qualitative researcher can improve the transferability of the results by detailing methods, contexts and assumptions that underlay it.

Within this study there is a single case study and therefore it is proposed that the process of generalisation utilised is that of 'inferential generalisation', i.e. generalising from the context of the research study itself to other settings or contexts (Lewis and Ritchie, 2003, Ritchie et al, 2003). As a result it is imperative that the methodological approach is documented and justified alongside the processes and procedures that led to the construction of the meanings developed from the study. Equally, it is important for the researcher to be aware of potential bias resulting from the possibility of multiple interpretations of reality. I include within this thesis a thorough description of the findings and interpretations that enable a judgement to be made with regard the transferability of the outcomes. The thesis has provided above a detailed description of the case study including the context, process and mechanisms utilised. This will enable other researchers to be able to make a judgement and/or effective comparison to other situations.

### ***3.8.3 Dependability***

Dependability relates to the consistency of observing the same finding under similar circumstances. Merriam (1998) indicates that it is the extent to which the findings can be replicated, all things being equal. This is a difficult area as behaviour and contexts are often dynamic, with differing influencing factors at any one point in time. Alongside this, as before, the potential for differing interpretations can lead to different outcomes. It is therefore suggested that reliability (internal validity) in a qualitative study should be via a number of different strategies including triangulation (multiple sources of data and/or techniques), member checks, observation over time,

peer discussion, participatory methods and outlining methods for data collection and analysis.

#### **3.8.4 Confirmability of the findings**

Confirmability is the extent to which a study's findings can be corroborated by others. It is generally considered appropriate to deal with this in terms of awareness of the involvement of subjectivity and alongside this taking a critical approach to the methodological approach and the research process.

### **3.9 Conclusion**

I have outlined within this chapter the philosophical stance of the study, the methodologies chosen and the methods utilised. My overriding aim is to explore how a knowledge mobilisation network develops from its inception through to it sustaining. As described above I utilise mixed methods and draw the results together in the following chapter. In order to be able to present a clear process model I outline the results by first presenting the overall framework developed and then unpacking each aspect of it. I draw on each relevant aspect of the data analysis from across the methods.

# CHAPTER 4 – FINDINGS

## 4.1 Introduction

In the previous chapters I have outlined the gap in the literature to which the research questions of this study relate and the method by which the study was undertaken. Within chapters 4 to 8 I delineate the findings from the study. Within chapter 4 I briefly present an overview of the findings in relation to the research question and conclude with a guide to the structure of the findings chapters in order to aid clarity when reading the results in detail. It should be noted that the data presented relate to the group's network and development of knowledge transfer or otherwise. Whilst all the UoAs conducted different projects as outlined below the process relates purely to the development of the network and not the project activity itself. As such when impact is referenced it relates only to the reported perception on the network impact and not the impact of the projects itself.

Initially, I outline the overall findings from this study a conceptual framework that delineates the evolution of the knowledge transfer networks (KTN) situated at the various boundaries inherent within my various Units of Analyses (UoAs). Ultimately, as a result of this study I term these networks; knowledge transfer boundary networks (KTBN). Figure 4.1 below outlines the overall structure of the resulting framework.

In order to clearly outline the proposed process framework and the data behind it I will firstly discuss the framework as a whole and then in each chapter take each part of the framework separately and discuss the relevant findings in more detail. I specifically outline the framework constructs, process themes and the overriding core categories resulting from the data analysis that address each sub-question – inception, evolution and sustainability.

# OVERVIEW OF FINDINGS – CONCEPTUAL FRAMEWORK OF THE EVOLUTION OF A KNOWLEDGE TRANSFER BOUNDARY NETWORK (KTBN)

## FRAMEWORK CONSTRUCTS

START-UP

DEVELOPMENT

ACTIVITY

SELF-ORGANSING

REITERATION

## PROCESS THEMES

Mandated Learning

Interaction and Activity

External Boundary Spanning

Organic Animation

Perpetuating cycle

## CORE CATEGORIES

INCEPTION

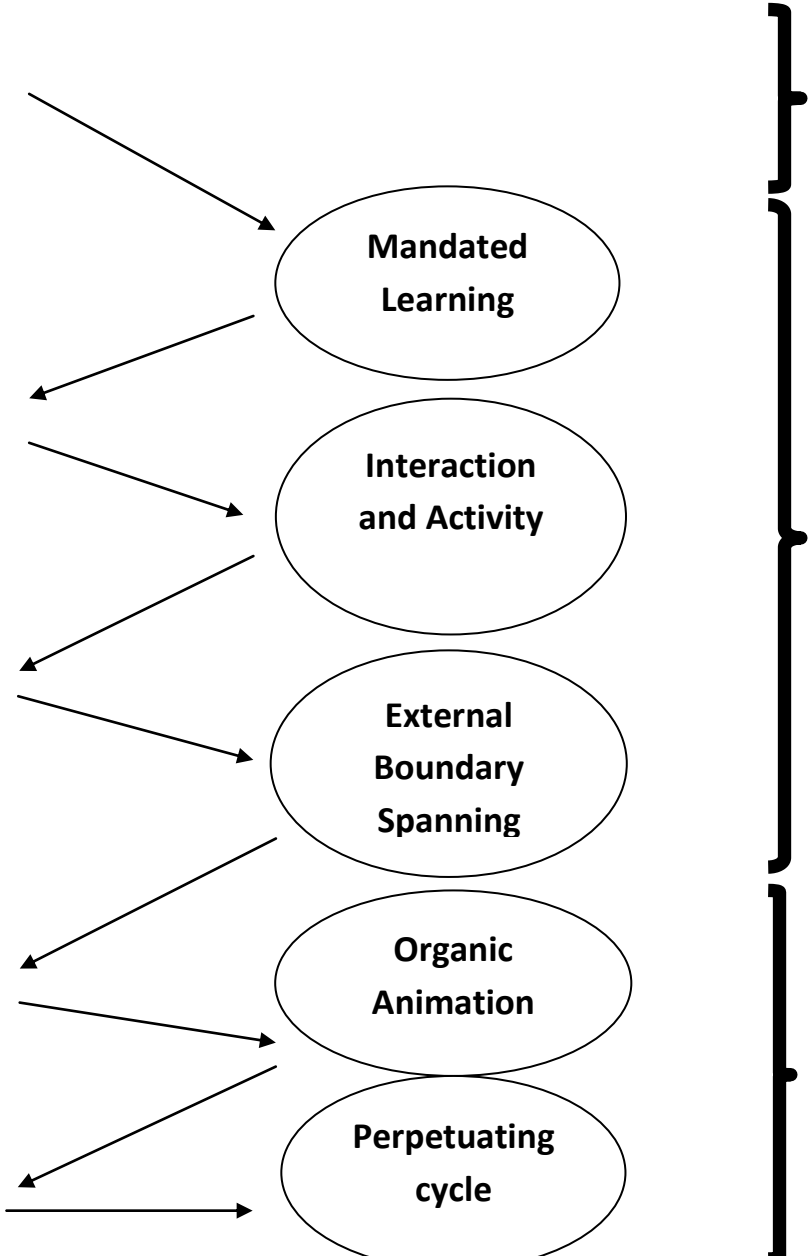
Chapter 6

EVOLUTION

Chapter 7

SUSTAINABILITY

Chapter 8



## **4.2 Conceptual framework - Overview**

The framework was developed *ex post* from the fieldwork observational work, interview and social network data collected. I established an initial process framework and then undertook a number of iterations by revisiting the data, the literature and discussion with experienced academic peers. The framework is intended to provide an empirical process model of change over time illustrating the developmental process and the outcomes at each stage. In short, it outlines the evolution of a sustainable cross-boundaries knowledge transfer network.

### ***4.2.1 Brief overview of the framework for the evolution of a Knowledge Transfer Boundary Network (KTBN)***

I propose that the CLAHRC process creates a knowledge transfer network (KTN) that includes the crossing of both professional and organisational healthcare boundaries in order to address the second translational gap. Essentially, a knowledge transfer boundary network (KTBN). The first stage is characterised when the various representatives of a care pathway or other area of healthcare come together to form a group of ‘convened representatives’. This is at the point of ‘start-up’. They are focused on CLAHRC and essentially start the process. Aspects that characterise this point of ‘start-up’ include lack of interaction, engagement, a hierarchy in place through to being involved with the process. As the process starts the group moves forward via a mandated set of learning objectives set by CLAHRC.

This results in the group (networks) reaching a stage of ‘development’. The group becomes more interactive, the hierarchy of the group starts to weaken and the members share various aspects such as knowledge, accountability and purpose. The network then moves forward via another set of mandated objectives from CLAHRC – interaction and activity. The focus is on group members interacting and creating the change (project) itself.

As a result of this the group becomes focused on ‘activity’. They are interacting more, hierarchy has weakened or disappeared from the network and professional and organisational boundaries are crossed. This is the point at which it is imperative a network transcends in order for it to become sustainable.

The CLAHRC organisation hoped to facilitate this through the requirement for the project learning to be spread throughout the network's respective teams. Also, within the project team CLAHRC positioned a member of the CLAHRC organisation alongside a tight timeline against which the intended outcome needed to be delivered. These combined to keep the momentum of the network moving forward towards 'self-organising', the next stage.

In order for the network to re-iterate it needed to 'loop' around the cycle again by recreating its hierarchy and identifying the next activity that needed to be achieved. This is followed by moving through the process again i.e. reduction in hierarchy, focus inward. In doing so it results in a perpetual cycle of contraction and retraction and thereby the networks process and relationships reach sustainability.

In summary, the network starts unconnected or loosely connected and with hierarchy, it closes inward to a tight knit group with no hierarchy and then relaxes outward again to a looser connected group with the ability to re-enact hierarchy and activity when necessary. In the process it crosses boundaries (professional, organisational), transfers and shares knowledge, spreads knowledge and uses the knowledge.

This framework addresses the overall research question: ***'How do knowledge boundary networks develop over time and how do they become self-sustaining?'***

It does that by addressing each of the sub-questions:

***RQ1. What were the developmental processes underlying network inception?***

***RQ2. How do knowledge boundary networks evolve from inception to sustainability?***

***RQ3. What factors are needed to create sustainability?***

### **4.3 Structure of the findings chapters**

Due to the volume and complexity of the findings it is necessary to outline how they are structured in order to assist their clarity. There are four chapters to the findings. These are centred on: contextual analysis of the CLAHRC process, inception, evolution and sustainability.

Chapter 5 summarises the approach taken within the North West London CLAHRC. This comprises the processes that were put in place with regard to the CLAHRC implementation, including the requirements, tools utilised and programmes.

Following this I move on to the overall conceptual framework of the process that has been developed as a result of the analysis of the data. The chapters are divided into each core category inception, evolution and sustainability.

At the start of each chapter I include a diagram to indicate which part of the framework above it relates to. Then, within each of these chapters the results are organised under the framework constructs and process themes. For example, the framework starts at 'start-up'. Firstly I discuss the findings for this stage of the process and then move on to the next part of the process, a process theme of mandated activity. Within each chapter the

As outlined in chapter 3 (methodology) this is a mixed method study and therefore the findings draw upon both quantitative and qualitative aspects of the research. I have included the quantitative findings at the appropriate point in the results section and also referenced the relevant table and section within the appendix. Within this chapter I outline the results with limited reference to the literature. I discuss the results with reference to extant literature and the contribution it makes in chapter 9. Figure 4.2 below outlines the structure of the chapter contents.

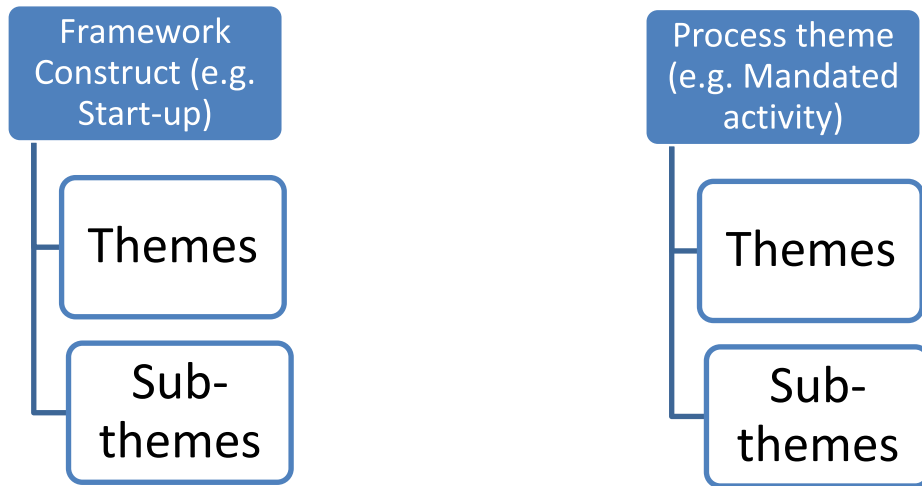


Figure 4.2: Structure of the findings chapters

A final guiding point for the findings chapters relates to the quantitative data from each of the UoAs. Quantitative data were not available from all UoAs for all stages. Findings from each UoA relates to a specific part of the framework as highlighted in the table below. Hence UoA 9 (Jaundice) provides data informing the ‘self-organising’ outcome. Due to the nature of the interviews and fieldwork data collection, UoAs data could relate to different points in the process depending on the timing and/or context.

Stage	UoA	UoA
Development	COPD	1
Development	IMPE H	2
Activity	Anaes	3
Activity	H alc	4
Activity	Stroke	5
Activity	Alcohol	6
Activity	F1	7
Activity	F2	8
Self-organising	Jaundice	9
Reiteration	IMPE	10

Table 4.1: A table to show the UoAs and the stage to which the quantitative data relates



## CHAPTER 5: CONTEXTUAL DETAILS

The overriding aim of CLAHRC is to close the second translational gap i.e. support evidence based medicine into clinical practice. It aims to do this by bringing together individuals to address a relevant second translational gap within the specific care pathway for which they are involved or responsible. CLAHRC then takes them through a process of learning and practice to deliver a beneficial change to their care pathway. In doing so the aim is to create a sustainable change with regard collaboration whereby translation and improvement can continue. Alongside this actual change within the care pathway the aim is also to provide learning and culture change to those involved, so they are able to continue applying the lessons in their practice.

The mainstay of North West London CLAHRC's approach is centred on two programmes: *projects* and *fellows*. The CLAHRC offered the opportunity for healthcare professionals to bid for a project or for a place on the fellows programme. The predominate criteria for a project or fellows application was to conduct a piece of translational research, i.e. to alter a process in line with a piece of research knowledge that would offer benefits if implemented. In the sections below I outline the two programmes and include a table of the study participants that represented each aspect. This includes job role and project focus.

### 5.1 Project programme

#### 5.1.1 Funding

Funding was provided for the project. The amount varied but there was a maximum of £100,000 across the eighteen months for the projects. Whatever the amount agreed for the project it had to be matched by the home organisation(s).

#### 5.1.2 Background

A project usually consisted of 8-12 individuals - a GP, nurse, physiotherapist, community nurse and patient representative depending on what was appropriate. They would also require an executive sponsor, from the local host NHS organisation. Once accepted by CLAHRC they would go through a process lasting 18 months. This would start with a 3 day residential course and continue with facilitated

interaction, improvement methodologies, networking events and project specific activity.

Whilst part of the CLAHRC process there were specific tasks, learning and actions required. These are outlined below.

### ***Stakeholder engagement***

NW London CLAHRC made it clear to the project teams that stakeholder engagement was very important if the project was to be a success. As such they needed to identify and involve key stakeholders outside the core team. They defined stakeholders as 'individuals, groups, departments and organisations that can influence success and keep you attuned to new developments that may affect your project for better or worse' (CLAHRC guide, 2010). The teams were led through various questions to enable them to identify the stakeholders. These questions included, for example, 'who will be affected by any decisions on the issue?', 'who can obstruct a decision if not involved?' and 'who has been involved in this issue in the past?' (CLAHRC guide, 2010).

### ***Public Patient Involvement (PPI)***

Involving patients was a key tenet of the NW London CLAHRC approach. It was suggested that, by involving patients, information could be gained regarding the care they receive and their experience of it, the concept being to move to patient-centred interventions, thereby improving satisfaction. The teams involved within CLAHRC were strongly encouraged to consider PPI and were given a substantial amount of help in this area. This involved assisting with patient recruitment to ensure the right patient profile is targeted i.e. the type of person who is or will be using the service. Again, a set of key questions was considered, including 'what is the purpose of involving patients?', 'who will be representative?', 'how will you recruit people?' and 'how do you plan to involve them?' (CLAHRC guide, 2010).

### ***Model for Improvement***

The taught model of improvement within CLAHRC is the framework for developing, testing and implementing changes (see figure 5.1 below). It outlines three key questions:

- 1) What are you trying to accomplish?
- 2) How will we know that change is an improvement?
- 3) What change can we make that will result in improvement?

These three questions are underpinned by an iterative cycle, commonly known as 'PDSA (Plan-Do-Study-Act) cycle' (CLAHRC guide, 2010). The diagram below delineates the model for improvement.

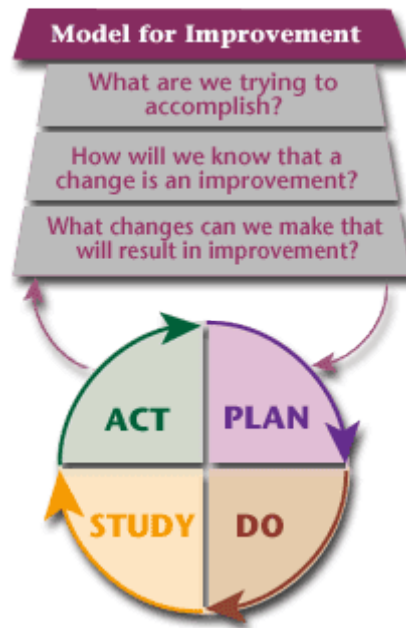


Figure 5.1: Model for improvement (<http://www.apiweb.org/services.htm>)

*Question 1 – What are you trying accomplish?*

A project team applying for CLAHRC funding would have this question answered in broad terms. For example, they might know they wanted to make a change to discharge summaries in X department of care. Goals would be quite broad at this stage.

*Question 2 – How will we know that change is an improvement?*

This is done through two predominant types of measures - Improvement and outcome measures. Improvement measures were weekly measures that enabled the team and CLAHRC to monitor progress. For example, if an audit of a newly implemented discharge summary sheet demonstrated that 8 out of 10 were incorrectly completed then it would be evident that the team needed to take steps to

address this. Across time this would be used to track progress of the project team, hopefully leading to an audit showing 10 out of 10 filled out correctly.

Outcome measures were focused on demonstrating the benefit to the patient and health system itself. For example, it might aim to show improvement to the quality of the patient experience or, a reduction in episode cost due to reduced hospital stay.

### ***Sustainability***

A final key focus of the CLAHRC was of project sustainability. In other words the project needed to sustain the improvement after the formal funding period had finished. Any changes to care processes needed to be embedded. CLAHRC required the project teams score their project on a number of different factors of sustainability.

The scores across the team were aggregated and then they were able to make alterations with a view to improving the likelihood of sustainability of the project.

### ***Question 3 – What change can we make that will result in improvement?***

In order for this generalised aim to become more crystallised the team were taught to conduct the following.

### ***Process mapping***

This was the equivalent of creating a baseline. It involved mapping how the process care pathway or process works currently. The concept was that if the baseline process is mapped in conjunction with any other relevant processes, it enables an exchange of perspectives, therefore enabling a more accurate view of the overall challenge. Process mapping was centred on the area of service improvement a project was focused on. Essentially, it mapped out the patient journey from beginning to end to identify areas for improvement and where to target interventions.

### ***Action Effect Diagram***

An Action Effect Diagram enabled a breakdown of improvement aims into contributing factors that in turn could provide focus for the various improvement efforts. In other words it enabled the articulation of the cause and effect relationships that exist. This was another method through which the teams were able to consider

at a more granular level and understand the various aspects that they needed to take into account when deciding on what needed to be altered and the impact of it once done.

### ***PDSA***

This underpinned the three questions worked through in the model, described above. It essentially enabled the team to test their intervention in context and then modify and adapt as necessary. The key idea was that an intervention could be rapidly trialled on a small scale. They were termed a 'rapid learning cycle' (CLAHRC guide, 2010).

### ***CLAHRC reporting tool***

The CLAHRC reporting tool was a web interface tool that enabled a team to collect, share and analyse data. It is within this tool that the regular PDSA cycles, which the team conducted, were entered along with the sustainability scores and other collected improvement and outcome measures. It also enabled the teams to minute actions and meetings in the one repository.

### ***Interaction***

The project teams were required to meet with CLAHRC managers monthly. At each of these meetings there was discussion around the current state of the project progress and any issues that had arisen were identified and discussed, with various targets and actions for the following month established. A member of the CLAHRC organisation – the project lead – attended these meetings and therefore there was a level of reporting back on all progress that occurred. Alongside the monthly meetings the project team was required to attend the quarterly Collaborative Learning Development (CLD) days. All CLAHRC members were supposed to attend and other healthcare representatives were also invited. A CLD day consisted of plenary sessions on varying topical subjects and break-out sessions around specific themes. Part of the day was set aside for project time, where the project teams convened to discuss parts of the project, its progress and issues.

The study participants and projects that were from the projects stream are outlined in the table below.

<b>ID</b>	<b>Project Description</b>	<b>Project members</b>
<b>COPD</b>	<b>Improving communication for patients with COPD using a Chronic Disease Management System</b>	
	<b>1</b>	Consultant and lead clinician
	<b>2</b>	Project lead
	<b>3</b>	Lead physiotherapist
	<b>4</b>	Clinical nurse specialist
	<b>5</b>	Respiratory physiotherapist
<b>IMPE H</b>	<b>Improving medicine prescribing and information project</b>	
	<b>1</b>	Project lead and consultant physician
	<b>2</b>	Deputy Director of Patient Experience and Nursing
	<b>3</b>	Clinical lead
	<b>4</b>	Deputy Director of Patient Experience and Nursing
	<b>5</b>	Assistant Director of QIPP
	<b>6</b>	Chief Pharmacist
	<b>7</b>	Senior Registrar
	<b>8</b>	Community Public Patient representative
<b>Anaes</b>	<b>Improving Anaesthetic care through developing quality indicators</b>	
	<b>1</b>	Project lead and Principal Researcher
	<b>2</b>	Researcher

	<b>3</b>	Lead clinician
<b>Halc</b>	<b>Collaborative Alcohol Strategy development between hospital and community</b>	
	<b>1</b>	Alcohol specialist practitioner
	<b>2</b>	Manager - clinical community practitioner
	<b>3</b>	Consultant Psychiatrist
<b>Stroke</b>	<b>Reducing stroke recurrence through addressing risk factors in routine care via implementation of an educational programme</b>	
	<b>1</b>	Project manager and Registrar
	<b>2</b>	Senior physiotherapist
	<b>3</b>	Senior occupational therapist
	<b>4</b>	Dietician
	<b>5</b>	Psychologist
<b>Alcohol</b>	<b>Alcohol screening project in both the community and hospital</b>	
	<b>1</b>	Public health and project manager
	<b>2</b>	Director of Public Health
	<b>3</b>	Registrar
	<b>4</b>	Community GP and clinical lead
<b>Jaundice</b>	<b>Implementation of technology in order to enable detection and monitoring of jaundice in newborns</b>	
	<b>1</b>	Midwife and Project manager
	<b>2</b>	Matron Antenatal clinic midwife

	<b>3</b>	Infant feed coordinator midwife
	<b>4</b>	Maternity matron
<b>IMPE</b>	<b>Improving medicine prescribing and information project</b>	
	<b>1</b>	Pharmacist
	<b>2</b>	Consultant Geriatrician
	<b>3</b>	Chief of Service Pharmacist
	<b>4</b>	Pharmacist
	<b>5</b>	Pharmacist
	<b>6</b>	Pharmacist
	<b>7</b>	Falls prevention specialist
	<b>8</b>	Specialist registrar
	<b>9</b>	Public Patient representative
	<b>10</b>	Public Patient representative
	<b>11</b>	Public Patient representative

Table 5.1: Study participants and projects studied

## 5.2 Fellows programme

The aim of the fellowship was ‘to develop a range of future leaders in innovation and improvement with the authority and ability to advance change in their organisations and beyond, thus building capacity and supporting spread and sustainability in line with CLAHRC objectives’ (CLAHRC guide, 2010).

It involved a nine-month programme, with the following objectives:

- Develop skills and expertise in leadership, research and improvement methodology
- Apply this learning in a project undertaken by the fellow
- Develop networks



- Spread the knowledge of service improvement

The group of fellows at the point of this study were 9 (round 1) and 13 (round 2) in total. Each fellow was from a distinct area of care, location and at different points in their healthcare careers. As part of the fellowship they conducted a project. The project was used as a vehicle to learn the improvement methodology and to develop leadership skills. The improvement methodology the fellows learnt was essentially the same as the projects outlined above. Again, the project was intended to be around a certain initiative to change a process that brought evidence into practice.

There were a couple of distinct aspects from the project programme outlined above. Firstly, the fellows' programme was considerably shorter than the duration of a project and therefore the project a fellow undertook had to be on a smaller scale. Also, in respect of funding, a fellow's organisation was given £6000, which had to be matched by their home organisation. This funding was to provide backfill or whatever else was necessary to enable the fellow to take part in the fellowship. The fellows' group were required to meet monthly and attend the quarterly CLD events. They did not use the web based reporting tool as their projects were unique to themselves i.e. they were all working on different areas and the fellow was the sole representative of their respective area.

The study participants and projects that were from the fellows' stream are outlined in the table below.

<b>ID</b>		<b>Job Role</b>	<b>Project Description</b>
<b>F1</b>	<b>1</b>	Consultant Pharmacist	Development of a breast cancer in menopause support service
	<b>2</b>	Service manager	Identification of barriers to following HIV testing guidelines
	<b>3</b>	Dietician	Introduction of a weight management programme
	<b>4</b>	Nurse	Development of a nurse led response to patient alerts
	<b>5</b>	Nurse	Development of patient referrals between primary and secondary care

	<b>6</b>	Dietician	Improve the identification and management of patients
	<b>7</b>	Nurse	Evaluation of district nursing case management
	<b>8</b>	Vulnerable adults nurse	Introduction of an electronic way of sharing information
	<b>9</b>	Psychiatrist	Investigating potential of cross-boundary clinic
<b>F2</b>	<b>1</b>	Clinical transformation manager	Investigate reasons behind improved consenting practice
	<b>2</b>	Consultant	Prepare the organisation to produce quality accounts
	<b>3</b>	Senior manager	improve efficacy in support services to rape victims with mental health needs
	<b>4</b>	Industrial pharmacist	Improve communication between healthcare professionals
	<b>5</b>	Senior physiotherapist	Implementation of a clinical assessment scale
	<b>6</b>	GP relationship manager	Improvement of patient waiting times
	<b>7</b>	Research manager	Develop an e-learning module
	<b>8</b>	Public health specialist	Introduction of a health screening programme
	<b>9</b>	Service delivery manager	Implementation of a customer service courtesy plan for staff
	<b>10</b>	Associate director of public health	Designed a public service questionnaire

Table 5.2: Study participants and respective project areas of the fellow groups studied

### 5.3 Conclusion

The project team or fellow enters the CLAHRC process, goes through a developmental process that includes various mechanisms to translate a piece of research into practice. The process the project team and fellows undergo can be characterised as the development of a knowledge transfer boundary network (KTBN)

that constitutes a number of professional and organisational boundaries. From the analysis of the data within the following chapters I outline the details of a conceptual framework that delineates the evolution of the KTBN.

## CHAPTER 6: INCEPTION

Above I have outlined the approach and process that the case study CLAHRC conducts. Within the chapters 6, 7 and 8 I am going to unpack each of the core categories Inception, Evolution and Sustainability focusing on the process through which the network progresses and highlighting the framework constructs at the appropriate point in time in order to distinguish the different stages observed.

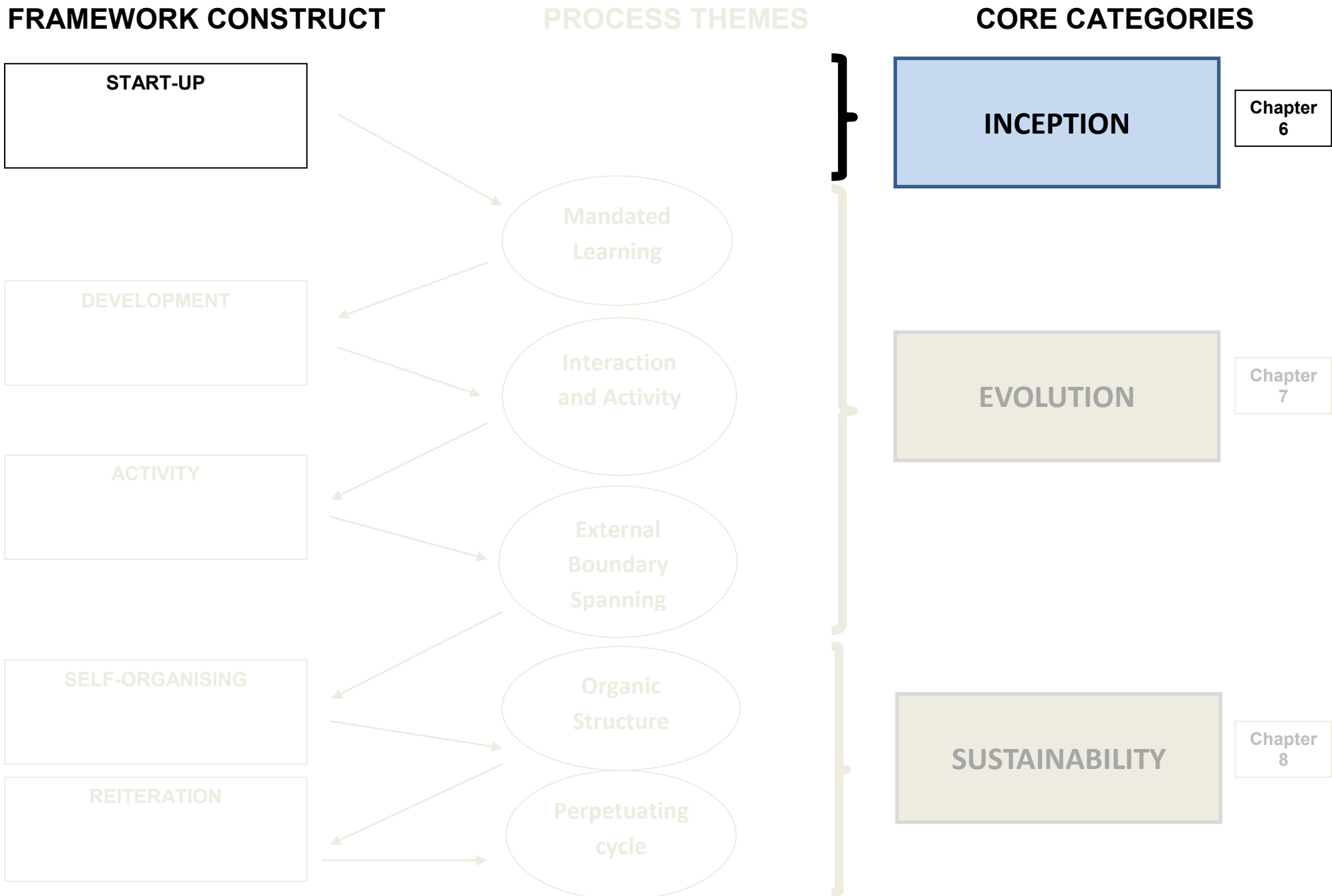
Within this section I am going to introduce and discuss the core category of Inception. In this category I am going to outline the ‘start-up’ of the network and the various aspects that were found at this point in the process. Following this, at the start of the next chapter, the first stage under the core category of evolution, I am going to discuss how the ‘start-up’ network moves to the point of ‘development’. This will be done by exploring the process that moves the network to a different state to that of ‘start-up’.

The table below highlights the core category (Inception) and framework construct (‘start-up’) alongside the themes and sub-themes discussed within this section. The discussion of the findings below are organised with reference to each.

1. INCEPTION				
Framework construct	Theme		Sub-theme	
Start-up	1.1	Network Creation	1.1.1	Stakeholder engagement
			1.1.2	Start-up funding and motivation
	1.2	Convened Representatives	1.2.1	Limited interaction within network
			1.2.2	Hierarchy amongst participants
	1.3	Boundaries defined	1.3.1	Within UoAs
			1.3.2	UoAs to CLAHRC organisation
			1.3.3	Boundary defined knowledge
	1.4	Driving force	1.4.1	Facilitation

Table 6.1: A table to show the framework construct, themes and sub-themes for ‘Start-up’

**Fig 6.1: CONCEPTUAL FRAMEWORK OF THE EVOLUTION OF A KNOWLEDGE TRANSFER BOUNDARY NETWORK (KTBN)**



## 6.1 Start-up

The creation of the Knowledge Transfer Network (KTBN) starts at the point at which an application has been accepted and approved by CLAHRC. The application typically outlines the project proposal, i.e. the change that will be enacted as part of the project and a number of other aspects such as stakeholders that are engaged with the project, the potential for sustainability, the need and suitability.

### 1.1 Network creation

#### 1.1.1 Stakeholder engagement

A key aspect of the application to CLAHRC for a knowledge translation project is that of stakeholder engagement. This includes the organisational stakeholders from which the application originates and those who will represent the various aspects of the care pathway, i.e. the individuals who will come together to enact the project.

In order to gain organisational and departmental engagement CLAHRC funds the project via 'matched funding' with the applying organisation. This can be 'in kind', for example the ability for someone to spend time on CLAHRC during their working hours rather than on their 'day job' (10102).

This approach of matched funding, however, did in some cases create a tension due to the lack of understanding of money 'in kind'. Even once clarified it was noted that CLAHRC remained distinct from the trust as highlighted by the quote below:

*'..there was a terrible freestyle of signing for funding, because people thought they were actually signing away money that they'd have to give to CLAHRC. And that's caused..a lot of tension....It's [matched funding] meant to be a valuation of time that staff may theoretically spend on something to do with the project'. (10115)*

There was evidence that the stage within an individual's career had an impact on degree of engagement with the concept of improvement methodology and potentially therefore the project itself. It was clear, for example, that those earlier in their career pathway appeared more open to the concept and new approaches to research than those later on in their career path as the quotes below highlight.

*'That (CLAHRC process) could certainly have worked with a couple of registrars.....they've usually been very open to look at what's happening and how to*

*do things and often are the first to say, can we do it differently, which has been really interesting'. (10159)*

*'so there was a professor who was at one of the CLAHRC meetings, and he came out of that meeting, he was saying, 'it's absolute rubbish, it's absolute hogwash'. And he was sort of transmitting that to the rest of the consultants'. (10103)*

This scepticism appeared to be largely a feature within the host National Health Service (NHS) Trust of the CLAHRC organisation itself and that locations further afield were more open to the CLAHRC organisation, its concepts and approach. As well as concerns over the credibility of the CLAHRC core management team in the eyes of the healthcare professionals, there was also evidence to suggest the scepticism stemmed from a particular set of views of CLAHRC as 'empire building' and 'male competitiveness', with concerns expressed that CLAHRC was failing to engage with other healthcare improvement initiatives because of this. There were also concerns that successful projects would be attributed to the leadership of CLAHRC and not to them as professionals:

*'I think they feel that they've got a buy-in at sort of chief executive level...Basically, at the centre is a pot of money sitting up here on the fourth floor, but the consultants aren't really bothered about it; it's [X's] empire..' (10103)*

*'I think there's a part of that which is about credibility, medical credibility so he's a professor, but they don't think that his professorship is worthy enough, they don't think that his research is credible enough. If it had been somebody that had an established reputation, from here, who'd taken a sidestep, it might have got a bit more attention'. (10103)*

*'....any successes will be his successes; it's not necessarily the consultants' (10103)*

*'And so I was saying to XXX, you're both doing exactly the same things, why don't you try and collaborate? He was not interested at all; it's his little empire'. (10103)*

This scepticism which largely emanated from a senior level was picked up by junior staff and there was a feeling of frustration as they realised that whilst they themselves had bought in to the CLAHRC concept and approach it was not something they could fully take forward until they were more senior themselves. It therefore appeared clear that there was a need for targeting the right level in order to ensure improved engagement to the process.

*'You're facing people who are 50-years old and they just are focused in their own approaches, they don't actually see the benefits of new ways of working. But, interesting, I think the junior doctors are much more open to it. And so getting junior*

*doctors involved is a slow process, but in ten years' time, will be in a much more influential position'. (10103)*

*'But medical doctors perhaps, a bit more junior, have something to learn, it would be really good for them. So I think in the future perhaps it could be rolled out to people like that, like acute medical junior doctors who had something where it could really make an impact'. (10113).545*

### **1.1.2 Start-up funding and motivation**

It was clear from my data that it was the offer of funding and potential kudos attached to this that initially attracted individuals to apply to be a part of CLAHRC, as one interviewee put it:

*'it was a source of money. That was the primary motivation. The secondary motivation being that, kudos; status and kudos'. (10094)*

Within the project UoAs the funding was primarily utilised for a project manager and/or some dedicated clinical staff. This was deemed particularly useful by participants because it allowed dedicated project time, which helped with focus and drive.

In all the project UoAs, funding was regarded as necessary for a project to be enacted:

*'Absolutely, we couldn't do it without them [CLAHRC funding]'. (10080)*

*'I think many of the fellows saw the fellowship as a way of bringing in funding for a project that they wanted to do'. (CCGP4)*

*'No. I think it wouldn't. It's purely because of funding, funding purposes, because we've been trying for years to even get someone into A & E...and then, we secured the CLAHRC funding and then we put XXX in there'. (10098)*

*I think the reason why it's happened now is because funding has enabled us to really focus on it...and we've got someone...having the project manager there and working closely with the doctors just gives focus to it'. (10141)*

Because the funding was viewed as *research* funding, it was seen as beneficial to medical professional's CVs. There was a perception of kudos around being part of CLAHRC and having attracted funding from it. This helped to enable engagement with the process initially. For example a senior member of a project team commented:



*'you are judged by your ability to bring in grant money from different sources....very good kudos to have a couple of CLAHRC projects'. (10094)*

## **1.2 Convened Representatives**

Once acceptance and engagement with the CLAHRC process has occurred, as outlined above, the group of individuals begin to come together and form the project team or a part of the fellows group. I collectively term them the 'convened representatives'.

Each representative tended to represent a professional grouping within a specific care pathway or area of healthcare.

At this point the group is diverse. Each of the participants has distinct specialist knowledge and a deep understanding of their context, as the quote below highlights.

*'I feel very strongly that somebody of a pharmacy background project managing a project like this has really helped. I'd like to think it's me, but I think any pharmacist would have been good at this project management role' (10086)*

In addition to the specialist knowledge each of the convened representatives possessed it was generally perceived that a skill inherent in participants at inception was 'people skills'. In other words those that chose to take part or were approached had the ability to engage effectively with others.

*'I think I'm a people person and I think that's helped a lot, especially in relation to our patient public involvement. I can speak the people's language'. (10086)*

The more senior members who were involved in the projects tended to have an additional attribute, 'potential influence'. They brought with them to the group a number of contacts from a wider sphere, as a senior member comments on:

*'the other thing is, because I'm in this organisation for seven years, I think I'm networked quite well within the trust, so it really helps when you've got someone like me, or anyone else in my position who has that network, to be able to say, right, so we need approval from, pick up the phone, and you know somebody in comms, or you know somebody in patient involvement, or you know somebody, as opposed to, okay, who the hell do I call? So I think that experience within the trust and the networks really helped'. (10086)*

At this point the group is not tightly bound and therefore I note the predominance of diversity. In other words it is what makes the individuals distinct that is the foremost force at play. The purpose of the group is to come together, bring their diverse skills

and create an agreed change in the care pathway in which they are all involved with. They are the 'convened representatives' where each individual is involved as a contributing member. A quote from a project member outlines the multi-disciplinary approach:

*'The people that are on the project are all multi-disciplinary and the people that are going to the CLAHRC events are all multi-disciplinary, so it cuts through the sectors that you get in each profession'. (10113)*

The group is a 'project team' or 'fellows' team' depending on which CLAHRC stream it is a part of. Its purpose is to accomplish a specified task, and the group's involvement in CLAHRC has been legitimised by senior management (via the funding agreement). It is held together by the project's milestones and goals and it is convened to last until the project is completed. At this point involvement is limited to a narrow focus – that of the convened group and primarily on CLAHRC as an entity, a body to learn from and as an authority to follow.

The difference between the 'projects' programme and 'fellows' programme is outlined above. It should be noted that there is a distinction at this early stage within the CLAHRC process between these programmes. The fellows' programme is similar to that described above in that they are a group of convened representatives. They are not, however, bound in the same manner i.e. to deliver a common specified task. They do, however, come together to create a group with common interests and have individual projects to deliver within their own specific domain. Broadly both streams go through the process I outline here. Due to the different focus of each programme there are, however, nuances across the process.

### **1.2.1 Limited Interaction within network**

At this point there is generally limited or less interaction between the members. The level of interaction at this point can be characterised by drawing on the social network analysis I conducted. For the all the quantitative tables please see appendix 1.

In general, interaction just before the process ranged from a density of 7.8% through to 80.6%, where density for a binary network i.e. any interaction or not is measured by the total number of ties divided by the total number of possible ties. This does, however, indicate that there is a wide range of densities amongst these cross

boundary networks at the start of the process suggesting varying levels of interaction amongst the members before joining the CLAHRC process.

A similar pattern can be seen in the case of 'reciprocity', which is measured by the proportion of ties that are reciprocated within the network. The results for this ranged from 50% to 100%, with the majority under 100%, indicating that there were a number of connections that were one-directional. Again, I return to the importance of this as the network moves through the CLAHRC process in the remaining findings chapters below. To summarise, it is clear from the 'before' density calculations and the interview data there were differing levels of interaction within the group of convened representatives at this point in the process across the UoAs. In two UoA cases there was a multi-disciplinary team already in place. One of these, the stroke project (UoA 5), was hospital based and another spanned the hospital/community boundary, the Jaundice project team (UoA 9). They both demonstrated some interaction across the disciplines and organisations prior to CLAHRC involvement compared to other projects at the start of the CLAHRC process. This was due to the hospital based team being co-located, enabling more frequent informal interaction. In the jaundice project team, where members crossed the hospital/community boundary, there was often a physical presence of members across locations, creating a degree of co-location.

*'it means that you can work on the CLAHRC aspects of the project throughout the day. I can run in and interrupt them about this and they can interrupt me about that. We don't have to schedule meetings after work or anything like that.....it's easier to catch someone in the corridor.'* (10134)

*'There's always that link. We always work together, in and out, in and out. Community midwives come in and work. Hospital midwives go out. So there's always that link.'* (10080)

In other UoAs, while there may have been some parts of the convened group already interacting, parts of the convened group were not interacting at all. The SNA network diagrams for the stroke project team (UoA 5) and the Halc project team (UoA 4) pictorially represent the differences in degrees of interaction (see figures 6.2 and 6.3 below).

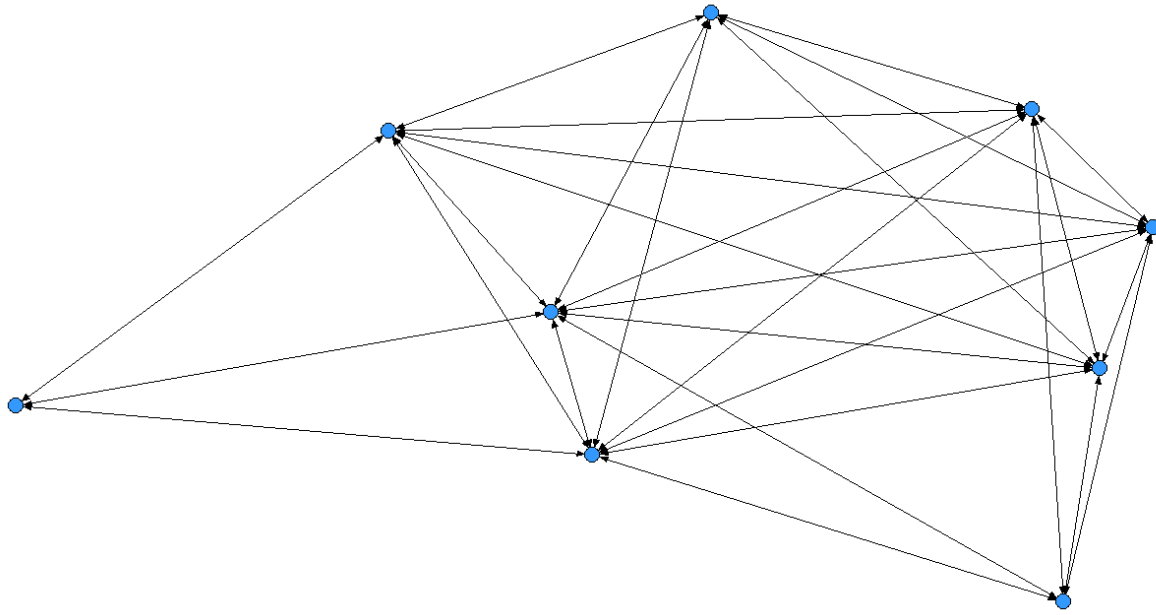


Figure 6.2. Stroke project team (UoA 5) network diagram before CLAHRC

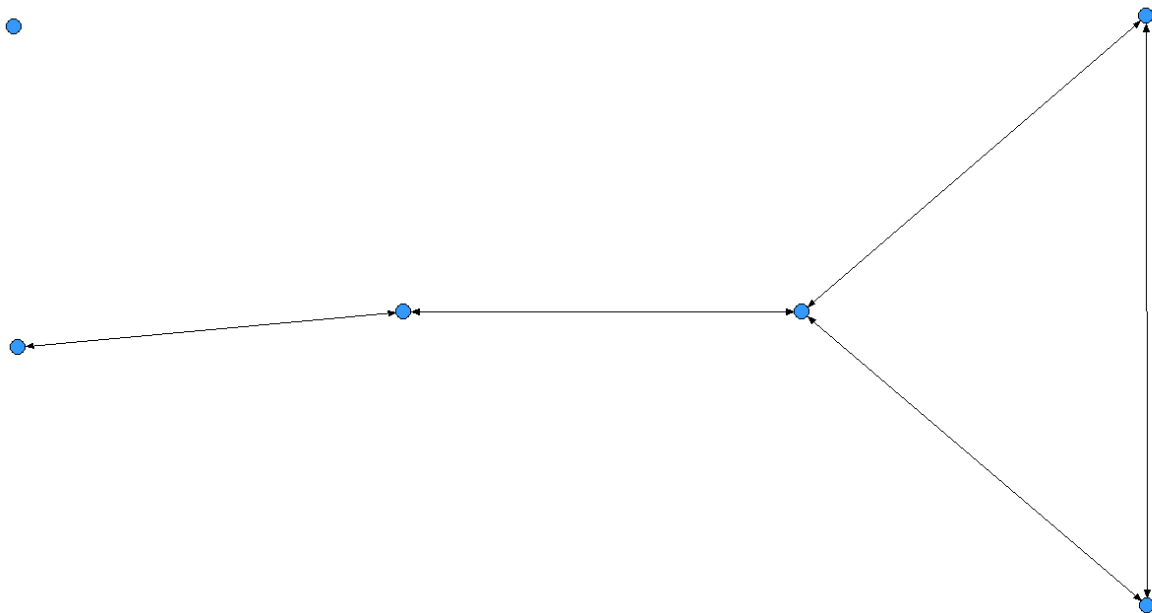


Figure 6.3. Halc (UoA 4) network diagram before CLAHRC

The lowest levels of interaction prior to CLAHRC involvement were for the two fellows networks (UoAs 7 and 8). Here, there was little if any interaction prior to their CLAHRC involvement. This was to be expected, as the fellows are drawn from

completely disparate groups across North West London. The figure below shows an example of a fellows network prior to coming together in CLAHRC.

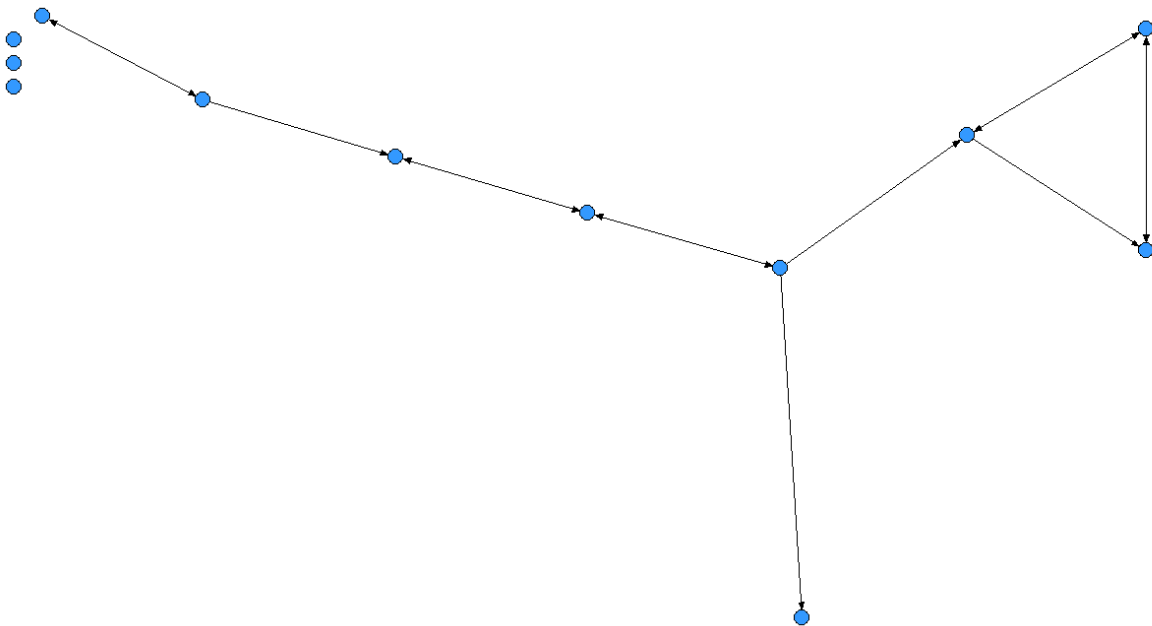


Figure 6.4: F2 (UoA 8) network diagram before CLAHRC fellows network

### **1.2.2 Hierarchy amongst participants**

A UoAs network at this stage is hierarchical in different ways. Within the project teams there is an appointed project manager who leads the co-ordination and activities of the group. There are a mix of professional levels within the team including for example, a consultant level and a junior doctor. The Social Network Analysis (SNA) demonstrates hierarchy in terms of both structure of the network and centrality of interaction at this stage (for SNA tables please see appendix 1).

Looking at the data based on any interaction at all, the degree of centralisation ranges from 14.8% to 62.5%. Equally, based on Krackhardt's graph theoretical dimension calculation for hierarchy within a network the range is from 0 to 0.33, with the majority above 0. The theoretical graph dimension calculates a value of hierarchy between 0 (no hierarchy) and 1 (hierarchical). Again, it should be noted as above that for the density of the network the values are of greatest interest when compared with the values from during the process (for SNA tables please see appendix 1).

## 1.3 Boundaries defined

### 1.3.1 Within UoAs

There is little to note about connection across the boundaries at this point in the CLAHRC process. At this point the boundaries within my UoAs are not crossed, rather they are convened together but no actual boundary relation has been created or built. In other words the boundaries that are evident at this point include cognitive (specialised expertise), technical (clinical guidelines and methods) and social (day to day interaction/education) or in broader terms organisational and professional.

In those UoAs where a level of interaction is already taking place the boundary relation I observed is that of 'cooperation'.

*'as we do work within a multidisciplinary team, we are used to dealing with a number of healthcare professionals, so I think that may have come a little bit easier from that aspect'. (10111)*

*'I think, in that way, stroke's quite lucky because there's already a core multidisciplinary team that work together every day. So it makes it a lot easier, to liaise, get along. We all knew each other anyway. We know our own strengths and weaknesses and how each other works'. (10134)*

Equally, if I draw on the SNA I can see the role of three types of boundaries – 'professional' (job role), 'where based' (hospital or community) and 'stage in career'. I was able to utilise a network calculation (the E-I index) in order to see where the interaction occurred, depending on specific pre-determined boundaries. The resulting value can range from -1 to +1, where -1 indicates 'homophily' and +1 indicates 'heterophily', i.e. the extent to which a group interacts within their predefined partition (boundary) or outside of it (for SNA tables please see appendix 1).

At this point in the CLAHRC process the data indicated that in general the UoAs demonstrated heterophily with regard to job role, i.e. they were interacting within the UoA between the different job roles, for example doctor to nurse. The calculated values ranged from -0.49 to 1.00. There were, however, only two UoAs that demonstrated a homophilous figure i.e. below 0. These were the alcohol project team and IMPE project team. This was probably due to aspects of the teams having

more than one member from a discipline and therefore had worked together before coming together in the network.

With regard to where based and stage in career, they demonstrated homophily, i.e. they were interacting predominantly with those who were also based within a hospital and with those who were at a similar stage of career. In both cases 7 of the 10 UoAs demonstrated a homophilous figure i.e. under 0. Here the results ranged from 0.43 to -1.00 and 1.00 to -0.97 respectively. There are a number of reasons for the range in results which are not the focus of this study. The focus of this study is the change, if any, during the CLAHRC process.

### ***1.3.2 UoAs to CLAHRC organisation***

Unsurprisingly, the level of interaction between the UoAs and the CLAHRC organisation was low prior to the start of the CLAHRC process. The density based on any interaction at all between them varied from 0 to 50%, although it is worth highlighting that 50% is an anomaly exhibited by the alcohol project team (UoA 6) (for SNA tables please see appendix 1). This UoA had two members of the team that were already involved with the CLAHRC organisation.

### ***1.3.3 Boundary defined knowledge***

At 'start-up' each of the convened representatives has specific professionally-defined knowledge. This knowledge was a mix of both tacit and explicit. The majority of UoAs had no or limited common routines or processes for co-ordinating knowledge within the convened group. This is important to be aware of as a part of the CLAHRC process was to create a layer of common knowledge in the group. Within the projects the aim was to create a dual layer of common knowledge of both the CLAHRC improvement science methodology and of the project outcome/activities itself. The fellows were endeavouring to build a single layer of common knowledge – the CLAHRC methodology of improvement science.

## **1.4 Driving force**

### ***1.4.1 Facilitation***

The most significant force at this point in the process is that of the CLAHRC organisation. At this point CLAHRC is fully involved with the project teams in terms of

direction and facilitation and provides the structure, impetus and funding as highlighted by the following quote:

*'...you would need funding for something like this, as simple as that. I mean I won't be naïve and think that you can't run projects without funding, of course you can but it's very difficult, and a project of this description along such a big geographical area, that would be impossible without funding. So for starters just purely the pound sign, you cannot do it without that, that's one thing and I think CLAHRC definitely keep you focused, there's no doubt about that'. (10086)*

## **Summary**

The main points at the stage of 'start-up' include a group of individuals coming together that each represents a part of their care pathway, organisationally and professionally. These convened representatives have limited interaction and they are mainly focused on CLAHRC itself. CLAHRC drives the group forward from 'start-up' via a mandated programme of learning, interaction and activity. The predominant aspect moving the group from this stage is 'learning' as I describe in the next section Mandated Learning.

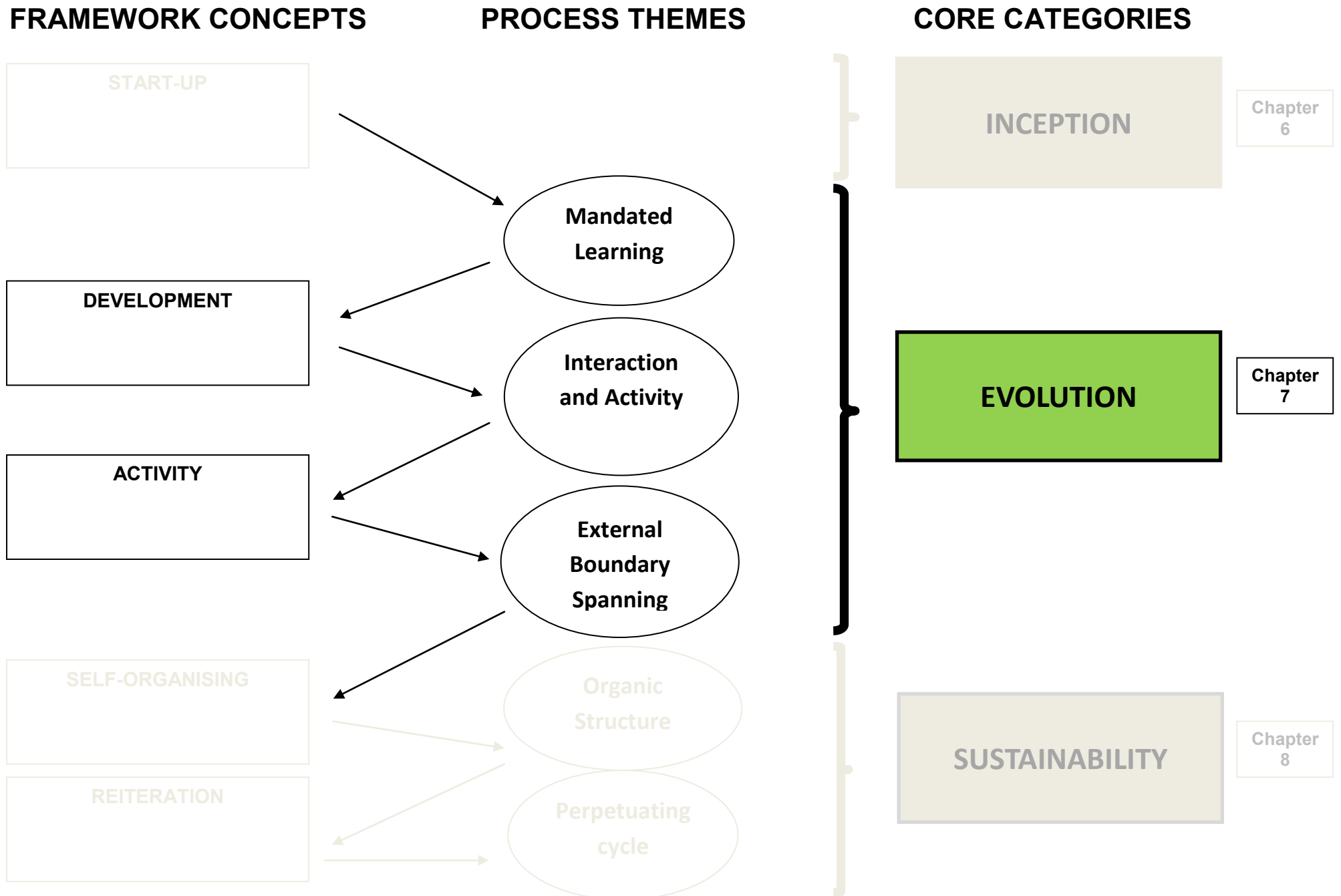


## **CHAPTER 7: EVOLUTION**

In the previous chapter I outlined the themes and aspects that were evident at the inception of the process. Within this section I move on to outline the results with regard to the core category of evolution. In other words how the network evolved after the 'start-up' phase. I am going to do that by discussing the process through which the network goes through and identify the various phases the findings demonstrated i.e. from 'start-up' to 'development', 'development' to 'activity' and 'activity' to 'self-organising'.

The diagram below outlines the overall findings – the conceptual framework of the evolution of a KTBN. The core category of evolution and the relevant framework construct and process themes discussed within this chapter is highlighted.

**Fig 7.1: CONCEPTUAL FRAMEWORK OF THE EVOLUTION OF A KNOWLEDGE TRANSFER BOUNDARY NETWORK (KTBN)**



## 7.1 Mandated Learning

Within this section I am going to unpack the process by which the start-up network discussed above moves forward to a stage of 'development' specifically via a mandated learning process.

The table below highlights the theme and sub-themes which underpin the process theme of Mandated Learning. The discussion of the findings below are organised with reference to each.

2. Evolution				
Process Theme	Theme		Sub-themes	
Mandated Learning	2.1	Start-up process	2.1.1	Mandated learning

Table 7.1: A table to show the framework concept, theme and sub-theme for 'Evolution' – Mandated Learning

### 2.1 Start-up process

#### 2.1.1 Mandated learning

At this first step along the process the project group follows a very structured, mandated process. This can be split into three parts – activity, interaction and learning. For example, participants have to use a mandated set of tools (PDSA cycles, Stakeholder mapping as outlined above), follow mandated communication and interaction structures (meeting once a month, reporting timescales) and actively gain mandated learning requirements i.e. specific knowledge and CLAHRC improvement methodology terminology. At this stage it is the mandated learning requirements that are predominant and therefore clearly drive this part of the process.

This mandated learning structure is initially unfolded to the participants at a three day residential workshop where CLAHRC, its approach, the methodology and communication structure is presented. Here, I clearly observed a linear transfer of explicit knowledge. It is important to note that the use of the term knowledge transfer is meaningful. In chapter 2 the literature review I clearly outline the definition of the term knowledge transfer and the type of knowledge it relates to. For clarity,

knowledge transfer relates to the transfer of explicit knowledge and knowledge sharing relates to the transfer of tacit knowledge. At this point in the overall process it is predominantly explicit knowledge that is being transferred. It is codifiable, formulaic, easily transferred via documents and presentation slides.

Knowledge transfer at this stage was between the CLAHRC organisation and the project teams (UoAs), and within the project teams (UoAs) themselves. Between CLAHRC and the project teams there was a linear process in a predominantly one-directional manner, driven by CLAHRC in a 'push' and 'pull' manner. In fact, participants utilised the term 'push' when referencing the CLAHRC demands and requirements from them.

*'Especially at the beginning, I felt it was push, push, push, push, push' (10086)*

Knowledge was exchanged between CLAHRC and the project teams, however it was specific aspects that were 'pulled' or 'pushed'. A participant's individual knowledge regarding specialism, the context in which they worked and their thoughts on the problem that was being addressed were all driven by a 'pull' from CLAHRC. In other words the knowledge was outlined following a 'demand' from CLAHRC. Conversely, the intervention (CLAHRC methodology) was driven by a 'push' from CLAHRC. This observation was frequently iterated within the interviews as the contrasting quotes indicating the 'pull' and 'push' respectively below highlight.

*'...it [CLAHRC] was quite didactic at some point, where it felt like you were just being asked to do stuff.' (10086)*

*'with CLAHRC, as you know we have to jump through lots of hoops and do lots of methodologies....' [115.684]*

This 'push' from CLAHRC had a mixed response from participants. At this stage the 'push' clearly enabled the process by providing focus, as the quote below suggests:

*'it has been good having CLAHRC because they do, kind of, focus you'. (10112)*

Interestingly, within the UoAs themselves knowledge transfer was similar in that it was largely in a linear manner. It was, however, driven by the push and pull forces of the CLAHRC organisation. For example, in the middle of an assigned task around creating a stakeholder map the communication was primarily based on members outlining explicit information around their particular knowledge domain. In other

words the requirement from CLAHRC for the stakeholder map to be completed drove the project team to exchange knowledge in a linear manner as they outlined their area of expertise.

*'..it was good to have an opportunity to listen to other people's perspectives and actuate knowledge in myself'. (10090)*

There was less linear 'pull' transfer. In fact, it was only noted from the individual who had taken on the task of collating the information ready to feedback to the organisational broker (CLAHRC) i.e. they would 'demand' information from each representative in order to gain the relevant information to fill the form in. At this stage this role tended to reside with the project manager or, if not in place at that point, a lead applicant.

*'..Having CLAHRC in the background, you know you've got a CLAHRC event coming up and there are deadlines X, Y, and Z, you're doing challenges for the project to bring the project forward'. (10111)*

A key difference between the projects and the fellows' programme could be observed at this early stage in the process. The fellows are convened and attend the residential meeting as described above. However, there is little structure and nothing is mandated in terms of learning or deliverables.

*'I'd say that the project seems a lot more structured than the fellowship was. There's more pressure to deliver, there's more deadlines and people action so people are actually putting in place that you have to get done, whereas the fellowship there didn't seem to be an expectation; and you didn't really know what they wanted from you'. (10131)*

## **Summary**

The convened representatives move forward in the process via a set of mandated requirements from CLAHRC. These are mandated learning of the CLAHRC approach including improvement methodology and terminology, mandated interaction and action. The most prominent aspect at this point is the mandated learning. This leads the group to interact more and create a shared outlook as I outline in the following section of the process framework - termed 'development'.

## 7.2 DEVELOPMENT

Within this section I am going to outline the network state found after having been convened in the 'start-up' phase and having undergone the process of mandated learning. This is the development state of the network. I am now going to explore the 'development' part of the framework by addressing the sub-themes and themes outlined in the table below before moving on in the following section to the process that moves the development network on to a network of activity.

2. Evolution				
Framework concept	Theme		Sub-themes	
Development	2.2	Network growth	2.2.1	Problems with network growth
			2.2.2	Growth of a shared perspective
			2.2.3	Internally focused
			2.2.4	Interaction increased at facilitated level
			2.2.5	Hierarchy reduction initiated
	2.3	Permeable boundaries developing	2.3.1	Within UoAs
			2.3.2	Outside the UoAs
			2.3.3	Between UoAs and CLAHRC organisation
	2.4	Developing process of knowledge exchange	2.4.1	Initiation of common knowledge
			2.4.2	Development of knowledge transfer and sharing
			2.4.3	Developing use of knowledge
	2.5	Driving force	2.5.1	Facilitation

Table 7.2: A table to show the framework concept, theme and sub-theme for 'Evolution' - 'Development'

### 2.2 Network growth

The group has convened together and gone through the initial process of starting to use CLAHRC improvement tools, gain certain knowledge and actively meet and

communicate to a pre-defined agenda. COPD and IMPE H project teams (UoA 1 and 2) were both at this stage within the process at the time of data collection and therefore the SNA data analysis highlighted within this section relates to these two UoAs.

### **2.2.1 Problems with network growth**

There were issues experienced at this part of the process predominantly concerned with the perceived mandated nature of the approach, understanding of the process and the extra overhead incurred by the CLAHRC work to the teams.

There was, for example, concern that despite the mandated approach 'one size doesn't fit all'. This was specifically commented on with reference to the context within which CLAHRC were expecting the methodologies learnt to be applied. A number expressed that CLAHRC did not understand the context i.e. the NHS and how it functions. This created a tension and led to the validity and relevance of the methodology to be questioned.

*'CLAHRC's doing research to better the quality of services, service provision for the patients, but we find very few clinicians there, so all of the managers, the support officers, or whatever they are, the backgrounds are very different, so I sometimes question myself how much do they know about the NHS and how it functions.'* (10072)

As a result there was a separation perceived between the CLAHRC organisation and the participants. For example, one participant suggested that they are separate and in an 'ivory tower', which in turn impacted the participant's engagement with the process.

*'I've just felt them [CLAHRC] a bit ivory tower. And they've not got a foot in reality. So the ivory tower syndrome....I think it prevents me from necessarily engaging too much.'* (10071)

Alongside the issue surrounding the application within the context of the NHS concerns were raised with regard to the terminology of the CLAHRC approaches and language used. There was a view that there was too much jargon being used and that the language used demonstrated a lack of understanding and hence had a negative impact on communication.

*'The whole language and way of working is very different, They seem to me to be rather cultish, they have their own personal way of doing things that they're evangelising about. And it is quite foreign to me'. (10154)*

*'there's a whole lot of other jargon. A lot of it I don't really understand, the jargon that's used'. (10134)*

Also, data showed an issue around the additional workload created as being part of the process. There was a considerable additional workload to the participants partly because of the project itself, but the foremost aspect appeared to be the overhead that the CLAHRC methodology and administration created. The two quotes below aptly highlight both these aspects. The first one relates to the extra work the CLAHRC methodology and approach creates and the second relates to the administrative burden.

*'I think, in its entirety it's [CLAHRC methodology] very heavy. It's definitely a lot of, stuff to do and stuff to make people do, who are already fighting for every minute of time of the day'. (10159)*

*'I do a lot of the admin, which is a pain.....it's just taking over'. (10080)*

This additional requirement created difficulty for the participants in terms of balancing their day job and their project/CLAHRC responsibilities.

*'From CLAHRC's point of view, they should be getting time off in their day to do CLAHRC things but that it clearly doesn't happen in practice'. (10134)*

The conflict with day to day responsibilities was observed most starkly with the fellows. This is because they were solely responsible for attendance at CLAHRC events and their project. Within the setting up of becoming a fellow the organisational agreement was a day a week of time to be committed to the CLAHRC fellowship. This was agreed with the organisation via the matched funding approach outlined earlier. However, it was clear that this rarely actually happened predominantly due to job responsibilities. This tension between day job and the responsibilities to CLAHRC created an emotional tension for some as outlined in the quote below.

*'The struggles were around time, mainly, but I think that's probably echoed by just about everyone..... I'm a bit sad about that, really'. (10088)*

This went on to open up the question as to whether or not being part of the process was really 'open' to certain people. The reality was that despite the 'agreement' with



the host organisation the day a week to work on the CLAHRC project was rarely achieved.

*'It's just an interesting aspect, whether or not this is really, truly open to people like me,....you know, when there's knowledge that you won't really be given your day a week.....you know you're not going to get it'. (10088)*

In terms of how the participants actually dealt with this tension between their 'day job' and the CLAHRC commitment they primarily 'fit' the CLAHRC work in as and when they could even to the extent of doing it in their 'own time'.

*'it's just a balancing act, I suppose, and sometimes the CLAHRC ends up getting done at lunchtimes'. (10142)*

Another aspect relating to the balance of time came from problems experienced in teams that did not have a dedicated project manager. For example, a team that experienced a turnover in personnel with regard to the project manager found that the momentum of the project was checked and progress stalled.

*'we've had a real, I don't know the word to describe it, but kind of a stop and start kind of approach because we didn't have a project manager for quite a while'. (10141)*

Also, other project managers commented that if they were not able to dedicate their time as employed to do they felt that conducting a successful project within CLAHRC would be difficult.

*'I had a lot of dedicated time to put into the project, which a lot of people don't get, which is, I'm sure, part of the success story'. (10086)*

Despite the negative views expressed above regarding the mandated nature and understanding there were notions that suggested that in fact there needed to be more training early on in the programme. This primarily came from participants with experience of other methodologies and that were not necessarily clinically trained. This meant that the issue of administrative overhead was not an issue for them.

*'I think it needs a much more intense training, right at the beginning, before people launch on the CLAHRC journey'. (10159)*

It is worth highlighting at this point that there was an opposing viewpoint that resulted from the fellows UoAs. This was with regard to the structure and mandated nature experienced by the project UoAs. The fellows followed a slightly different programme

and whilst they were made aware of aspects such as the CLAHRC improvement methodologies they were not mandated with regard to learning in any way. As a result I found there was a lack of understanding of the methodologies, a lack of purpose within the group and confusion as to what was being achieved and gained through the fellowship. The following three quotes represent each one of these aspects.

*'I was a bit, like, I'm not really sure what this is about, I haven't quite worked it out yet'. (10131)*

*'I got a bit frustrated with the meetings, because we would meet and we'd discuss about whether we were happy with where we were going, but we wouldn't actually go anywhere. So, it felt like there was a lot of talking about what we were doing, and not much doing'. (10131)*

*'there didn't seem to be an expectation; and you didn't really know what you...what they wanted from you'. (10131)*

Although there were issues as raised above there was a commitment to deliver regardless of an individual's view. A part of this I found came from the group coming together at this point and having a shared perspective.

### **2.2.2 Growth of a shared perspective**

The network was at this stage focused around 'working out' the details of the change they were going to make to the care pathway including how to go about it. One project member highlighted this well by commenting on how it was coming in late to the project team and found that the network had a clear sense of a shared agenda.

*'I mean I think by the time I got into the project, the MDT had set up and there was a real buzz about the project'.(10111)*

I also noted at this stage the terminology employed by participants referred to 'we' when referring to the project team.

*'and we have to make sure we're doing certain things in order for us to get that funding, basically'. (10112)*

Alongside this shared purpose the network had also reached a stage of shared accountability. There was a sense of having received something and now there was an onus on the team to deliver. For example, a number of participants acknowledged

that CLAHRC had a right to demand certain things as they had provided funding and this also accounted for the participants' continued adherence to the process.

*'..... somebody to answer to is too strong a phrase, but you know it is somebody in the background that you've got the funding from and you're trying to develop the project so that actually it's been worth their while'. (10111)*

I have outlined the outcomes that resulted from the process of having convened the representatives and them having gone through mandated learning objectives. I now move on to what the knowledge transfer network looks like at this point of the process.

### **2.2.3 Internally focused**

The mandated nature of the tools and communication structures that each group has to adhere to leads to the formation of a coherent 'group' of representatives. At this point the group is focused around a specific purpose. It is focused on the project itself and learning – that of methodology, inherent specialised knowledge and overriding aims and objectives. As such the groups are building and exchanging knowledge and growing their capabilities.

The group is beginning to be held together with its own inherent passion and commitment. It is, however, important to note that a level of facilitation is still in place from the CLAHRC organisation. The quote below demonstrates this as the individual highlights their engagement with CLAHRC and alongside that comments on approaching CLAHRC for advice.

*'You see, I quite... well, I love, I love it now, and I'm a complete advocate... I probably will be asking CLAHRC as well what they think about the two'. (10153)*

At this point I also noted that the focus of the group had altered. At the point of inception I outlined that the focus of the group was on CLAHRC itself. At this point the focus moves to the project and inwardly to the team itself.

*'... you have to deliver on , and I think that is really good at focusing everybody's mind so that actually you know that you have to be delivering on how you're doing the project and your numbers and the data collection'. (10111)*

Another aspect that highlights this more inward focus was observed at the CLD events. At this point the group had attended a collaborative learning event, however,

they did not interact at any length with others from outside of their group. In fact, they found the event useful for them to come together as a group as opposed to for any of the broader networking it was intended for.

*'I find it useful to have head space, and I find it useful to have team time'. (10153)*

*'so it is very much project team time and team time' (10161)*

This was backed up by views from the fellows. At the CLD events they had the impression that the project teams would use it to come together as a group. As a result the fellows found it hard to interact with the project teams despite that being the intention from CLAHRC.

*'but usually they were quite, I think my impression was that there were groups that didn't normally get the opportunity to meet so often as a group, so usually, when I would join them at a table, they were like, talking and it was really, a bit hard to break into that, from a fellow's sort of perspective so in the end we actually asked that we sit together as fellows, and then we were told, well, the idea is, you interact with the projects, and we understood the idea, but it wasn't really happening'. (10088)*

#### **2.2.4 Interaction increased at facilitated level**

I see at this stage from the SNA data that interaction and reciprocity had increased within the group. This was demonstrated by an increase in the network density. This increase ranged from a 16% increase to as high as 92%. This was for any interaction at all and therefore included the facilitated interaction required of the UoAs as part of the process. It is a large range of increase demonstrated, which is to be expected when you consider the varying contexts. The stroke project team (UoA 5) had the lowest increase of 16%. This however needs to be considered with reference to the level of density within the network prior to the process, which was high (80%). Equally, if I look at the higher end of the increase these pertain to groups that had limited or no reason to interact prior to the process. For example, the anaes project team and the two fellows UoA (UoAs 3, 7 and 8) were all from disparate care pathways and professions prior to their CLAHRC involvement (see appendix 1 for SNA data tables).

The increase in interaction, however, is at this stage still seen predominantly at the facilitated, mandated times e.g. monthly project meeting/residential event/CLD event. The SNA data analysis delineates this when I look at the density in the network

above that which is mandated by CLAHRC. Here, the data clearly shows that at this stage in the process there is no increase above the mandated interaction. The COPD project team and IMPE H project team show a difference of 0% and -0.8% when comparing prior to the process and during. The remaining UoAs (3 to 10), which were further along the process all demonstrate an increase in interaction above that which was mandated (see appendix 1).

There is some suggestion from the interview data that the location and knowledge domain of participants had an impact on the level of interaction created. For example, collaboration between those individuals that are co-located offered greater collaboration at this stage. This was particularly seen within the fellows UoAs where the distance between participants was greater in general than those within the project teams. The two representative quotes below highlight this. In both cases they are from a fellows' UoA and are referring to separate locations and interactions away from the main co-ordinated group.

*'I have weekly contact with XXX, she's another dietician [based in the same location] so we talk about things within ourselves and we're sector leads within our department so we've been back on events and stuff that we've gone to, but with the other Fellows I only ever really have contact at those [monthly] meetings'. (10064)*

*'One of the things that's come out with colleagues who are based here is where we've set up a meet-and-greet and coffee where we talk about things and support each other. That's an element that's interesting'. (10066)*

This was also seen in those that came from similar knowledge domains. This was predominantly seen in the fellows' UoA as the projects were much more involved within the sphere of their jobs and the fellows came from more disparate parts of the NHS. Having a shared knowledge domain clearly instigated interaction at an early stage.

*'I think with the fellows it's slightly different, because you're all in such different areas, that you have a natural affinity to most of the people that have a more similar background to you and are looking at similar projects to you'. (10131)*

There was also evidence to support this but for the opposite reason i.e. interaction reduced when a participant located somewhere else or increased when a participant became based more locally to another participant.

*'I [Interact with X] more now. [XX] isn't so much involved anymore because she's not based here'. (10112)*

*'Yes, I mean, the one person that I did start to come across was [person x], because she got seconded to my organisation, so she started to work on the floor below me in the same building, so we then started to go out for coffee and stuff'. (10087)*

### **2.2.5 Hierarchy reduction initiated**

The group at this stage demonstrated a reduction in hierarchy both from a level of centrality and structurally. Whilst it has reduced there is still some evidence of hierarchy being present from the SNA data analysis.

The degree of centrality within the network has decreased at this point. This is best demonstrated if I look at the data based on any interaction at all. Here, the degree of centralisation has decreased in both the COPD and IMPE H project teams (UoAs 1 and 2) by 8.2% and 13.2% respectively. Equally, based on Krackhardt's graph theoretical dimension calculation for hierarchy within a network I note that the COPD project team and IMPE H project team reduce from 0.07 and 0.35 to 0.0. Whilst this appears that there is no hierarchy structurally present if I look at the granular detail of each of the measures I can see that there is still some hierarchy present with regard to the structural measures. Efficiency is at 0.2 and 0.3, which reduces further when I look at the analysis from the UoAs further along in the process (for SNA tables please see appendix 1).

Alongside the quantitative data highlighted above, evidence of hierarchy was also found at this stage from the interview data analysis, for example, a senior member of a project team stated the following with reference to the importance and expectation of response to information:

*'To me it's [information received] useful further down the line. If I give him information I would expect him to act on it straightaway. That's not equal, because I am the senior partner. I'd expect not to have to do anything immediately with what he gives me, but I'd expect him to act more quickly.' 094.69*

There was also a suggestion in relation to hierarchy that the process needed to be targeted depending on the seniority level it was being delivered to. This was a view that came from both the projects and the fellows' UoAs, but only from those that were more senior. The view was that at a managerial corporate level it was useful to learn broadly about improvement and the specific 'skilling up' with regard to the

project which could be done at a different level of seniority as the quote below highlights.

*'but it has been useful for me at a more... at a more corporate, managerial level... I've been included in the CLD, that network that learnt broadly about improvement, and it depends on where you're aiming to skill up, and are you aiming to skill up at different levels? Probably. (10153)*

## **2.3 Permeable boundaries developing**

### **2.3.1 Within UoAs**

I start to see at this point the relational boundaries become 'leaky' and permeable within the group itself and generally more cooperative. This 'leaking' is important as it starts to move the group toward cohesiveness, a more shared stance and co-ordinated practice. For example, from the interview data I can highlight the following quote that indicates the importance of the interaction across the disciplinary boundaries and how this will lead on to further involvement i.e. co-ordinated practice.

*'I think it does [multidisciplinary approach useful], I think that's really, really important. I think that those that aren't directly involved in actually doing the medication reviews are a little bit peripheral at the moment but as it becomes more widespread through the hospital and then when the medication passport is added, and if we look to it being in the community, then that part will become much more valuable'.(10154)*

Whilst the move toward cross boundary interaction as described above was evident there were also comments made relating to the difficulty of crossing professional boundaries. The quote below highlights this with reference to the administration and clinical team boundary. Here it is clear that they are seen as separate, which led ultimately to resistance from clinicians.

*'it's still seen as two different job streams, but actually we're all trying to achieve the same thing, but I think the clinical and administrative sides are still seen as opposite ends of the magnet, which is a shame, really.....they had a lot of consultants who were very protective of their turf and didn't feel they wanted any administrators meddling with it'. (10159)*

I still note, however, that at this stage in the process whilst there was engagement across the boundaries it was not necessarily comfortable within the UoAs. A senior member observed this with reference to the interaction between patient representatives and clinicians and between pharmacists and doctors as respectively demonstrated in the two quotes below:

*'for the pharmacists seeing the patients was fantastic because I could really see how it was relatively easy for me, as somebody senior, to talk to the patients just like they were a colleague and the junior staff just couldn't. You know, they were treating these patients and were really uncomfortable, really uncomfortable in a meeting if I was disagreeing with a patient rep'. (10094)*

*'but the junior people of the team, and they're not desperately junior, the middle rank file, found that much harder. And they used to, sort of, ooh, ah, revere, revere, revere, which comes with being a pharmacist actually because we revere, revere, revere doctors, and then we were doing it to patients'. (10094)*

I was also from the quantitative data able to analyse the interaction across pre-defined boundaries. In order to this I utilised a calculation termed E-I index. This provides a measure of homophily i.e. how much of the interaction is 'like with like'. In other words the extent to which the group interacts within their predefined boundary. The E-I index is from -1 to +1. 0 to 1 is heterophilous i.e. the interactions are with others from a different partition and under 0 with those from the same partition. The three types of boundaries I predefined were – job role (professional), where based (hospital or community) and stage in career.

At this point in the process the data indicated that regarding job role and where based the UoA had become more homophilous in terms of interaction i.e. doctor to doctor or hospital to hospital based. This is demonstrated when I compare the figures from before the process to during for the COPD project and IMPE H project team. In both cases the calculated E-I index changes to a more homophilous figure e.g. from an E-I score of 0.12 to -0.21. (See appendix 1 for SNA tables). Whereas with regard to stage of career the UoAs had become more heterophilous i.e. early stage to later stage. For example, the COPD project team had moved from an E-I score of -0.11 to 0.05.

### **2.3.2 Outside the UoAs**

At this stage the UoAs had started to attend facilitated networking events such as the CLD. Here, I noted that encounters outside of their immediate team were brief if at all and where they did interact the exchange was a more general interaction than specifically useful take away information. Equally, there was a clear sense of 'how does this benefit me' and in doing so was concerned about the value they were attaining from attending. So, there was low contact and low traction. The quotes below highlight both these aspects of this type of relational tie.



*'I don't remember these people's names but I met them. There's a nurse on there that I met; I just can't remember what her name is. Because I saw her [I can remember that I met her]....it was general. It wasn't very specific [discussion]...well, it was but I was just listening to them. (100077)*

*'And I want to really get something that's useful out of that [a CLD meeting]. And while it's interesting to learn about other projects they seem very different..... A lot of them happen in very different environments, a lot of them happen in teaching hospitals, where there are more staff available to do this kind of work, a little bit more used to doing this kind of work. And have to do less juggling, they probably have less clinical work'. (10154)*

The characterisation of the relational ties perceived at this point outside of the UoA is difficult to define with reference to commonly used definitions of either weak or strong. Clearly, the tie was within the realm of 'weak', however, as these relational ties were compared across the process it was clear that there were differences between the 'types' of relational tie at different stages. Here, the relational ties outside of the UoA were of limited contact and limited traction i.e. value. At this point the ties were characterised by the brief encounters where nothing really sticks or was more general interaction than specifically useful take away information. . When compared across the other characterisations found across the process I termed this a footprint 'trace'. This definition and term was synthesized from the analysis of the results and not an applied term and definition from literature.

### **2.3.3 Between UoAs and CLAHRC organisation**

The SNA data indicated an increase in interaction between the UoAs and the CLAHRC organisation at this point. The COPD project team and IMPE H project team increased by 0.64 and 0.46 respectively (see appendix 1).

I did note at this point that between CLAHRC and the UoA that alongside this increase in interaction a 'strain' had developed as the quotes below demonstrate.

*'the bureaucracy and protocol and the start-up, and all the rest of it, was appalling. And their driver diagrams and this, that and the other that was not intuitive, and it caused a lot of tension between us because I had, for both projects we seconded bright young middle grade pharmacists who were just being consumed in this documentation bureaucracy'. (10094)*

*'I wrote last week to say, are we going to get any feedback? And I haven't even had a response to that email.... and we did a sustainability review meeting in October where we had to do a presentation, fill out some documentation; they came and we had to present it, and then we discussed it and then we don't know what the point was, because we didn't get feedback on it .'. (10094)*

## **2.4 Developing process of knowledge exchange**

### **2.4.1 Initiation of common knowledge**

At this point I observe the first steps toward building a common knowledge. The network has gone through the process of the mandated linear push and pull of knowledge transfer outlined above and now reaches a stage of shared knowledge. The knowledge sharing comprised four aspects. These were: the CLAHRC methodology and approach, other participant's specialist areas, contexts from which they all were representatives and the project plan. For example,

*'I think what they've done it's provided an opportunity for clinical staff to get some project management experience, to get quality improvement, science experience and knowledge, PDSA and all that stuff. So, I think it has built an infrastructure around those things that's been great...'* (100094)

### **2.4.2 Development of knowledge transfer and sharing**

I found at this point in the process from the quantitative data that the predominant knowledge exchange was that of tacit knowledge sharing within both the COPD project team and IMPE H project team. This was shown from the density of the explicit knowledge transfer matrix vs that of the tacit sharing matrix. COPD and IMPE H project teams both reported a higher density of tacit knowledge sharing than explicit knowledge transfer. For example, a density of 4.6 for IMPE H project team tacit knowledge sharing and 3.3 for explicit knowledge transfer.

There was also a higher level of reciprocity shown in the tacit knowledge exchange within both COPD and IMPE H UoAs. For example, a reciprocity of 0.8 for IMPE H tacit knowledge sharing and 0.7 for explicit knowledge transfer.

With regard to vertical differentiation i.e. hierarchy (outlined in the table below) within the COPD and IMPE H UoAs and related to type of knowledge exchange I found that there was a mix between tacit knowledge exchange showing a higher level of centrality and explicit knowledge exchange showing a higher level of centrality respectively. It should be noted, however, that the difference between COPD and IMPE H's level of explicit and tacit knowledge exchange centrality was low indicating it was fairly balanced.

UoA (%)	EK	TK
<b>COPD</b>	13.90	18.70
<b>IMPE H</b>	43.40	36.10

Table 7.3: A table to show the degree of centrality in the EK and TK networks

If I look at the results in the table below, in terms of structure overall there was no hierarchy indicated for either knowledge type.

UoA	COPD	IMPE H
<b>EK</b>	0.00	0.00
<b>TK</b>	0.00	0.00

Table 7.4: A table to show the krackhardt theoretical measure for EK and TK networks

I was also from the quantitative data able to analyse the interaction across pre-defined boundaries in terms of type of knowledge exchange across that interaction. So, with regard to type of knowledge exchange i.e. explicit and tacit the results indicate that for the 'job role' boundary in general the exchange was on the heterophilous side of the scale. The results were mixed for both 'where based' and 'career stage'. I also noted that in each case tacit knowledge sharing demonstrated more heterophily than explicit knowledge transfer.

Stage	UoA	EK	TK
<b>JR</b>	<b>COPD</b>	0.46	0.53
<b>JR</b>	<b>IMPE H</b>	0.20	0.57
<b>Based</b>	<b>COPD</b>	0.48	0.49
<b>Based</b>	<b>IMPE H</b>	-0.47	-0.37
<b>CS</b>	<b>COPD</b>	0.11	0.21
<b>CS</b>	<b>IMPE H</b>	-0.46	-0.42

Table 7.5: A table to show the calculated E-I index measure for pre-defined partitions within the EK and TK networks. Key: JR = Job role, CS = Career stage.

Interestingly, between the CLAHRC organisation and the COPD UoA and the IMPE H UoA the predominant knowledge exchange was split between tacit knowledge sharing and explicit knowledge transfer. In COPD the density between the COPD UoA and the CLAHRC organisation was 4.21 for explicit knowledge transfer and 2.93 for tacit knowledge sharing. IMPE H shows the opposite 1.73 and 3.73 respectively (see appendix 1 for SNA data tables).

### **2.4.3 Developing use of knowledge**

Another aspect relating to the knowledge transfer aspect of the network is that of knowledge use. There are three types of knowledge use that I collected data about. These were conceptual knowledge use, symbolic knowledge use and instrumental knowledge use. For clarity, conceptual knowledge use is knowledge that is used as 'general enlightenment', symbolic knowledge use is knowledge that is used to confirm an approach or position and instrumental knowledge use is knowledge that is put into practice. I collected data relating to the type of knowledge use received explicitly and tacitly.

To aid understanding of the results below I highlight the two aspects that I look at for each type of knowledge use, both within the UoAs and between the UoAs and the CLAHRC organisation. These include:

- a) What type of knowledge use was evident and the predominant type of knowledge use when knowledge is delivered explicitly and tacitly

For example, of the three types of knowledge use looked at, which ones were evident and, when knowledge is delivered explicitly, which is the most predominant type of knowledge use.

- b) Compare the predominant type of knowledge use between when the knowledge is delivered explicitly and tacitly

For example, for knowledge that is delivered explicitly and its use is categorised as instrumental how does this compare to knowledge that is delivered tacitly and its use is categorised as instrumental. In other words, is instrumental knowledge use higher when the knowledge is received via explicit knowledge transfer as opposed to tacit knowledge sharing?

- a) At this stage I note that the symbolic use of knowledge was highest in both explicit and tacit knowledge exchange i.e. the knowledge that was received was used to confirm an approach or position. This was the case within the COPD and IMPE H UoAs and between the both UoAs (COPD and IMPE H) and the CLAHRC organisation.

There was also evidence of instrumental and conceptual knowledge use via both explicit and tacit knowledge exchange. This was the case within the COPD and IMPE H UoAs and between the UoAs (COPD and IMPE H) and the CLAHRC organisation.

It should be noted that there was one type of exchange that did not produce any conceptual knowledge use and that was explicit knowledge exchange between the UoAs (COPD and IMPE H) and the CLAHRC organisation.

b) There is a mix of results when comparing the predominant type of knowledge use between knowledge that is delivered explicitly and tacitly. For example, in COPD explicit knowledge exchange demonstrates higher symbolic use and in IMPE H tacit knowledge exchange demonstrates higher symbolic use. Between the UoAs (COPD and IMPE H) and the CLAHRC organisation symbolic use was equal between the two types of knowledge exchange.

Instrumental knowledge use was produced predominantly via explicit knowledge exchange within both COPD and IMPE H. However, between the UoAs (COPD and IMPE H) and the CLAHRC organisation there was again a mix of results. In COPD it was equal between the two types of exchange whereas in IMPE H tacit knowledge exchange demonstrated higher instrumental knowledge use.

Explicit knowledge created less conceptual knowledge use than tacit knowledge exchange within both COPD and IMPE H. This was also the case between the UoAs (COPD and IMPE H) and the CLAHRC organisation.

(%)	EK Use			TK use		
	Conceptual	Symbolic	Instrumental	Conceptual	Symbolic	Instrumental
<b>COPD</b>	27.10	49.20	23.70	36.10	47.50	16.40
<b>IMPE H</b>	12.20	53.70	34.10	12.50	54.20	33.30

Table 7.6: A table to show the % of different knowledge use types resulting from explicit transfer and tacit sharing within the UoAs

Density	EK Use			TK use		
	Conceptual	Symbolic	Instrumental	Conceptual	Symbolic	Instrumental
UoA	C(O)	C(O)	C(O)	C(O)	C(O)	C(O)
<b>COPD</b>	0.00	0.21	0.07	0.07	0.21	0.07
<b>IMPE H</b>	0.00	0.18	0.09	0.09	0.18	0.18

Table 7.7: A table to show the density of different knowledge use types resulting from explicit transfer and tacit sharing between the UoAs and the CLAHRC organisation

I also looked at the vertical differentiation i.e. hierarchy of the network but this time in relation to the type of knowledge use. There is not a clear outcome at this stage as to what type of knowledge use is more centralised. The explicit knowledge exchange shows both conceptual knowledge use and instrumental knowledge use with the highest degree of centrality and tacit knowledge exchange shows symbolic and instrumental knowledge use in COPD and IMPE H respectively.

If I also compare which of the types of knowledge exchange demonstrates the highest centrality in the case of both symbolic and instrumental knowledge use there is generally an even split between both types being more centralised between COPD and IMPE H. With regard to conceptual knowledge use, however, explicit knowledge exchange in both COPD and IMPE H demonstrates the higher degree of centrality. In other words knowledge that is received explicitly and then used conceptually is more concentrated (more centralised) than if it is received tacitly and then used conceptually.

UoA	EK			TK		
	Conceptual	Symbolic	Instrumental	Conceptual	Symbolic	Instrumental
<b>COPD</b>	75.50	70.90	25.00	69.40	70.90	28.10
<b>IMPE H</b>	41.30	39.70	57.90	19.80	51.20	54.50

Table 7.8: A table to show the degree of centrality for each type of knowledge use and each knowledge exchange

As above I also looked at the knowledge use in relation to a set of pre-defined boundaries. This is in relation to both when knowledge is transferred explicitly and tacitly. Again, I looked at pre-defined boundaries of stage of career, job role and where based and I outline the results for each in turn below.

Regarding the career stage partition, for each type of knowledge use – conceptual, symbolic and instrumental – the measures demonstrate low heterophily and homophily. In both the case of EKT and TKT the knowledge that was most

heterophilous in terms of type of use was symbolic. In other words the knowledge received by a participant explicitly that was used symbolically came from another participant that was not at the same career stage.

Interestingly, if I compare the level of heterophily between types of knowledge use in relation to knowledge that is received explicitly or tacitly I note that both conceptual and instrumental knowledge use are less heterophilous when knowledge is exchanged explicitly. Symbolic knowledge use showed a mixed result i.e. in one case it was equal and the other explicit knowledge was more heterophilous.

CS	EK			TK		
	Conceptual	Symbolic	Instrumental	Conceptual	Symbolic	Instrumental
<b>1</b>	0.00	0.10	0.00	0.09	0.10	0.09
<b>2</b>	-1.00	0.00	-0.57	-0.67	-0.23	-0.50

Table 7.9: A table to show the E-I index measure for each type of knowledge use and each knowledge exchange Key = CS – Career stage

Moving on to the job role partition for each type of knowledge use it is less obvious. In general, for both COPD and IMPE H the measures indicate heterophily with regard each type of knowledge use. For both explicit and tacitly shared knowledge the most heterophilous are symbolic (IMPE H) and conceptual (COPD) knowledge use. As before, for clarity this means that in the case of knowledge received explicitly and that was used symbolically or conceptually more often came from another participant that represented a different job role. If I compare the level of heterophily between types of knowledge use in relation to knowledge that is received explicitly or tacitly it shows the same as for stage in career above. Conceptual and instrumental knowledge use are both less heterophilous when exchanged explicitly. Symbolic knowledge use showed a mixed result i.e. in one case it was equal and the other explicit knowledge was more heterophilous.

JR	EK			TK		
	Conceptual	Symbolic	Instrumental	Conceptual	Symbolic	Instrumental
<b>COPD</b>	0.63	0.52	0.43	0.82	0.52	0.45
<b>IMPE H</b>	-0.60	0.73	0.29	0.00	0.69	0.38

Table 7.10: A table to show the E-I index measure for each type of knowledge use and each knowledge exchange (Key - JR = Job Role)

Finally, with regard to the where based partition. Here I noted a different type of knowledge use as being the most heterophilous. For both explicit and tacitly shared

knowledge the most heterophilous is conceptual knowledge use in both COPD and IMPE H. In other words knowledge that is received explicitly and used conceptually most often came from a participant based elsewhere. Again, if I compare the level of heterophily between types of knowledge use in relation to knowledge that is received explicitly or tacitly it shows that instrumental knowledge use is less heterophilous when exchanged explicitly and are mixed with regard conceptual and symbolic knowledge use.

Based	EK			TK		
	E-I index	Conceptual	Symbolic	Instrumental	Conceptual	Symbolic
<b>COPD</b>	0.88	0.52	0.14	0.82	0.52	0.27
<b>IMPE H</b>	-0.20	-0.82	-0.71	0.33	-0.77	-0.63

Table 7.11: A table to show the E-I index measure for each type of knowledge use and each knowledge exchange (Based)

## 2.5 Driving force

### 2.5.1 Facilitation

The most significant force at this point in the process remains that of the CLAHRC organisation. At this point CLAHRC is still driving the project teams. As such the process remains very much designed and delivered through and by the CLAHRC organisation. They continue to use tools and communicate and interact to a mandated timetable. A project member highlights the rigidity and mandated nature of the CLAHRC process at this point and yet the second quote highlights how the CLAHRC process enables the process of the knowledge transfer boundary network.

*'we have seen CLAHRC develop over time because we've been very vocal and fairly critical of the CLAHRC early on. We found it very rigid.'* (10094)

*'I think it's the funding and structure. So it provides me a structure that I can get people to meet monthly and do, yes, through the CLAHRC process.'* (10153)

## Summary

The main points at the stage of 'development' above include a group that has started to interact more amongst the group and with the CLAHRC organisation. Alongside this the hierarchy in the group is reduced. Interaction tends to be more focused amongst those who are based in a similar environment or within the same job role. Where there is interaction between boundaries within the UoAs there is cooperation



between the different professions and organisations. Across the UoAs and CLAHRC organisational boundary, however, there are signs of strain at this point. The group has developed a shared purpose, accountability and knowledge. Its focus is primarily on the purpose i.e. the project and task and on the group itself. The group predominantly exchanges knowledge tacitly within the group but it is predominantly explicit transfer between the UoA and the CLAHRC organisation. Finally, the knowledge received is predominantly used in a symbolic manner i.e. using knowledge received to confirm a stance or position. This is the case both within the UoA and between the UoA and the CLAHRC organisation. The predominant aspect moving the group from this stage 'development' is a set of mandated activities and mandated levels of interaction as I describe in the next section 'Interaction and Activity'.

## 7.3 Interaction and Activity

Within this section I am going to examine the process by which the network moves from the state of ‘development’ to a stage of ‘activity’ specifically via a mandated interaction and set of activities process.

The table below highlights the theme and sub-themes which underpin the process theme of ‘Interaction and Activity’. The discussion of the findings below are organised with reference to each.

2. Evolution				
Framework construct	Theme		Sub-themes	
Interaction and Activity	2.6	Advancement	2.6.1	Mandated interaction and activity

Table 7.12: A table to show the framework concept, theme and sub-theme for ‘Evolution’ – ‘Interaction and Activity’

### 2.6 Advancement

#### 2.6.1 Mandated interaction and activity

At this point in the process the UoAs continue to follow a structured, mandated process. It continues, as in the process between ‘start-up’ and ‘development’, to be split into three parts - activity, interaction and learning. I highlighted in the mandated learning process that whilst there were a number of mandated aspects to the process at that point it was the learning requirements that took precedence. It is the same at this point in that all the mandated aspects remain and contribute to moving the process along. However at this point it is the mandated communication structures and mandated activities that have precedence and are key to driving it to the next stage.

For example, they are mandated to meet as a team at least once a month. In doing so I note that, through this regular interaction, communication moves to more of a dialogue. In other words the knowledge user(s) start to respond and feedback.

I am able to highlight an example at this point in the process of a couple of the UoAs that struggled at this stage due to changes in personnel. The COPD project team and IMPE H project team both moved through to the ‘development’ stage – they had

come together, engaged with the process and learnt the methodologies and concepts. However, due to changes in personnel the momentum of the group moving forward stalled. In fact, in both cases they lost their original project manager i.e. the leader and driver of the group. As one member below highlights without this interaction progress stalled.

*'it didn't really have that sort of drive to it to take it forward in terms of meeting the deadline for getting all the other bits and pieces'. (10111)*

As in the mandated learning part of the process above the mandated nature of the activities and interaction were not always met with enthusiasm. However, there was acknowledgement amongst the networks that it was useful to some extent in terms of moving the project along.

*'I think as well having CLAHRC in the background, you know you've got a CLAHRC event coming up and there are deadlines X, Y, and Z, you're doing challenges for the project to bring the project forward, I think has been really good at focusing people. You know by the next few months we have to have done X, Y, Z,'. (10111)*

The regular meetings were deemed useful and the interaction at these meetings became more reciprocal across this part of the process as the participants were meeting and learning from each other.

*'the great thing about the Fellows was meeting each other and learning from each other and having that support' (10117)*

This reciprocity also started to develop between the CLAHRC organisation and the UoAs itself. For example, I start to observe commentary back from the UoAs to CLAHRC with questions, comments and complaints with regard to different aspects of the process. In other words the knowledge exchange had become multi-directional both within the UoAs and between the UoAs and the CLAHRC organisation.

A good example of this comes from the stroke project team (UoA 5) that had learnt a tool, was interacting appropriately and had to use the tool. They went through a process of using the tool alongside CLAHRC requiring them to use it and chasing for the output. The tool was used, the team did not like it and did not agree with it. As the stroke project team went through the process they started to feedback this opinion of the tool to CLAHRC. The initial response from CLAHRC was to keep telling them to use the tool using different measures to persuade them. Eventually it

got to the point where the stroke project team decided to stop using the tool and pushed back to CLAHRC to that effect. I include a member of this UoA perspective on what unfolded with regard to the use of this tool and ultimately their push back to CLAHRC.

*'So the sustainability scorers is the big one that I just think it's just an absolute waste of time [CLAHRC would come] saying, oh, we've got the CLAHRC event coming, make sure you do your sustainability scores.... So, eventually I said I just don't like this. None of the team liked it and so we had a meeting so we've eventually just stopped, we stopped doing it'. (10134)*

Equally, as stated above, the mandated activities are a predominant part of this section of the process. The quote below highlights the mandated nature of the various activities such as PDSA cycles, Action effect diagrams.

*'I feel like they send you a lot of stuff, or treat you like a school kid again, giving you homework and stuff like that'. (10134)*

The requirement to complete and enact various activities such as PDSA cycles, stakeholder mapping worked alongside the mandated interaction. There was a duality evident; an increase of required activity created an increase level of interaction and a required increase in interaction created an increase in level of activity.

With regard to the fellows' UoAs, as described above, very little is mandated, however they are made aware of the methodology and they are subject to the mandated aspect of communication i.e. they attend a facilitated meeting once a month. They do, however, also go through this development of feedback and multidirectional interaction. I noted, for example, early meetings within the process where they were asked to construct what they needed and wanted from the fellowship. There was a change that resulted over time that essentially moved the UoAs from a lot of discussion to activity. It was as the group moved through to a more interactive state that activity was created and enabled.

## **Summary**

The network moved forward in the process again via a set of mandated requirements from CLAHRC. These are mandated interaction and activities such as the enactment

of various CLAHRC methodologies. Alongside this the interactions demonstrated more reciprocity and therefore the knowledge transfer became more multi-directional as opposed to the linear direction of knowledge I characterised earlier in the process. This leads the group to become progressively more focused on the project activities and with it develop an identity to the network as I outline in the following section of the process framework - termed 'activity'.

## 7.4 ACTIVITY

Within this section I am going to outline the network as it reaches the state of 'activity'. It has at this point moved from being a collection of representatives convened to partake in the CLAHRC process to a group that has undergone the process of having to interact, learn specific methodologies and undertake various activities. At this stage the knowledge transfer network is interacting, it has established the details of the project to be undertaken, learnt the improvement methodology and the CLAHRC approach and developed a reciprocal interaction.

I am going to examine the 'activity' part of the framework by addressing the sub-themes and themes outlined in the table below. Following this I will again turn the discussion to the process the network undergoes that moves the network from a state of 'activity' to a network that is 'self-organising'. In other words the process through which it moves in order to organise itself and for it not to be organised and driven by CLAHRC as it still is at this point in the process.

2. Evolution				
Framework concept	Theme		Sub-themes	
Activity	2.7	Evolution of network activity	2.7.1	Balancing of mandated and emergent action
			2.7.2	Development of a shared identity
			2.7.3	Creation of a sense of ownership
			2.7.4	Inwardly focused
			2.7.5	Highly interactive network
			2.7.6	Hierarchy diminished
	2.8	Cross-boundary relations evolving	2.8.1	Within the UoAs
			2.8.2	Between UoAs and CLAHRC organisation
			2.8.3	Outside the UoAs
	2.9	Knowledge exchange evolving	2.9.1	Multi-directional knowledge exchange
			2.9.2	Knowledge transfer and sharing evolving
			2.9.3	Evolution of knowledge use
	2.10	Driving force	2.10.1	Facilitation

Table 7.13: A table to show the framework concept, theme and sub-theme for 'Evolution' - 'activity'

## 2.7 Evolution of network activity

### 2.7.1 *Balancing of mandated and emergent action*

I highlighted that at the 'development' stage there were issues experienced predominantly concerning the understanding and approach taken by CLAHRC and the extra overhead in terms of time requirements the CLAHRC work delivered to the teams. I note by this point that the demand on time remains but appears more manageable as understanding has developed. Equally, I note that the perspective of CLAHRC as an organisation and its approach had evolved.

Earlier the views were critical of the mandated nature of the approach. Whilst this remained to some extent, for example, they were still referred to on occasion as

'dictatorial and demanding' and 'they have hard and fast rules that they were not willing to flex on' the perspective had definitely started to include consideration with regard to the value in the mandated process they had been subject to thus far. For example, the following quotes demonstrate both the continued view of the mandated nature of the approach but also that something positive came out of it.

*'I think it's got benefits. I now think more about sustainability of projects. So it's changed, it's made sure that I think of that. But I think it was very regimented'. (10096)*

*'And it seems to be painful all the time. And then I do look back and I go, okay, I accept that that was a good thing to do'. (10103)*

Finally, I can draw on both the fellows and the project UoAs in order to compare the mandated approach vs a more emergent one. Highlighted above demonstrates how the perspective has moved from quite a negative stance to one that has started to see the value in it. The fellows on the other hand are not subjected to the same level of mandated actions. They unilaterally felt there was not enough structure to the programme and whilst they appreciated a level of autonomy over their programme more of a balance with demands and structure was required.

*'There's been a lot of opportunity to have consensus, and what would you like, and I think as mature people and mature learners that's really good. But I think it's about that balance between actually what's quite democratic and really what are the clear outcomes that CLAHRC wants to get at the end of the Fellowship really. So something that just weighs up that balance a bit more in terms of commitment and responsibility for delivering things'. (10085)*

This balance was also made evident in terms of requirement within the project UoAs. As I have outlined above the network at this stage had started to perceive a value in the mandated structure and this led to the following observation by a team member:

*'So I think what we've learned through CLAHRC is actually... although we wanted very much a bottom-up approach, you need both, and one or the other don't work. You have to have both. So you have to have a top-down support to say, yes, you need to do this with the bottom up then saying, okay, we do need to do it'. (10153)*

### **2.7.2 Development of a shared identity**

The group had at this point in the process developed a shared identity. They had built it from their shared experiences up to this point. The definition I use for shared identity within this study is a group of people who have come together and that are



able to 'generalise from individual encounters to a sense of solidarity with the broader community' (Muir, 2007). In this case in the process the members had a sense of togetherness and belonging. This was demonstrated by a number of aspects including how members of the UoA refer to themselves, a shared perception on which they act and the development of kudos in relation to them being associated with CLAHRC.

Shared identity was partly demonstrated in the project 'badge' by which they referred to themselves as JETSET or IMPE. At the start of the process the UoAs had to create a 'badge' with which to refer to the team and the project. These 'badges' had at this point moved into common parlance for the individuals.

Having observed the teams on the residential course where they were creating the team acronym/team badge, at this point it was clearly a reference term they were not used to or indeed identified with for the team. I noted how they did not refer to themselves in conversation as JETSET rather it was still 'the jaundice project'. However, as I met and observed these teams over time at various events this changed to clearly using the 'badge' in a way of referring to the team they belonged to. Equally, there was also the terminology for description of the team and project became much more collective if I look at the pronoun i.e. it had moved from 'I' to 'we':

*and we have to make sure we're doing certain things in order for us to get that funding, basically 112.529*

Another aspect relating to the shared identity is that of a shared perception. At this stage of the process, the individual's perception of the tools, approach or project was generally held by the participants as similar within any particular UoA (positive or negative). Alongside having a shared perception I could identify that it contributed to action. To highlight this I reiterate the example of the stroke project team outlined in the process section above. As a team there was a common negative perception associated with one of the tools they had learnt about and attempted to use. This resulted in rejection from the team as a whole to the point that the tool was not utilised as part of the project despite the original mandated intention from CLAHRC.

Finally, it was at this point I noted that participants were attaching a certain level of kudos to being part of CLAHRC and the project team. For example, one project

member specifically highlights the kudos that being part of the CLAHRC process offered.

*'kudos, status and kudos.....at one stage it was considered a good thing to do be able to get hold of some of the CLAHRC money.'* (10094)

*'Very, very good kudos to have a couple of CLAHRC projects'* (10094)

*'I know we're excited about it, because its kudos and all with national interest, but we can't forget what the project is about'.* (10086)

### **2.7.3 Creation of a sense of ownership**

I use the phrase sense of ownership here based on a definition that it relates to individuals who are 'intimately and authentically engaged' and who have influence of some sort over the outcome of the community (LaChapelle, 2008). Here I noted that the sense of control an individual perceives they have with regards contribution and direction increased. In other words the sense of ownership increased within the group.

One indication of the move to this sense of ownership within the group was first noted via terminology. Terminology in terms of the possessive pronoun had moved from 'the' project to 'our' project. For example,

*'so **our** length of stay has decreased'* (10080)

I can demonstrate this in a richer sense by highlighting some perspectives from individuals where this sense of ownership and ability to have an input and contribute was apparent and when on occasion it had not.

In the quote below a project member was discussing how they went about winning over other people to the change in process the project was creating. It is clear from this quote that there is a sense of ownership to the project outcome – a medication passport.

*'So there're certain particular people who the issue was that it would make their life harder or basically mean that they have so many more papers to carry around and do. It's just winning them over and the fact that in the long run if you do this now, it actually makes it easier. So with the medication passport if a patient has everything written down, the next time they come in it'll be easier for you, because you'll just look at this. So in that sense trying to incentivise them with what they... with what they want.* (10113)

Also, in another project where the changing political contexts were making the environment difficult they spoke of how they were established, people knew what they do and who they were. In the quote below the participant senses they have an identity within the location and alongside that or through that ownership and therefore the ability to keep the project on track.

*'And I guess that's [change in context] unpredictable, but it has nothing to do with CLAHRC and it's nothing that we could have controlled either. But we'll just have to kind of wait and see what happens. But it's like... because I think people know who I am now, it's unlikely to really affect it because luckily I've been in the post long enough. But if it happened at the beginning of the post, I think it would have completely thrown the project'. (10112)*

There was, however, some feedback from an individual who felt the opposite in terms of ownership and the ability to influence. It should be noted that this quote was from a project team who when mapped against this process structure had not reached this stage and therefore aids my ability to highlight the difference between the point at 'development' (no sense of ownership) and 'activity' (a sense of ownership).

*'there are some key personalities and key drivers within this that are basically saying, like it or lump it; do it. So feedback's not being taken onboard'. (10161)*

#### **2.7.4 Inwardly focused**

At this point the focus of the group has altered again. At 'start-up' I outlined that the focus of the group was on CLAHRC itself, then in 'development' it was focused on the purpose and internally, now in 'activity' it is focused on practice and internally. In other words the UoAs at this stage are actively going through the various activities surrounding the project including the use of the various tools. In doing so the project becomes more clearly defined as it is tested in context, altered and additional stakeholders brought in where necessary.

The predominance of the team to focus on its own group is outlined in a quote from a project member below:

*'But frankly when we're doing our own stuff we haven't got time to go and persuade another load of people and hold their hands and this that and the other.' (10115)*

As outlined above the fellows' UoAs were more focused on discussion. It was clear that they discussed broad topics such as political environment, any specific queries

regarding their individual projects and what training they would find useful. Alongside this more discursive focus the fellows' UoAs had a more outward view. As the group had less to focus on collectively they had a more outward looking prospect earlier along the process.

The fellows' group at this point demonstrated a shared identity in the same manner as described above. However, without the shared practice from a shared project goal the focus on practice was not observed within the fellows group. The fellows' group became more a community of cognition i.e. focused on understanding, reasoning, learning and general discussion. Please note the term cognition is used based on the definition of 'the process of acquiring knowledge and understanding through thought, experience' (Oxford dictionary, 1996). It was, however, evident that a sense of ownership had developed within the group. This was not necessarily around a common project in the same way that I saw in the projects; it was more related to their learning and the necessity to skill up. The fellows' programme as I have highlighted previously did not have the same mandated structure as the projects. In fact, one fellow stated 'there was a lot of chat but actually no action.' This lack of structure caused some issues in terms of direction and focus. It did, however, offer the group the ability to create and design their own programme to some extent. This I observed as the second group of fellows at this stage started to create additional sessions for the group to address specific training aspects that they were interested in developing.

*'At some point we took over, well not me personally, one of the girls took over running some extra sessions after our CLAHRC to be able to just do some extra support because we felt once a month just wasn't enough to be able to cover certain aspects'. (10108)*

At this stage the groups had become tightly bonded and sealed. It was more cohesive whereas earlier in the process the group demonstrated more diversity. Alongside this cohesion the focus of experience and involvement remained inward. It was close-knit and driven through practice i.e. the group's focus was the actual practice of doing the project itself. It has essentially moved from a group being held together by a common purpose, as in 'development' to a group being held together by practice, albeit with some facilitation still evident.

### **2.7.5 Highly interactive network**

At this point the group had become highly interactive. The UoAs networks were high density and importantly at this point the interaction above that which is mandated by CLAHRC had increased. The UoAs data that informed this part of the process were Anaes, Halc, Stroke, Alcohol, F1 and F2 (UoAs 3, 4, 5, 6, 7 and 8). The SNA data indicated that interaction increased in three aspects. These were any kind of interaction including that which was mandated (increase range of 16% to 92%), interaction above that which was mandated (increase range of 10% to 42%) and the frequency of interaction (increase range of 0.7 to 3.3). The increase above that which was mandated is particularly interesting as at the previous stage 'development' interaction had not increased above that which was mandated (see appendix 1 for SNA data tables).

Reciprocity had also increased at this point within the UoAs. Each of the UoAs demonstrated an increase to 100%, apart from the alcohol project team (UoA 6) where reciprocity stayed at the same level of 80%. (see appendix 1).

### **2.7.6 Hierarchy diminished**

In terms of hierarchy the UoAs overall demonstrate less hierarchy both in terms of structure and in terms of how centralised the interaction is. The centrality of any level of interaction reduces significantly in each case apart from UoA 8, the second fellows' group. This demonstrates a significant increase in centrality. Interestingly, apart from one anomaly (Halc project team) in both interaction above that which was mandated and in terms of frequency of interaction centrality reduces within the project groups. For example, the alcohol project team reduces from 43.8% (before) to 0% (during). In the fellow groups F1 and F2 centrality increases. For example, increases from 17.4% to 55.6% in terms of degree of centrality before and during the CLAHRC process (See appendix 1 for SNA data tables).

From a structural perspective the measures reduce to 0 based on Krackhardt's graph theoretical dimension measures. This is primarily because the efficiency score is reduced within the calculation i.e. there is more than one route to contact someone within the network (See appendix 1).

The reduction in hierarchy also was apparent from the analysis of the interview scripts. For example,

*'What I like about it is it is free of hierarchy, so when you go there you can get nurses, like, doctors sat next to you, so it gets through all of that' (10113)*

## **2.8 Cross-boundary relations evolving**

### **2.8.1 Within the UoAs**

Alongside this development of interaction and reduction in hierarchy I was able to identify at the various professional and organisational boundaries within the community the development of cooperation. This was evident as the various professional and organisational representatives were interacting more regularly and it was commented upon how useful it had been working with others from different professions and organisations. An example of this comes from a project member's response to a question asking about working with people from different professions. They stated:

*'Yes, so with the doctors, definitely. So I only worked with [person A] and [person B] before, they were pharmacists but with the different doctors it's been really good, and physiotherapists'. (10113)*

I was also able to identify, through a project that essentially failed to get through the entire process as delineated within these findings, neglect at the various boundaries and to some extent strain. There were a few key points regarding this project that are worth highlighting that led or at least contributed to the friction demonstrated at the various boundaries.

The project involved a combination of primary and secondary care. The participants started out as two separate projects and the one in primary care was already up and running before being involved with CLAHRC. This in particular was regarded as a hindrance by the clinician running it on the primary care side. Alongside this it appeared that to be involved with the project from the primary care side was not a choice and had been dictated by a senior member of the team.

*'So, it was a bit weird because it started, the work had started before CLAHRC became involved which has always made it very difficult. I think it was done in the wrong way; it doesn't work as well if you've got... I think it works well for the new projects'. (10096)*

*'My boss told me to. I mean I wasn't involved with the bid process at all. They bid for a couple of projects and when they got awarded it, they needed someone to do the work and so it was, like, you do this'. (10096)*

There were two problems that occurred during the process. Firstly, the senior member left and became distantly connected to the project and it became more difficult for the clinician running it to get the required time for the project. Secondly, the clinician expressed a problem with the CLAHRC methodology and approach. It 'fit' the secondary care side of the project well but was not suitable in the main for primary care.

*'So, but because [XX] was my boss then, he ran the practice as well - it's a PCT run practice - so he was just like, you need to go to CLAHRC, you need to go to CLAHRC. But when he left it was then much more difficult for me to get time away from the practice, because they needed to get a locum and that cost money, so that was much more difficult'. (10096)*

*'But one of the problems I would say about it was the methodology fitted perfectly into the secondary care arm...And at the beginning we had a real struggle trying to make people understand the difference of doing a project in primary care. I still don't think they could get their head round it'. (10096)*

It was also clear that there was a sense of strain between the project team and the CLAHRC organisation partly due to their inflexibility and partly due to the perception that the methodology did not 'fit' primary care. Interestingly, there was evidence of cooperation across the organisational boundary in this project as the clinical leads from both primary and secondary care felt they worked well together.

*'I project managed the GP arm of it, the primary care arm of it, and [person x] managed the secondary care arm of it, which is why the two of us work with each other. It went fine because we got on. If we hadn't have got on, then it would have been very different. But because we got on, it's been really very easy to work together'. (10096)*

I was also from the quantitative data able to analyse the interaction across pre-defined boundaries within the UoAs. As described previously in order to do this I utilised a calculation termed E-I index. This provides a measure of homophily i.e. how much of the interaction is 'like with like'. In other words the extent to which the group interacts within their predefined boundary. The E-I index is from (1) to +1. 0 to 1 is heterophilous i.e. the interactions are with others from a different partition and under 0 with those from the same partition. The three types of boundaries I

predefined were – job role (professional), where based (hospital or community) and stage in career.

At this point in the process the data indicated that with regard ‘job role’ and ‘where based’ the UoAs had become more heterophilous in terms of interaction i.e. doctor to doctor or hospital to hospital based. This is demonstrated when I compare the figures from before the process to during for UoAs Anaes, Halc, Stroke, Alcohol, F1 and F2. The table below highlights the figures with regard ‘job role’ and ‘where based’.

Stage	UoA	B4 E-I	During E-I	Stage	UoA	B4 E-I	During E-I
JR	Ana	1.00	0.50	Based	Ana*	-1.00	-1.00
JR	Halc	0.04	0.19	Based	Halc	0.33	-0.01
JR	Stroke	0.21	0.30	Based	Stroke*	-1.00	-1.00
JR	Alcohol	-0.49	-0.21	Based	Alcohol	-0.54	-0.39
JR	F1	1.00	0.58	Based	F1	-0.62	-0.05
JR	F2	0.34	-0.01	Based	F2	-0.58	-0.08

7.14: A table to show the calculated E-I index measure for pre-defined partitions (Job Role and Based) before and during the CLAHRC process \* N/A – Based in same location

With regard to ‘stage of career’ the UoAs had become, in general more homophilous, i.e. early stage to later. This is demonstrated when I compare the figures from before the process to during for UoA Anaes, Halc, Stroke, Alcohol, F1 and F2. The table below highlights the figures with regard ‘stage of career’.

Stage	UoA	B4 E-I	During E-I
CS	Ana	1.00	0.32
CS	Halc	0.19	0.07
CS	Stroke	-0.28	-0.29
CS	Alcohol	0.54	0.21
CS	F1	-0.62	-0.01
CS	F2	-0.52	-0.46

7.15: A table to show the calculated E-I index measure for pre-defined partitions (Career stage) before and during the CLAHRC process

### **2.8.2 Between UoAs and CLAHRC organisation**

In addition to within group interaction increase there is also an increase in terms of interaction between the UoAs and the CLAHRC organisation (see appendix 1). In all



UoAs this rose to 100%, i.e. all members of the UoA were interacting with CLAHRC. It was less clear in terms of interaction above that which was mandated, however there was still an increase observed. For example, the stroke project team increased its interaction above that which was mandated from 38% to 88%.

I found a range of boundary relations between the UoAs and the CLAHRC organisation. These included supportive, neglected and strained. Evidence for boundary strain came predominantly from the interviews when participants were discussing the relationship across the CLAHRC to project team boundary. This was demonstrated earlier in the process as well (see above). The quotes below highlight this boundary strain.

*'if they could see something in it for them, like, they thought they were going to get publication they'd suddenly get involved and then you would hear nothing and you'd get lots of broken promises'. (10117)*

*'But, the final report, ... again the bureaucracy; they gave us a format and then they gave us some big BMJ paper or some sort of paper framework. And so we put a lot of time in [completing the report] and we haven't had a response, and I don't feel confident you get one.' (10094)*

*'An email normally. We still haven't had this or whatever it is....: So, it's like they often want a lot of things from us, but we don't necessarily get what we're asking them for immediately'. (10112)*

This strain between the UoAs and the CLAHRC organisation impacted action by the UoAs participants. It was clear despite demands from CLAHRC that it did not always create action or at least not immediately.

*'[Email] mainly, yes, telling me to do things. No, and so I get follow-up urgent email. [And then maybe action it] Yes'. (10134)*

Equally, in some cases it was clear that between the UoAs and the CLAHRC organisation it was deemed a supportive relationship, although this was not as prominent at this point as the evidence of strain.

*'We were... I was going to keep doing it just means nothing to me but she's, like, if you don't agree with it, don't do it. So quite supportive'. (10135)*

I outlined above that within the UoAs during the process from moving from 'development' to 'activity' that the interaction had become more reciprocal and knowledge transfer multidirectional. Whilst I do not have a quantitative reciprocity

measure between the UoAs and the CLARHC organisation I was able to observe the CLAHRC organisation had become more responsive as an organisation to the participants of the process. An example I was given was around patient stories. Patient stories were a requirement introduced by CLAHRC at a collaborative learning event. The project teams had to collect patient stories that were relevant to the project. Initially, the UoA was told to do everything including the videoing and editing. The UoA fed back that whilst able to do the groundwork they were not experts on video editing and so if they did the groundwork would CLAHRC find someone skilled to edit it. CLAHRC did this and got an external company to do all the video editing.

*'I think CLAHRC have relaxed a little bit, I think they've changed...they've taken on feedback. I know they always say this, oh, at CLAHRC we always take on feedback, and a lot of organisations say that, but I think these guys genuinely do'. (10086)*

### **2.8.3 Outside the UoAs**

At this stage the UoAs are at least attending each quarterly CLD event and possibly more facilitated events around, for example, public patient engagement. I found here that whilst attendees still focused primarily on their project team time there was some interaction away from the project team. Attendees tended to meet between presentations or over the lunch break and through conversation found something useful. So, there was low contact but some value attained ranging from it being useful seeing how others were approaching their projects through to making specific contacts with those that were doing a project in a similar domain. The quotes below highlight these aspects.

*'where there are people I think could help me with a project, so I spoke to the director a couple of times'. (10084)*

*'so that was quite useful, just seeing what other people were doing and setting it up'. (10134)*

*'It wasn't very specific, although, actually, with XX it was.... I know I never emailed any of them, it was just... I mean I did actually with XX; with XX it was detailed, about information tools; how to'. (100077)*

As described above in 'development' the characterisation of the relational ties perceived at this point outside the UoAs is difficult to define with reference to commonly used definitions of either weak or strong. The tie at this stage remains in the realm of 'weak', however, when compared to the relational ties across the process it demonstrated a difference in that whilst contact was low there was clearly

a value perceived in it. Here, the relational ties outside the UoA were of limited contact but with some perceived value and traction achieved from it. When compared across the other characterisations found across the process I termed this a footprint 'mark'. This definition and term was synthesized from the analysis of the results and not an applied term and definition from literature.

The CLAHRC organisation was also deemed to have some influence across boundaries. It was commented on that it had an ability to network people together from a wide sphere crossing various boundaries – organisationally and professionally.

*'CLAHRC are extremely very well networked themselves, so again, some of the links we made to the project, some of the speakers we get at the CLD events, we wouldn't get that without CLAHRC, you know, you wouldn't have that sort of far reaching influence'. (10086)*

## **2.9 Knowledge exchange evolving**

### **2.9.1 Multi-directional knowledge exchange**

At this point I note an increase in reciprocity and the development of feedback loops that creates a change to the process by which knowledge is being transferred. The transfer of knowledge at this stage is multidirectional.

I outlined in 'development' that the group had built a shared knowledge around three aspects: the CLAHRC methodology, each other's specialist knowledge and the proposed schema of the project. As a result of the focus on activity inherent at this stage of the process the UoAs were utilising each aspect of their shared knowledge and essentially in doing so modifying and creating the outcome of the project practice itself i.e. a new discharge process.

### **2.9.2 Knowledge transfer and sharing evolving**

I found at this point in the process from the quantitative data that within the UoAs the knowledge transferred was evenly split in terms of which type of knowledge exchange is more prevalent between explicit knowledge transfer and tacit knowledge sharing. As the table below shows UoAs Ana, Halc and Alcohol have a higher level of explicit knowledge transfer and UoAs Stroke, F1 and F2 have a higher level of tacit knowledge sharing.

UoA	EK	TK
<b>Ana</b>	5.10	4.90
<b>Halc</b>	6.40	3.60
<b>Stroke</b>	4.50	5.50
<b>Alcohol</b>	5.10	3.70
<b>F1</b>	0.80	1.90
<b>F2</b>	2.90	3.00

Table 7.16: A table to show the calculated densities for EK and TK networks within UoAs

Knowledge exchange was predominantly explicit transfer between the UoAs and CLAHRC organisation as the table below delineates (only F1 has a higher tacit knowledge exchange with the CLAHRC organisation).

UoA	EK	TK
	<b>C(O)</b>	<b>C(O)</b>
<b>Ana</b>	6.00	4.00
<b>Halc</b>	8.20	1.80
<b>Stroke</b>	8.88	1.13
<b>Alcohol</b>	8.25	1.78
<b>F1</b>	2.56	7.44
<b>F2</b>	5.50	1.90

Table 7.17: A table to show the calculated densities for EK and TK networks between the UoAs and the CLAHRC organisation

There was also a higher level of reciprocity shown in the tacit knowledge exchange within UoAs Ana, Halc, Stroke, Alcohol, F1 and F2. For example, the Stroke project team showed 100% tacit knowledge sharing but 79% explicit knowledge transfer. The only UoA to differ was the Alcohol project team which showed higher reciprocity with explicit knowledge transfer (80% tacit reciprocity and 100% explicit). (see appendix 1).

With regard to vertical differentiation within the network and related to type of knowledge exchange I found that there was a mix in my UoAs between tacit knowledge exchange showing a higher level of centrality and explicit knowledge exchange. It should be noted, however, that the difference between each UoA's level of explicit and tacit knowledge exchange centrality was higher than in 'development'. In 'development' it averaged 6% and at this stage 13%.

UoA (%)	EK	TK
<b>Ana</b>	17.20	31.70
<b>Halc</b>	14.00	36.70
<b>Stroke</b>	48.80	32.10
<b>Alcohol</b>	31.90	42.50
<b>F1</b>	19.00	6.90
<b>F2</b>	28.10	19.10

Table 7.18: A table to show the degree of centrality in the EK and TK networks

If I look at the results in the table below, in terms of structure overall it was only explicit knowledge exchange in F2 fellows UoA that demonstrated any hierarchy.

UoA	Ana	Halc	Stroke	Alcohol	F1	F2
<b>EK</b>	0.00	0.00	0.00	0.00	0.00	0.06
<b>TK</b>	0.00	0.00	0.00	0.00	0.00	0.00

Table 7.19: A table to show the krackhardt theoretical measure for EK and TK networks

I was also from the quantitative data able to analyse the interaction across pre-defined boundaries in terms of type of knowledge exchange across that interaction. So, with regard to type of knowledge exchange i.e. explicit and tacit the results indicate that they are the same at this stage as they were in 'development' with regard the boundary of 'job roles'. The knowledge exchange is, in general, more on the heterophilous side of the scale (0 to 1). However, the boundaries of 'where based' and 'stage of career' both show, in general, more homophilous measures based on the scale (0 to -1). Table 7.20 below outlines the data.

Equally, if I compare the results for tacit and explicit knowledge exchange with regard each defined boundary the 'where based' boundary and 'stage of career' tacit knowledge sharing was more heterophilous than explicit knowledge transfer as in the 'development' stage. With regard to job role, however, tacit knowledge was more homophilous i.e. the opposite to what was demonstrated in 'development' and explicit knowledge was more heterophilous. Table 7.20 below outlines the data.

UoA	Partition	EK	TK	Partition	EK	TK	Partition	EK	TK
Ana	JR	0.68	0.65	Based	N/A*	N/A*	CS	0.11	0.58
Halc	JR	0.28	0.01	Based	-0.02	0.28	CS	0.17	0.28
Stroke	JR	0.62	0.20	Based	N/A*	N/A*	CS	-0.29	-0.17
Alcohol	JR	0.16	0.03	Based	-0.26	-0.15	CS	-0.02	0.33
F1	JR	0.66	0.55	Based	-0.61	0.12	CS	-0.15	-0.06
F2	JR	0.16	-0.07	Based	-0.09	0.08	CS	-0.56	-0.38

Table 7.20: A table to show the calculated E-I index measure for pre-defined partitions within the EK and TK networks (Job Role, Where based, Career stage). \*N/A – Based in same location

### 2.9.3 Evolution of knowledge Use

Another aspect relating to the knowledge transfer aspect of the network is that of knowledge use. As above I look at three types of knowledge use. These were conceptual knowledge use, symbolic knowledge use and instrumental knowledge use. For clarity, conceptual knowledge use is knowledge that is used as ‘general enlightenment’, symbolic knowledge use is knowledge that is used to confirm an approach or position and instrumental knowledge use is knowledge that is put it into practice. For each type of knowledge use I collected data relating to the knowledge use type with regard to how knowledge was received explicitly and tacitly.

To aid understanding of the results below I briefly highlight three aspects that I look at for each type of knowledge use, both within the UoAs and between the UoAs and the CLAHRC organisation. These include:

- a) What type of knowledge use was evident and the predominant type of knowledge use when knowledge is delivered explicitly and tacitly
- b) Compare the predominant type of knowledge use between when the knowledge is delivered explicitly and tacitly

a) At this stage I note that the symbolic use of knowledge was highest in both explicit and tacit knowledge exchange i.e. the knowledge that was received was used to confirm an approach or position. There was, however, more of a mix in the results i.e. across the UoAs at this stage some had other types of knowledge use as the predominant type.

If I look between the UoAs and the CLAHRC organisation, however, I can see that whilst symbolic knowledge use is the highest type across tacit knowledge exchange it is instrumental across explicit knowledge exchange. Again, there is a mix in the results and these are just the most prominent ones. Table 7,21 below outlines the data.

b) There is a mix in terms of which type of exchange (explicit or tacit) demonstrated a higher level of a particular knowledge use within each UoA. It was only with regard to symbolic knowledge use that tacit exchange marginally produced a higher level of use than via tacit knowledge exchange.

Between the UoAs and CLAHRC there was also a mix in term of which type of exchange (explicit or tacit) demonstrated a higher level of a particular knowledge use. It was only with regard to instrumental knowledge use that explicit exchange marginally produced a higher level of use than via tacit knowledge exchange. It is also worth highlighting that there were more UoAs that did not demonstrate any tacit knowledge instrumental use with the CLAHRC organisation at all. These were the project teams Ana, Alcohol and fellows team F1. Table 7.22 below outlines the data.

UoA (%)	EK Use			TK use		
	Conceptual	Symbolic	Instrumental	Conceptual	Symbolic	Instrumental
<b>Ana</b>	25.00	37.50	37.50	0.00	50.00	50.00
<b>Halc</b>	6.70	53.30	40.00	8.30	25.00	66.70
<b>Stroke</b>	3.80	30.80	65.40	2.60	53.80	43.60
<b>Alcohol</b>	20.00	20.00	60.00	16.70	66.70	16.70
<b>F1</b>	7.60	84.60	7.70	66.00	17.00	17.00
<b>F2</b>	32.90	38.60	28.60	38.10	45.20	16.70

Table 7.21: A table to show the % of different knowledge use types resulting from explicit transfer and tacit sharing within the UoAs

UoA	EK Use			TK use		
	Conceptual	Symbolic	Instrumental	Conceptual	Symbolic	Instrumental
	C(O)	C(O)	C(O)	C(O)	C(O)	C(O)
<b>Ana</b>	0.33	0.33	0.00	0.00	0.67	0.00
<b>Halc</b>	0.00	0.60	0.00	0.00	0.00	0.20
<b>Stroke</b>	0.13	0.13	0.38	0.13	0.00	0.38
<b>Alcohol</b>	0.25	0.25	0.50	0.25	0.50	0.00
<b>F1</b>	0.11	0.33	0.11	0.44	0.11	0.00
<b>F2</b>	0.17	0.25	0.33	0.17	0.33	0.25

Table 7.22: A table to show the density of different knowledge use types resulting from explicit transfer and tacit sharing between the UoAs and the CLAHRC organisation

As above I look at the vertical differentiation i.e. hierarchy of the network but this time in relation to the type of knowledge use.

There is not a clear outcome at this stage as to what type of knowledge use is more centralised. Symbolic knowledge use comes up as the most centralised in both the case of explicit and tacit knowledge exchange, although this is not clear cut in the data. This is also the case if I compare which of the types of knowledge exchange (EK or TK) demonstrates the highest centrality i.e. there is no clear answer as there is a mix of results in each. Table 7.23 below outlines the data.

(%)	EK			TK		
	Conceptual	Symbolic	Instrumental	Conceptual	Symbolic	Instrumental
<b>Ana</b>	44.40	66.70	22.20	0.00	66.70	22.20
<b>Halc</b>	16.00	32.00	40.00	16.00	40.00	48.00
<b>Stroke</b>	10.90	45.30	62.50	10.90	42.20	62.50
<b>Alcohol</b>	6.25	56.30	50.00	6.25	37.50	25.00
<b>F1</b>	9.90	84.00	17.30	37.00	88.90	77.00
<b>F2</b>	77.80	29.90	30.60	47.90	45.80	35.40

Table 7.23: A table to show the degree of centrality for each type of knowledge use and each knowledge exchange

As above I also looked at the knowledge use in relation to a set of pre-defined boundaries. This is in relation to both when knowledge is transferred explicitly and tacitly. Again, I looked at pre-defined boundaries of stage of career, job role and where based and I outline the results for each in turn below.

With regard to the career stage partition, for each type of knowledge use – conceptual, symbolic and instrumental - the knowledge received explicitly in general



was a mix of heterophilous and homophilous measures and tacitly it was predominantly more homophilous. In both the case of explicit knowledge and Tacit knowledge exchange the knowledge that was most heterophilous in terms of type of use was symbolic as in ‘development’, although again it should be noted there is a mix in the results. In other words the knowledge received by a participant explicitly that was used symbolically came from another participant that was not at the same career stage. Table 7.24 below outlines the data.

If I compare the level of heterophily between types of knowledge use in relation to knowledge that is received explicitly or tacitly I note that there is only a definitive result with regard symbolic knowledge use whereby it is less heterophilous when knowledge is exchanged explicitly. Both conceptual and instrumental knowledge use showed a mixed result i.e. some were equal, more or less. Table 7.24 below outlines the data.

CS	EK			TK		
	Conceptual	Symbolic	Instrumental	Conceptual	Symbolic	Instrumental
<b>Ana</b>	0.00	0.33	0.33	-1.00	0.50	0.33
<b>Halc</b>	1.00	0.25	0.00	1.00	0.50	0.00
<b>Stroke</b>	-1.00	-0.25	-0.53	-1.00	-0.05	-0.53
<b>Alcohol</b>	0.33	0.33	0.11	0.00	0.50	-0.33
<b>F1</b>	-1.00	0.27	-0.33	-0.14	0.56	-0.11
<b>F2</b>	-0.64	-0.41	-0.47	-0.30	-0.30	-0.62

Table 7.24: A table to show the E-I index measure for each type of knowledge use and each knowledge exchange (Key - CS = Career stage)

Moving on to the job role partition for each type of knowledge use. For both explicitly shared knowledge the most heterophilous is conceptual knowledge use and for tacit it is symbolic. There is, however, a mixture of UoAs demonstrating the other types of knowledge use as being for that network the most heterophilous. In other words this means that in the case of knowledge received explicitly and that was used conceptually more often came from another participant that represented a different job role. Again there is a mix in results, as to which is more or less heterophilous if I compare each type of knowledge exchange. Table 7.25 below outlines the data.

JR	EK			TK		
	Conceptual	Symbolic	Instrumental	Conceptual	Symbolic	Instrumental
<b>Ana</b>	1.00	0.33	0.33	0.00	1.00	0.33
<b>Halc</b>	-1.00	0.50	0.00	-1.00	0.50	0.00
<b>Stroke</b>	1.00	-0.25	0.18	1.00	0.05	0.18
<b>Alcohol</b>	1.00	-0.33	0.11	1.00	0.00	-0.31
<b>F1</b>	1.00	0.82	1.00	0.54	0.78	0.33
<b>F2</b>	-0.09	-0.11	0.05	-0.07	-0.35	0.14

Table 7.25: A table to show the E-I index measure for each type of knowledge use and each knowledge exchange (Key - JR = Job role)

Finally, with regard to the where based partition. Here I note conceptual knowledge use as being the most heterophilous in both explicit and tacit knowledge exchange, which is the same as in 'development'. In other words knowledge that is received explicitly and used conceptually most often came from a participant based elsewhere. Again, if I compare the level of heterophily between types of knowledge use in relation to knowledge that is received explicitly or tacitly it shows that there is a mix between which type of knowledge is more or less heterophilous when comparing explicitly exchanged knowledge and tacitly exchanged knowledge. Table 7.26 below outlines the data.

Based	EK			TK		
	Conceptual	Symbolic	Instrumental	Conceptual	Symbolic	Instrumental
<b>Ana*</b>	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00
<b>Halc</b>	1.00	0.25	0.33	1.00	0.00	0.50
<b>Stroke*</b>	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00
<b>Alcohol</b>	-0.33	-0.33	-0.11	0.00	0.00	-0.33
<b>F1</b>	-1.00	-0.27	-0.33	0.09	-0.11	0.11
<b>F2</b>	0.27	-0.11	-0.58	0.26	0.12	-0.62

Table 7.26: A table to show the E-I index measure for each type of knowledge use and each knowledge exchange (Based) \* Located same place so not applicable

## 2.10 Driving force

### 2.10.1 Facilitation

The most significant force at this point in the process as before remains that of the organisational broker (CLAHRC), although this has started to reduce. One individual referred to the change as CLAHRC relaxing their input but still receiving requests from time to time:

*'So I think CLAHRC have relaxed their approach. They still do the whole, you need to give us sustainability scores every quarter, you still need to give us....' (86.681)*

## **Summary**

The main points at the stage of 'activity' include a group that is highly interactive and focused on the activity of the project. The group has established a shared identity and a sense of ownership to the project. The hierarchy in the group has reduced and where there is interaction between boundaries within the UoAs there is cooperation. In less successful groups there was neglect and strain delineated at the boundaries. At this point the UoAs is interacting more with the CLAHRC organisation. There is evidence to suggest differing relations between the UoAs and the CLAHRC organisation including supportive and strained. At this point the group may still have a negative view of the CLAHRC approach but individuals are starting to see the value in them. Explicit knowledge is the predominant exchange with the CLAHRC organisation. CLAHRC are still involved as the driving force but there are signs that this is lessening. Finally, there are varying levels of different types of knowledge use at this point for knowledge received tacitly and explicitly.

There is a distinct possibility that the group remains at this stage as it has become very closed and inward focused. The groups that had moved past this stage had started to spread the project changes to a wider sphere. The CLAHRC representative actively present provided a reminder and direction of the need to spread the project change and this was done to a tight timeframe all of which combined to prevent complete group closure and stagnation as I describe in the next section 'External Boundary Spanning'.

## 7.5 EXTERNAL BOUNDARY SPANNING

Within this section I am going to unpack the process by which the network moves from the state of ‘activity’ to a state of ‘self-organising’ specifically as a result of the CLAHRC driving the group to move to a more outward looking group via a requirement to spread the project change out and to do so within a relatively tight timeframe.

The table below highlights the theme and sub-themes which underpin the process theme of Boundary Spanning. The discussion of the findings below are organised with reference to each.

2. Evolution				
Framework construct	Theme		Sub-themes	
External Boundary Spanning	2.11	Transition	2.11.1	Mandated spread and timeliness

Table 7.27: A table to show the framework concept, theme and sub-theme for ‘Evolution’ – ‘External Boundary Spanning’

### 2.11 Transition

#### 2.11.1 Mandated spread and timeliness

There are three distinct aspects that drive the process forward from ‘activity’. These are the inclusion of a CLAHRC member within the group, a mandated timeline for the delivery of outcomes and the mandated deliverable to include the wider teams of which each group member is a representative. I unpack each of these aspects further below. However, in essence it ensures the knowledge transfer boundary network moves forward from the ‘activity’ stage because these three aspects combine to prevent the network from either becoming or remaining bonded in a sealed manner.

A project had an 18 month timeframe in which to deliver its outcomes. This was an absolute deadline and created a drive to keep moving the project forward. The quote below highlights an interviewee’s view of the time period available for the process. There was a sense of urgency and continued pressure to keep the project moving

and this prevented the group from remaining in a cohesive, inward looking state I delineated in 'activity'.

*'... I almost feel that 18 months is too short for, to learn improvement methodology within a busy'. (10153)*

Whilst I highlighted in the commentary surrounding 'activity' that CLAHRC's involvement had reduced it was still present and importantly from the very beginning of the process it was clear that there was a timeframe in which the team had to deliver the outcomes. I observed this requirement throughout the process and the reason the group remained cognisant of this was due to the inclusion of a CLAHRC member to the project team (UoA). In other words the inclusion of a CLAHRC member into the project team prevented the team becoming too tightly sealed and separated from the wider environment. The quote below demonstrates the level of contact a project member states that they have with their CLAHRC project team member.

*'I've got one person in my mind [CLAHRC project member] immediately who I just think I lost hours and hours' (10096)*

Another aspect that was a strong part of CLAHRC's requirements surrounded sustainability. For a project's outcome to deliver on sustainability there was a strong focus on including the other members of the team from which the participant was representing. In other words there was a drive to embed a new process or action into the wider care pathway network. This was an important part of the success of a project and as such it enabled the group to move forward from becoming too insular and looking only inward.

*'I mean, the project's really been centred... with all the talks we were having, is centred on sustainability... I would hope to think that the project we do allows it to be embedded.' (10153)*

As a result the project team worked to embed the new process within the care pathway. The key aspect was to move the project from being done by those who were part of the project team to those in the wider care pathway. As the quote below highlights the challenge is to get it to run smoothly when the project team is not present.

*'And it's, that's the challenge, trying to get things in place that when we're [the project team] not there, things still tick along'. (10134)*

This engagement and spread to the other individuals within the care pathway and the professional and/or organisational areas the individuals were representative of had a certain amount of difficulty.

This difficulty resulted from a number of different reasons. For example, there was a need to clarify the need for the change. The team often met with views that they were already doing whatever the change was supposed to instigate.

*'had the view that for him it doesn't work, it's a tick box exercise, because he does this anyway in his practice'. (10113)*

Equally, there was the problem surrounding the constant change of personnel. This depended to some extent on the level the change was targeted at. Within a care environment there is a working rotation for trainee level doctors, for example. For those projects where the change was at a trainee level as the training cycle came round there was an on-going need to keep training and embedding the process.

*'just even within my, like, rotation, you know, [person A] has taken it over and she's now involved'. (10139)*

The methods that the projects utilised with regard to engagement varied. A project member even commented on how random the approaches that they as a team utilised.

*'Well everyone tells me, there are magic formulas about spending time and making them feel like everyone's doing it, but actually I find it's quite random'. (10159)*

It was suggested by some that in order to instigate change 'you need high-level support' (10153), you need 'repetition' (10154), and making it clear the value they would gain from doing it, for example, less waste would equal greater efficiency. The view was then that 'people sort of think, oh yes, I see, maybe it is a point; I will do it now'. (10159)

## **Summary**

The network has the momentum to move forward from the 'activity' phase due to three reasons, which combine to create a network that does not become completely sealed and stagnant. The core network itself has a CLAHRC member in it, there is an aggressive timeframe in which to deliver the project and there is a requirement for the project to be embedded with a wider sphere of people than just those in the

project team. This leads the group to move forward to being able to look outwards from the group itself and become 'self-organising' as I outline in the following sections of the process framework - termed 'reiteration'.

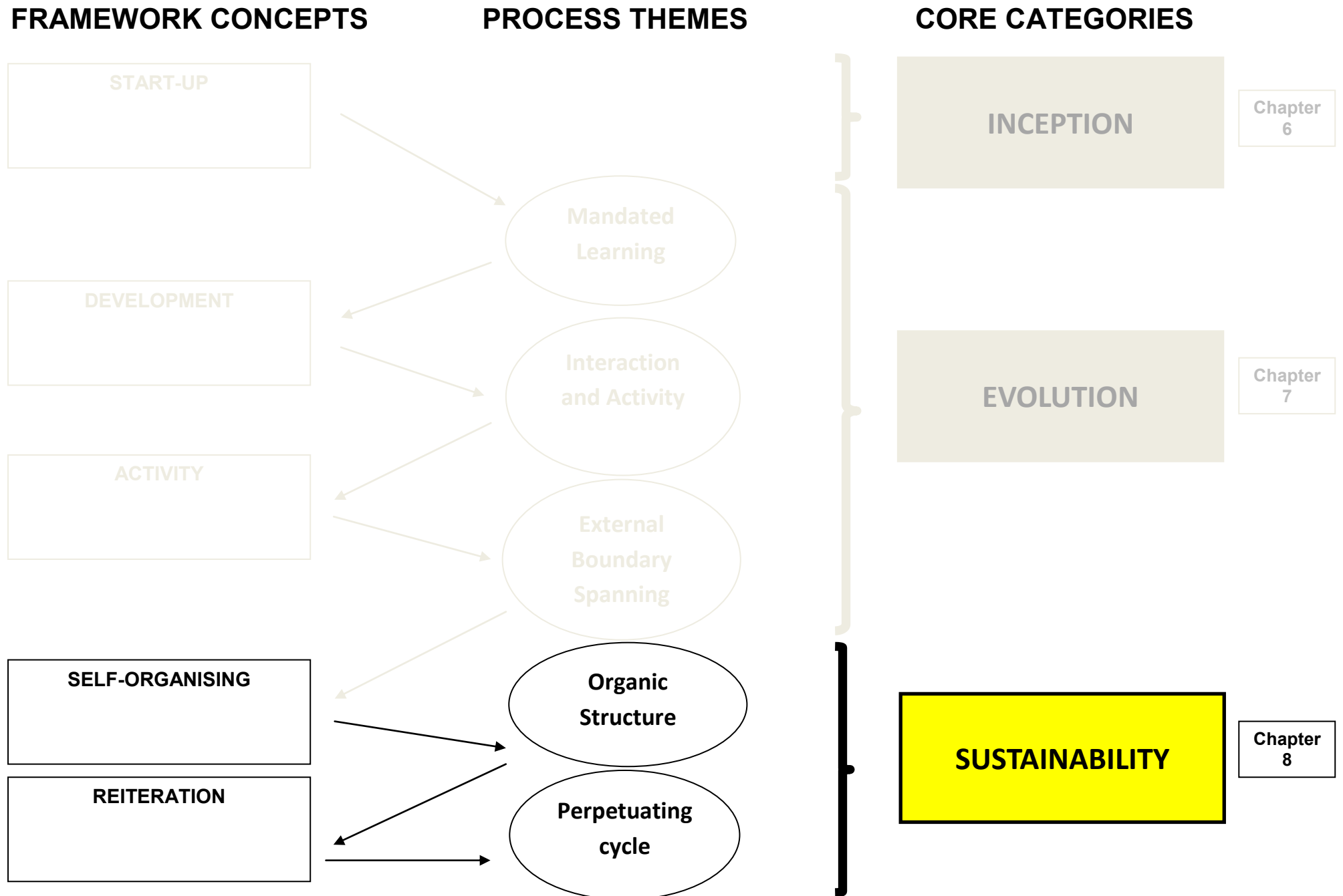
## **CHAPTER 8: SUSTAINING**

In the previous chapter I outlined the themes and aspects that were evident as the network evolved across the process. Within this section I move on to outline the results with regard to the core category of sustainability. In other words what I found in those networks that reached a stage of being self-driven and self-organising. In the same structure as in the previous chapters I am going to do discuss this by delineating the process through which the network goes and identifying the various phases the findings demonstrated i.e. from 'self-organising' to 'reiteration'.

The diagram below outlines the overall findings – the conceptual framework of the evolution of a KTBN. The core category of sustainability and the relevant framework construct and process themes discussed within this chapter are highlighted.



**Fig 8.1: CONCEPTUAL FRAMEWORK OF THE EVOLUTION OF A KNOWLEDGE TRANSFER BOUNDARY NETWORK (KTBN)**



## 8.1 Self-organising

Within this section I am going to outline the network as it reaches the point of being 'self-organising'. I described above the process of how the network continued past 'activity'. It was essentially encouraged to do so as a result of a requirement to complete within a short timeframe, continued influence from CLAHRC and the requirement to incorporate their wider networks within the care pathway of which they are a representative member.

I am going to discuss in this section how the network as a result of the process to look outward actually moves to a state of 'self-organising'. Following this I will again explore the process that I found moved the network from a state of 'self-organising' to a network that could 'reiterate' when required.

I will discuss the various aspects of this by unpacking each of the relevant themes and sub-themes highlighted in the table below.

<b>3. Sustainability</b>				
<b>Framework concepts</b>	<b>Theme</b>		<b>Sub-themes</b>	
<b>Self-organising</b>	3.1	Self-organising network	3.1.1	Skill-set created
			3.1.2	Perceived value in process developed
			3.1.3	Common experiential knowledge developed
			3.1.4	Focus moving outwards
			3.1.5	Interaction levels sustaining
			3.1.6	Limited re-introduction of hierarchy
	3.2	Relations across boundaries developed	3.2.1	Within UoAs
			3.2.2	Between UoAs and CLAHRC organisation
			3.2.3	Outside the UoAs
	3.3	Knowledge exchange continuing	3.3.1	Knowledge transfer and sharing ongoing
			3.3.2	Knowledge use ongoing
	3.4	Driving force	3.4.1	Organically self-sustaining

Table 8.1: A table to show the framework concept, theme and sub-theme for 'Sustainability' - 'self-organising'

## **3.1 Self-organising network**

### **3.1.1 Skill-set created**

Within the data collection it was clear that participants at this point predominantly considered that they had increased their skill set. In fact, there was definitely a sense of passion for the personal skills gained from being part of the process. The skills learnt ranged from the CLAHRC methodology through to the ability to liaise with more senior people and practical skills e.g. presentation, data handling, negotiating and influencing. Finally, there was a clear sense that the skills gained had ultimately improved a participant's career prospects and development.

*'...the expertise on quality improvement. I feel I could go on a podium in Hyde Park, what do they call it? Speaker's corner, about quality improvement.'* (10086)

*'[Before CLAHRC] I don't think I had it in me to be able to, chair meetings with very senior people. I didn't think I had it in me to have meetings with the regional directors of places or actually negotiate the position of the project.'* (10086)

*'...and I'll go on record to say this, that the skills I've acquired in the last 20 months have been absolutely instrumental in me getting this [more senior post at a large hospital] job.'* (10086)

A couple of additional aspects a number of people credited as having resulted from the CLAHRC experience was that of awareness of the importance of patient engagement and involvement and sustainability. I highlight below a couple of quotes that highlight this perspective.

*'PPI [Public Patient Involvement] definitely...I learnt a lot about that'* (10115)

*'Sustainability, which is one of their themes, was shock, shock and more shock. We hated it. We thought it was such a waste of time, why are we doing this? And now, we cannot live without sustainability. It's the stuff I talk about at every talk.'* (10086)

### **3.1.2 Perceived value in process developed**

I highlighted in 'activity' that the UoAs had developed a shared identity - they had a shared perception (positive or negative) of a number of aspects ranging from the CLAHRC methodology through to the project itself. By this stage of the process this aspect of shared perception had developed further to being positive in the case of each UoAs. Aspects of the analysis that demonstrated this, for example, ranged from

volunteering to use the CLAHRC 'tools' again independently of CLAHRC, having bought in to the ideology and aligning with the outlook of the organisation.

*'Yes, I would definitely use the PDSA cycles and I would definitely use the stakeholder thing'. (10113)*

*'I think sort of the ideology and the methodology is good' (10111)*

There was also a sense at this point that the project outcome, the project team, CLAHRC approach and performance was justified i.e. that it had come together to be a legitimate and worthwhile approach and change. A good example of this comes from a project team member who expresses surprise that there was a real interest shown in the project.

*'I think it's going well. It's really surprising when you people are so interested in it, because by now it's just normal we're trying to get it out. But for this morning I met X, who is the medical director, so he asked me to come and give a five minute presentation. And when you do that, you realise that actually he's really interested, and you're like, oh, okay'. (10113)*

Another aspect regarding the perceived value having being created could be seen when looking at the data surrounding whether people would apply or be involved again if they had an opportunity. There was a strong response to this that they would apply again. Equally, leading on from the notion of applying to be involved again is around whether or not there was an appetite for recommending being involved to others. In the most part I also found that people would recommend to others to get involved.

*'I would as I've learnt a lot. I think it's given me a new perspective, so I would apply again'. (10113)*

*'I would thoroughly recommend the experience'. (10086)*

Another aspect I can draw upon to demonstrate that a level of perceived value had been built is by drawing on the responses to the question around whether they were supportive of their tax money to go to CLAHRC i.e. should it be re-funded in the next government bid. By this point in the process there was a positive consensus regarding the use of their tax money. In particular, there was support for funding the concept of service-based, translational research.

*'If I was a government? [Yes, it's your tax money] I would, I think I would'. (10113)*

Finally, at this point there was a strong sense that there was a consensus regarding the value of the process. For example, in the earlier part of the process there was commentary around the difficulty and issues participants felt toward the methodology and approach. I also highlighted at various points how participants were commenting on understanding the need for the methodologies and the approach. By this point the responses were generally more in line with the process being worthwhile and understanding the value of having gone through it.

### **3.1.3 Common experiential knowledge developed**

Having gone through the process together and, as outlined above, built a skill set and developed a perceived value regarding the approach and project change, I also note at this point the UoAs had a common understanding and knowledge base i.e. they had a common experience. This could be observed in the conversations that took place between members e.g. the casual inclusion of acronyms to their dialogue. Also, when there was a problem that arose there was a clearer sense of the group knowing how to handle it, where to go within the team for assistance.

### **3.1.4 Focus moving outwards**

At this point the focus of the group has altered again. At 'start-up' I described how the focus of the group was on CLAHRC itself, then at 'development' it was focused on the purpose i.e. the project outline and internally, in 'activity' it was focused on practice i.e. the activity of the project and internally and now at the stage of 'self-organising' the focus of the group moves outward. At this stage the UoAs are moving out of their team to engage with others. Initially this is with individuals from their representative care pathways and moving wider as the project becomes progressively more embedded. In short they increasingly have the capacity to engage with others.

*'...but they have some valid points, which you don't see some times when you look at the project, you become a little more focused on what you're doing and then other people's opinions tend to shed some light.'* (10113)

The group continued to work on the project and report the necessary data back to CLAHRC, collect relevant outcome measures and make alterations when necessary. At this point the group became less tightly bound not in terms of level of interaction necessarily but in terms of focus. As explained above the group's focus is more

external to itself than internal. A crucial point to note here, however, is that the group remained connected but was more self-organising and self-directed than in previous stages.

This was evident when looking across the UoAs at the various stages they were at in the process I was mapping out. The UoAs, which were at this stage of the process demonstrated this aspect well. There was a sense of independence and direction that had not necessarily been reached in other UoAs. This sense of self-organising was also commented on by a project member:

*'you know the drive came from them [the project team] because by now you are just, like, it's just normal we're trying to get it out'. (10113)*

Another quote also pertains to these groups being self-organising and self-directed or in their words the drive for the project coming from them. This person is in a good position to comment on this as they had been part of this particular project team and then moved on to another location where they happened to get involved in another CLAHRC project team. They were clearly noting the difference and in order for clarity the two projects they were comparing being a part of were at different stages in the process.

*'At [original location] I think, because the pharmacy team are there and obviously very enthusiastic about the project, you know the drive came from them....[whereas new location] it didn't really have that sort of drive to it to take it forward in terms of sort of meeting the deadline for getting all the other bits and pieces'. (10111)*

### **3.1.5 Interaction levels sustaining**

Despite the outward focus the quantitative data demonstrates that the UoA is still sustaining. The level of interaction, frequency and reciprocity continues at an increased level within the UoA. For example, if I compare the density of the network before CLAHRC and during CLAHRC the SNA data delineates an increase of 38% for the Jaundice project group for any kind of interaction and an increase of 18% in terms of interactions that are not mandated. Frequency also shows an increase of 2.2 and reciprocity remains at 100% (see appendix 1).

### **3.1.6 Limited re-introduction of hierarchy**

With regard hierarchy, in both structural and centrality terms the data demonstrate a difference at this stage. At the basic level (any level of interaction) and in terms of

frequency it still demonstrates the same as in 'activity' i.e. a lower centrality measure. However, at non mandated interaction levels and from a structural perspective a limited level of hierarchy appears to be evident again. For example, the degree of centrality has increased by 2% in the jaundice project team, whereas the UoAs at the 'activity' stage generally decreased. Also, with regard to the krackhardt hierarchical structural calculation it indicates an increase in the efficiency score (0 to 0.07) (see appendix 1).

## **3.2 Relations across boundaries developed**

### **3.2.1 Within UoAs**

At the boundaries – that of professional and organisational - I note that collaboration had been achieved. For example, a project manager states that from their point of view collaborative working across boundaries had been achieved by going through the process.

*'I think a lot of the things they do, some consciously, some probably subconsciously, do help that approach into the collaborative working across boundaries and networks and so on.'* (10086)

I noted cooperation occurring at the boundary level. I outlined in 'activity' that at that point I was noting neglect and strain at the boundaries. The project where I noted neglect did not reach this part of the process despite having completed its time with CLAHRC. I did not observe any neglect or strain at the various boundaries at this stage within the UoAs.

From the quantitative data I again was able to analyse the interaction across pre-defined boundaries. As before, with regard to interaction and relating to three types of boundaries – 'job role' (professional), 'where based' (hospital or community) and 'career stage' - again, I utilised the E-I index as a measure of homophily, i.e. how much of the interaction is 'like with like'. The E-I index is from -1 to +1. 0 to 1 is heterophilous i.e. the interactions are with others from a different partition and under 0 with those from the same partition.

At this point in the process the data indicated that with regard 'job role', 'where based' and 'career stage' the network had become more heterophilous with each type of boundary looked at. This is demonstrated when I compare the figures from

before the process to during for the jaundice project team. The table below highlights the figures with regard each pre-determined boundary. (See appendix 1).

Stage	UoA	B4 E-I	During E-I
JR	9	0.07	0.28
Based	9	-0.15	-0.08
CS	9	-0.97	-0.71

Table 8.2: A table to show the calculated E-I index measure for pre-defined partitions (Job Role, Based and career stage) before and during the CLAHRC process

### 3.2.2 Between UoAs and CLAHRC organisation

In addition to the continued increase within the group interaction the increase between the UoA and the CLAHRC organisation also remains increased. This follows a similar pattern as in the previous stage ‘activity’ in that interaction is considerably increased when looking at any level of interaction but not as much for interaction above that which is mandated and in terms of frequency of interaction. For example, the jaundice project team increased its interaction from 10% to 100% at any level of interaction and from 0 % to 30% for interaction above that which was mandated. Frequency density increased from 0.20 to 0.73 (please note these figures are ratios as it is based on valued data as opposed to binary – see appendix 1).

At the previous stage I outlined that there was strain evident at the boundary between the UoAs and the CLAHRC organisation. However, I found that where strain was perceived at the boundary between the UoAs and CLAHRC it was less evident at this point. In fact, where there had been strain in some cases the view of the relationship between the UoAs and the CLAHRC boundary had moved to that of, a supportive and responsive relationship i.e. interaction and assistance when required.

*‘So I think it [CLAHRC] gives me the support that if I needed to basically find out more about how to do something or how to approach something, they seem quite supportive in doing that. They hold a lot of their sessions that we go to, the CLD events, are a lot about approaching situations or like patient and public involvement. It’s quite informative in that sense’. (10113)*

### 3.2.3 Outside the UoAs

At this point the group is now in a position to be able to look outside of itself and engage on a wider basis. The first aspect of this is to engage with those in the care



pathway they are representing. They are able to do this at this point as alongside the mandated process they also now have assimilated the experiential knowledge, gained an understanding and created the change and therefore have the capacity to engage outside the network. In simple terms initially the workload makes it difficult to do anything other than what is core to the project itself. For example, when *'one location, has taken a huge amount of discussion, meetings, emails, papers, this that and the other'* (10151) the capacity to liaise and conduct anything non-core is difficult.

Alongside the engagement of the other members within the care pathway the group also has more capacity to enable it to engage and spread further afield. Up until this point in the process I have highlighted in the previous stages that there was low contact with regard to the wider sphere. Here, I note a shift to a higher level of contact. At this stage the group continues to attend the quarterly CLD events and other facilitated events around, for example, public patient engagement. Individuals attending had a higher level of contact as they now knew what to expect and were less overawed by the new terminology and approach and therefore had the capacity to meet and greet away from their inherent network. However, at this point the perception of the value gained from the interactions at the quarterly CLD events reverted back to a lower level, as opposed to within the 'activity' stage where the individuals suggested that they received value from the interactions they had at the wider networking events. So, individuals may have had a high level of contact, for example, extended interaction at a collaborative learning event but do not necessarily perceive value in it. For example,

*'that they've got great facility to be able to network you with other people...they know a lot of people. But that connection's too weak in our experience, to act on it. So, I think the challenge for CLAHRC is how to make that networking work for people, apart from being just nice and knowing lots of people which is frankly not productive. You get ideas, meet interesting people, but it's how to get some traction onto that networking.'* (10115)

When compared across the other characterisations found across the process I termed this a footprint 'etched'. This definition and term was synthesized from the analysis of the results and not an applied term and definition from literature.

### **3.3 Knowledge exchange continuing**

At this point knowledge transfer continues to be multi-directional and the knowledge within the group regarding methodology and new practice schema has become fully shared. These are the methodology and approach and the new practice schema. Alongside this to some extent there has been a certain amount of sharing of individual knowledge domains and therefore a more fluid structure to the specialised knowledge.

*'obviously when we're going through things and discussing issues and the experience of things that we've had. So lots of sharing, lots of openness and lots of knowledge passing'. (10104)*

#### **3.3.1 Knowledge transfer and sharing ongoing**

According to the quantitative results tacit knowledge remains the higher type of exchange at this stage within the Jaundice UoA. For example, the density of explicit knowledge within Jaundice was 4.4 and 5.1 for tacit knowledge. However, the exchange between the UoA and the CLAHRC organisation whilst still predominantly explicit knowledge there is a more even split between explicit and tacit knowledge exchange, density of 5.1 and 4.9 respectively. (See appendix 1).

As before reciprocity remains high and tacit knowledge exchange exhibits a higher level of reciprocity than with explicit knowledge exchange, reciprocity of 96% and 100% respectively. (See appendix 1).

With regard to vertical differentiation within the network and related to type of knowledge exchange I found that tacit knowledge was more centralised and that the difference between explicit knowledge centrality and tacit knowledge centrality remained high as I demonstrated in 'activity'. For example, degree of centralisation for explicit knowledge was 10.4% and for tacit 26.4%. If I look at the results in terms of structure overall no hierarchy was evident i.e. the krackhardt graph theoretical dimension was 0 for both explicit and tacit knowledge exchange. (See appendix 1).

I was also from the quantitative data able to analyse the interaction across pre-defined boundaries in terms of type of knowledge exchange across that interaction. So, with regard to type of knowledge exchange i.e. explicit and tacit the results indicate that for both 'career stage' and 'job role' explicit knowledge is more

heterophilous than tacit and vice versa for 'where based'. This was the same as in 'activity' apart from for stage of career. Here, it had moved from tacit knowledge being more heterophilous to explicit knowledge being more heterophilous. Table 8.3 below outlines the data.

Stage	UoA	EK	TK
JR	Jaundice	0.40	0.16
Based	Jaundice	-0.11	0.09
CS	Jaundice	-0.57	-0.65

Table 8.3: A table to show the calculated E-I index measure for pre-defined partitions within the EK and TK networks (Job Role, Where based, Career stage)

### 3.3.2 Knowledge use ongoing

As above I look at three types of knowledge use. These were conceptual knowledge use, symbolic knowledge use and instrumental knowledge use. For clarity, conceptual knowledge use is knowledge that is used as 'general enlightenment', symbolic knowledge use is knowledge that is used to confirm an approach or position and instrumental knowledge use is knowledge that is put into practice. For each type of knowledge use I collected data relating to the knowledge use type depending on how knowledge was received explicitly and tacitly.

As above to aid understanding of the results below I briefly highlight two aspects that I look at for each type of knowledge use, both within the UoA and between the UoA and the CLAHRC organisation. These include:

- a) understanding what type of knowledge use was evident and the predominant type of knowledge use when knowledge is delivered explicitly and tacitly;
- b) comparing the predominant type of knowledge use between when the knowledge is delivered explicitly and tacitly

a) At this stage within the Jaundice UoA I note that the symbolic use of knowledge was highest in both explicit and tacit knowledge exchange i.e. the knowledge that was received was used to confirm an approach or position. The data demonstrates that between the Jaundice UoA and the CLAHRC organisation, however, the predominant type of knowledge use is conceptual for both explicit and tacit exchange. Table 8.4 below outlines the data.

b) I also note that if I compare between explicit and tacit exchange the conceptual and instrumental knowledge use is higher in the case of explicit knowledge exchange but lower in symbolic. They are all, however, equal between explicit and tacit knowledge exchange between the Jaundice UoA and the CLAHRC organisation. Table 8.5 below outlines the data.

	EK Use			TK use		
	Conceptual	Symbolic	Instrumental	Conceptual	Symbolic	Instrumental
<b>Jaundice</b>	33.3	40	26.7	28.6	48.6	22.9

Table 8.4: A table to show the % of different knowledge use types resulting from explicit transfer and tacit sharing within the UoAs

	EK Use			TK use		
	Conceptual	Symbolic	Instrumental	Conceptual	Symbolic	Instrumental
	C(O)	C(O)	C(O)	C(O)	C(O)	C(O)
<b>Jaundice</b>	<b>0.20</b>	<b>0.10</b>	<b>0.10</b>	<b>0.20</b>	<b>0.10</b>	<b>0.10</b>

Table 8.5: A table to show the density of different knowledge use types resulting from explicit transfer and tacit sharing between the UoAs and the CLAHRC organisation

As above I look at the vertical differentiation i.e. hierarchy of the network but this time in relation to the type of knowledge use. Conceptual knowledge use demonstrates the most centrality in both the case of explicit and tacit knowledge exchange. If I also compare which of the types of knowledge exchange (EK or TK) demonstrates the highest centrality it appears that in the case of symbolic and instrumental knowledge exchange explicit knowledge is more centralised whereas for conceptual it is equal between the two. Table 8.6 below outlines the data.

(%)	EK			TK		
	Conceptual	Symbolic	Instrumental	Conceptual	Symbolic	Instrumental
<b>Jaundice</b>	35.00	33.00	30.00	35.00	25.00	28.00

Table 8.6: A table to show the degree of centrality for each type of knowledge use and each knowledge exchange

As before another aspect around the set of pre-defined boundaries I investigated is that of if and how the knowledge is used. This is in relation to both when knowledge is transferred explicitly and tacitly. Again, I looked at pre-defined boundaries of stage of career, job role and where based and I outline the results for each in turn below.

With regard to the career stage partition, for each type of knowledge use – conceptual, symbolic and instrumental - the knowledge received explicitly and tacitly was predominantly more homophilous. In the case of both explicit and tacit

knowledge exchange the knowledge that was most heterophilous in terms of type of use was conceptual. In other words the knowledge received by a participant explicitly that was used conceptually came from another participant that was not at the same career stage. Table 8.7 below outlines the data.

If I compare the level of heterophily between types of knowledge use in relation to knowledge that is received explicitly or tacitly I note that conceptual was equal and symbolic and instrumental was more heterophilous in explicit knowledge transfer. Table 8.7 below outlines the data.

Moving on to the job role partition the most heterophily can be seen with symbolic and instrumental knowledge use when explicitly exchanged and instrumental when tacitly exchanged. In other words this means that in the case of knowledge received explicitly and that was used symbolically or instrumentally they most often came from another participant that represented a different job role. If I compare each type of knowledge exchange I see a similar pattern as for career stage – conceptual use is equal between both explicit knowledge transfer and tacit knowledge sharing and symbolic and instrumental are both more heterophilous in the case of explicit knowledge transfer. Table 8.7 below outlines the data.

Finally, with regard to the where based partition. Here I note conceptual knowledge use as being the most heterophilous in both explicit and tacit knowledge exchange, which has been the same throughout. In other words knowledge that is received explicitly and used conceptually most often came from a participant based elsewhere. Again, if I compare the level of heterophily between types of knowledge use in relation to knowledge that is received explicitly or tacitly it shows that for conceptual knowledge it is equal, explicit knowledge transfer is less heterophilous in symbolic and more with regard instrumental knowledge use. Table 8.7 below outlines the data.

Partition	EK				TK		
	UoA	Conceptual	Symbolic	Instrumental	Conceptual	Symbolic	Instrumental
<b>CS</b>	<b>Jaundice</b>	-0.60	-0.80	-0.75	-0.60	-0.88	-0.78
<b>JR</b>	<b>Jaundice</b>	0.00	0.50	0.50	0.00	0.29	0.33
<b>Based</b>	<b>Jaundice</b>	0.00	-0.50	-0.50	0.00	-0.18	-0.56

Table 8.7: A table to show the E-I index measure for each type of knowledge use and each knowledge exchange (Key - CS = Career stage, JR=Job role, Based = Where Based)

## **3.4 Driving force**

### ***3.4.1 Organically self-organising***

At this stage there is a limited amount mandated from CLAHRC. Interaction and involvement with CLAHRC tends to be more around updating and/or asking for advice and support when needed. The driving force from the organisational broker has gone away and predominantly comes from the group itself. This is characterised by the group having become 'self-organising' as described above.

### **Summary**

The network at this point has become 'self-organising', there is a limited amount driven by the CLAHRC organisation and the direction and action of the group now stems from within. There are five prominent outcomes. These are: increased skill set, perceived value in the process developed, developed a common experiential understanding and knowledge base, focus of the group moves outward and engagement with a wider sphere of individuals begins. Alongside this I found that interaction remains increased both within the UoA and between the UoA and the CLAHRC organisation and a slight increase in hierarchy within the network again. The network is cooperating across the boundaries and also the relationship between the UoA and the CLAHRC organisation has moved from 'strain' to one of 'support'. Tacit knowledge is the predominant type of knowledge exchange within the group and it is explicit between the UoA and the CLAHRC organisation. Finally, the knowledge that is received within the UoA is predominantly used symbolically i.e. knowledge that is used to confirm a position or stance. However, knowledge that is received from CLAHRC by the UoA is predominantly used conceptually i.e. for general enlightenment.

The group at this stage has moved through the framework and completed their journey. As they are self-sustaining and reiterative there is another aspect to what can be deemed as relating to sustainability of the network. What does the network demonstrate to be fully sustainable as a knowledge transfer boundary network. It is this that I outline in the next two sections. It is essentially the ability of the network to re-enact its hierarchy when required in order to move the group back around the framework as described below under 'organic animation'.

## 8.2 ORGANIC ANIMATION

Organic animation is the process by which the network moves from being a ‘self-organising’ group to one that is able to continue to go round the process either to conduct another project or assimilate additional individuals into the boundary network. I am going to discuss this below.

The table below highlights the theme and sub-themes which underpin the process theme of Organic Animation. The discussion of the findings below are organised with reference to each.

3. Sustainability				
Framework concepts	Theme		Sub-themes	
Organic animation	3.5	Network animation	3.5.1	Re-enactment of structure

Table 8.8: A table to show the framework concept, theme and sub-theme for ‘Sustainability’ – ‘Organic animation’

### 3.5 Network animation

#### 3.5.1 Re-enactment of structure

There was only one UoA that I analysed that demonstrated moving forward across process d. There were two aspects through which I was able to study the UoA effectively moving forward to becoming reiterative and perpetual. These were moving the original project change out to other locations and starting a new project change in the original location. The quote below highlights both these aspects:

*‘the project’s developed and gone into different phases... and the other as a spin off from the original project’ (100094)*

The UoA 10 firstly re-enacted its hierarchy. In the ‘self-organising’ stage the hierarchy from a quantitative perspective started to show. The UoA moved forward in the process by the re-enactment of that hierarchy. In other words the senior part of the network takes action again with regard the UoA and therefore decides and directs what action to take and where to place resources.

*‘my role as the chief of service, I bring the senior pharmacy management perspective into the project and advise on appropriate use of the resource. I am the person that decides what’s the best way to spend that resource....So I’m a member*

*of the project team.....my role is about I guess it's about setting the overall direction and keeping the sort of shape of it.' 094.13*

The ability of the senior part of the group network to do this comes from the focus having moved from the project and inwardly on the group network itself. The team know what they are doing, the original project is almost completed and therefore there is capacity to look outwards i.e. scan the horizon for what else needs or can be done. The important point is, that in having the capacity to look for other opportunities for the group and then the ability to re-enact the hierarchy to make the decision to do it and make it a requirement of the group network to do it, the UoA moves to the next stage described below ('reiteration'). The quote below highlights a quote from a senior member of the team having found a reason to go around the process again and which led them to decide to do so.

*'we realised that, reviewing and stopping inappropriate medicines is clearly good, however, it will fall flat on its face if two other things don't get looked at; one of them being, involving patients in decision making, and empowering them to take decisions about their medicines, and two, communicating it to primary care colleagues.'* (10086)

## **Summary**

In order for the team to move forward to becoming a sustaining knowledge transfer network it draws on the re-emergence of a hierarchy within the group network. This, in conjunction with the capacity to focus further out from the group network itself enables the group to perceive opportunities for another change to be made. It is then the enactment of this hierarchy that creates the structure and direction required for instigating the action. It is the enactment of the hierarchy and outward focus that drives the group network forward. In doing so the network continues around the process and in essence becomes self-sustaining and reiterative as I describe below.



## 8.3 REITERATION

Within this section I am going to outline how the network sustains itself via the ability to re-iterate the process through which it has been through. I am going to discuss in how the network demonstrates the ability to re-enact its hierarchical structure when necessary to continue to transfer knowledge amongst itself and ultimately to a wider audience. In other words, it directs itself back through the process that has been unpacked across these findings.

I will discuss the various aspects of this by discussing and outlining each of the relevant themes and sub-themes highlighted in the table below.

<b>3. Sustainability</b>				
<b>Framework constructs</b>	<b>Theme</b>		<b>Sub-themes</b>	
<b>Reiteration</b>	3.6	Organically self-sustaining network	3.6.1	Organic use of network structure
			3.6.2	Increased interaction remains
			3.6.3	Re-introduction of hierarchy
	3.7	Spread of boundary crossing	3.7.1	Within UoAs
			3.7.2	Between UoAs and CLAHRC organisation
			3.7.3	Outside the UoAs
	3.8	Knowledge exchange established	3.8.1	Knowledge transfer and sharing
			3.8.2	Knowledge use
	3.9	Driving force	3.9.1	Self-created drive

Table 8.9: A table to show the framework concept, theme and sub-theme for 'Sustainability' - 'Reiteration'

### 3.6 Organically self-sustaining network

#### 3.6.1 Organic use of network structure

The knowledge transfer network had at this point enacted its hierarchy and utilised its capacity to look outward to find and create an activity. In doing so the knowledge transfer network had moved forward into a position of 'reiteration'. The key aspect here is the network's ability to 'cycle' around the process as and when required and the 'cycling' to be driven from within the network itself.

At this stage the individuals within the UoA believe that the network that has been created and gone through the CLAHRC process will sustain. At the same time the original project has reached a point where it is effectively 'running itself' thereby enabling the network to move on to other tasks. The quotes below demonstrate both these points.

*'I think our network will [sustain]. Yes. Certainly I feel like... yes, certainly I feel like I've established a good working relationship with the people that I've been dealing with on our project, yes, and I feel like, yes, I feel like we've got an effective working relationship that will carry on. Yes. I do feel like we've really established links there. Yes. Definitely'. (10100)*

*'so it's quite good, you feel like it's a bit...it's got a life of its own now, once it's got its own legs. It's got a life of its own'. (10113)*

At this stage the network is similar to that described in 'self-organising'. It is less tightly bound partly as its focus is wider and outward but also because it does not need to be as there is a common understanding, experience and knowledge that were not there earlier on in its evolution. The network knows what it is doing with regard to the methodology and the approach to take and it essentially has an inherent ability to go back around the process under its own volition.

### **3.6.2 Increased interaction remains**

As above, despite the outward focus, the quantitative data demonstrates that the UoA is still sustaining. The level of interaction, frequency and reciprocity continues at an increased level within the UoA. For example, interaction increased by c.70% between before and during the process and reciprocity increased from 50% to 90% (see appendix 1).

### **3.6.3 Re-introduction of hierarchy**

With regard to hierarchy, UoA 10, the IMPE project team, demonstrated a low centrality in terms of any level of interaction, however, the centrality is significantly increased (from 15% before the process to 53% during the process) regarding any interaction above that which is mandated by CLAHRC. This is indicative of the hierarchy being present again at this stage of the process. Also, with regard to the krackhardt hierarchical structural calculation it indicates an increase in the efficiency score if the IMPE project team is compared to UoAs earlier in the process (0 to 0.02) (see appendix 1).

This concept of a hierarchy being in place at this point is also endorsed by a member of the team. They state:

*'So it almost goes in a hierarchy – [person X] does the most, I do the second most and then [person X] does the third most. (10113)*

In fact it is the hierarchy at this stage that created the movement forward. A senior member's comment below outlines how as and when required involvement alters and how they are responsible for setting overall direction and control.

*'So I'm a member of the project team.....we've actually got a change now in that the project leader has taken a new job and will be moving on. And so, as a result of that I'll get back more and get much more involved to make sure we've got continuity through the pharmacy staff to ease our way through. So, my role is about setting the overall direction and keeping the shape of it.'* (10094)

### **3.7 Spread of boundary crossing**

#### **3.7.1 Within UoAs**

In terms of boundaries I note as I did at the 'self-organising' stage cooperation within the UoA. It is interesting to note how the knowledge transfer network itself is now moving on to cross boundaries as it spreads the original project out to new sites. The quote below highlights how the group network is actively making efforts to engage the new sites and go through the process to cross the boundaries both professionally and organisationally.

*'In terms of rolling it out to different sites, it would be me going to St Mary's or the Falls clinic or a particular site, seeing how it's going, tap any problems, speak to who's involved.'* (10113)

They also work with the new convened representatives to ensure the project outcome is not just taken and put into another context. They participate again and when necessary enable another reification of the process for that setting.

*'So again what we did for each of the falls clinics is we talked to the doctors in there, and said what's the best way for it to work? And sort of localise it. And the same thing for the admissions units, it depends on the teams there. So it's very much how it's actually applied locally, it varies, one size doesn't fit all. We go and see how best to do it. And then we see what data is collected and then we go back and say, we don't seem to be getting many forms, how do we change it? What do we need to do differently? Who needs to what and when?'* (10094)

From the quantitative data I again analysed the interaction across pre-defined boundaries. The interaction was analysed according to three types of boundaries – ‘job role’ (professional), ‘where based’ (hospital or community) and ‘stage in career’. At this point in the process the data indicated that for each partition the group had become more heterophilous. In other words they were interacting with people more than before across the boundaries defined by ‘job role’, ‘where based’ and ‘career stage’. Table 8.10 below outlines the results.

Stage	UoA	B4 E-I	During E-I
JR	IMPE	-0.46	0.31
Where Based	IMPE	-0.73	-0.15
Career stage	IMPE	-0.42	-0.09

Table 8.10: A table to show the calculated E-I index measure for pre-defined partitions (Job Role, Based and career stage) before and during the CLAHRC process

### **3.7.2 Between UoAs and CLAHRC organisation**

In terms of boundaries I note as I did at the ‘self-organising’ stage influence and support between the UoA and the CLAHRC organisation. Also, the level of interaction continues at an increased level between the UoA and the CLAHRC organisation. For example, for any level of interaction density increased from 9% prior to the CLAHRC process to 100% during the process. An increase is also seen with interaction above that which is mandated through the process, however, the level is low in comparison to those UoAs earlier in the process e.g. 18% vs. a range of 20 to 88%.

### **3.7.3 Outside the UoAs**

At the previous stage I highlighted that the network had engaged others within its care pathway in order to embed the new practice. At this stage the UoA does still attend various networking events such as the CLD, however, the tendency is for them to be asked to present and showcase their progress. As a result the individuals tended to have a high level of contact. Equally, as part of this exposure and the stage at which the project and group are they also tend to gain a high amount of traction/value from the events in terms of contacts and spread of their project on a wider basis. When compared across the other characterisations found across the

process I termed this a footprint 'cast' in order to distinguish it from the other types of relational tie evident outside the UoA as described above. This definition and term was synthesized from the analysis of the results and not an applied term and definition from literature.

A leading representative of the UoA from this stage of the process in response to a query about interaction away from the project team itself states:

*'There's in fact tons of people'.....'it's just there are so many...so many people'* (10086)

*'There are thousands [of people]'* (10115)

There was evidence to suggest that the senior members of the team felt it was their job to create the wider spread, which backs up the perspective outlined earlier around the hierarchy creating movement forward to this point and regarding the impetus to become reiterative.

*'...that was about the project....Trying to spread it a bit really. That is my job.'* (10094)

Another aspect that arose at this point in the process was the perspective and understanding that CLAHRC had the ability to facilitate interaction and collaboration across organisational and/or professional boundaries on a wider basis.

*'they facilitate quite nicely these sort of things, such as networking and working across professional boundaries.'* (10086)

### **3.8 Knowledge exchange established**

#### **3.8.1 Knowledge transfer and sharing**

At this point knowledge transfer continues to be multi-directional and the group has a lot of shared knowledge inherent within it.

According to the quantitative results tacit knowledge remains the higher type of exchange at this stage within the IMPE UoA and between the IMPE UoA and the CLAHRC organisation. For example, the explicit knowledge density was 3.3 for explicit knowledge exchange within the UoA and 5.8 tacit knowledge exchange. The difference for between the IMPE UoA and the CLAHRC organisation was a density of 3.45 for explicit knowledge exchange and 6.55 for tacit knowledge exchange.

This is interesting as in the process it has been predominantly explicit knowledge as the main interchange between the UoAs and the CLAHRC organisation. As before reciprocity remains high and tacit knowledge exchange exhibits a higher level of reciprocity than with explicit knowledge exchange e.g. 78% reciprocity for explicit knowledge exchange and 90% for tacit knowledge exchange. Please note the reciprocity relates to within the UoA only. (See appendix 1)

With regard to vertical differentiation within the network and related to type of knowledge exchange I found that tacit knowledge was more centralised (27.5% vs 21.6%), however, the difference between EK centrality and TK centrality had reduced to 6%. This is interesting as this is similar to the difference at the early stage of the process. As the UoAs moved through the process the difference between explicit and tacit knowledge exchange degree of centrality grew wider and has now reduced again. If I look at the results in terms of structure overall explicit knowledge exchange shows some level of hierarchy present – an increase from the other UoAs earlier in the process demonstrating in general 0.00 in terms of structural explicit knowledge hierarchy, to 0.05.

From the quantitative data I analysed the interaction across pre-defined boundaries with regard knowledge exchange i.e. explicit and tacit. The interaction was analysed according to three types of boundaries – ‘job role’ (professional), ‘where based’ (hospital or community) and ‘stage in career’. The results in the table below indicate that for both ‘career stage’ and ‘where based’ explicit knowledge is more heterophilous than tacit and vice versa for job role (see appendix 1).

Stage	UoA	EK	TK
<b>CS</b>	<b>IMPE</b>	0.07	0.06
<b>Based</b>	<b>IMPE</b>	0.11	0.01
<b>JR</b>	<b>IMPE</b>	0.18	0.53

Table 8.11: A table to show the calculated E-I index measure for pre-defined partitions within the EK and TK networks (Job Role, Where based, Career stage)

### 3.8.2 Knowledge use

As above I look at three types of knowledge use. These were conceptual knowledge use, symbolic knowledge use and instrumental knowledge use. For clarity, conceptual knowledge use is knowledge that is used as ‘general enlightenment’, symbolic knowledge use is knowledge that is used to confirm an approach or

position and instrumental knowledge use is knowledge that is put it into practice. For each type of knowledge use I collected data relating the knowledge use type with regard to how knowledge was received explicitly and tacitly.

As above to aid understanding of the results below I briefly highlight two aspects that I look at for each type of knowledge use, both within the UoA and between the UoA and the CLAHRC organisation. These include:

- a) understanding what type of knowledge use was evident and the predominant type of knowledge use when knowledge is delivered explicitly and tacitly;
- b) comparing the predominant type of knowledge use between when the knowledge is delivered explicitly and tacitly

a) At this stage within the IMPE UoA I note that the instrumental use of knowledge was highest in explicit knowledge exchange and symbolic in tacit knowledge exchange. If I look between the IMPE UoA and the CLAHRC organisation, however, I can see that the predominant type of knowledge use is conceptual with explicit exchange and both conceptual and symbolic with tacit exchange.

b) I also note that if I compare between explicit and tacit exchange the conceptual and instrumental knowledge use is higher in the case of explicit knowledge exchange but lower in symbolic within the IMPE UoA. They are all, however, different between the IMPE UoA and the CLAHRC organisation. Explicit knowledge transfer is lower in symbolic knowledge use, higher in instrumental and tacit knowledge sharing is equal in conceptual knowledge use (see appendix 1).

UoA	EK Use			TK use		
(%)	Conceptual	Symbolic	Instrumental	Conceptual	Symbolic	Instrumental
<b>IMPE</b>	3.8	30.8	65.4	2.6	53.8	43.6

Table 8.12: A table to show the % of different knowledge use types resulting from explicit transfer and tacit sharing within the UoAs

UoA	EK Use			TK use		
	Conceptual	Symbolic	Instrumental	Conceptual	Symbolic	Instrumental
	C(O)	C(O)	C(O)	C(O)	C(O)	C(O)
<b>IMPE</b>	<b>0.45</b>	<b>0.09</b>	<b>0.09</b>	<b>0.45</b>	<b>0.45</b>	<b>0.00</b>

Table 8.13: A table to show the density of different knowledge use types resulting from explicit transfer and tacit sharing between the UoAs and the CLAHRC organisation

As above I look at the vertical differentiation i.e. hierarchy of the network but this time in relation to the type of knowledge use. The table below delineates the degree of centrality for each type of knowledge use for knowledge that is delivered explicitly and tacitly. Conceptual knowledge use demonstrates the most centrality in the case of explicit knowledge exchange and symbolic in the case of tacit knowledge exchange. If I also compare which of the types of knowledge exchange (EK or TK) demonstrates the highest centrality it appears that in the case of symbolic and instrumental knowledge exchange tacit knowledge is more centralised whereas for conceptual it is explicit exchange (see appendix 1).

%	EK			TK		
	Conceptual	Symbolic	Instrumental	Conceptual	Symbolic	Instrumental
<b>IMPE</b>	56.20	38.00	39.70	47.90	57.90	41.30

Table 8.14: A table to show the degree of centrality for each type of knowledge use and each knowledge exchange

From the quantitative data I again was able to analyse the interaction across pre-defined boundaries both in terms of interactions and also in terms of type of knowledge exchange across that interaction.

From the quantitative data I can analyse how the knowledge is used against pre-defined boundaries. This is in relation to both when knowledge is transferred explicitly and tacitly. Again, the pre-defined boundaries are 'stage of career', 'job role' and 'where based' and I outline the results for each in turn below.

With regard to the 'career stage' partition, for each type of knowledge use – conceptual, symbolic and instrumental - the knowledge received explicitly and tacitly was predominantly more heterophilous. In both the case of explicit knowledge transfer and tacit knowledge transfer the knowledge that was most heterophilous in terms of type of use was instrumentally. In other words the knowledge received by a participant explicitly and that was used instrumentally most often came from another participant that was not at the same career stage. Please see table 8.15 below for the results and appendix 1 for more details.

If I compare the level of heterophily between types of knowledge use in relation to knowledge that is received explicitly or tacitly I note that in each type of knowledge



use they were more heterophilous with regard to tacit knowledge sharing. Please see table 8.15 below for the results and appendix 1 for more details.

Moving on to the 'job role' partition the most heterophily can be seen with conceptual knowledge use when exchanged both explicitly and tacitly. If I compare each type of knowledge exchange I see that conceptual knowledge is more heterophilous when exchanged explicitly and vice versa for symbolic and instrumental. Please see table 8.15 below for the results and appendix 1 for more details.

Finally, with regard to the 'where based' partition, here I note that conceptual knowledge use is the most heterophilous in both explicit and tacit knowledge exchange. In other words knowledge that is received explicitly and used conceptually most often came from a participant based elsewhere. Again, if I compare the level of heterophily between types of knowledge use in relation to knowledge that is received explicitly or tacitly it shows that in each case explicit knowledge transfer produces more heterophily in terms of each type of knowledge use. Please see table 8.15 below for the results and appendix 1 for more details

Partition	EK			TK			
	Conceptual	Symbolic	Instrumental	Conceptual	Symbolic	Instrumental	
<b>CS</b>	<b>Jaundice</b>	-0.20	-0.27	0.13	0.16	-0.14	0.17
<b>JR</b>	<b>Jaundice</b>	0.66	0.00	0.13	0.53	0.49	0.17
<b>Based</b>	<b>Jaundice</b>	0.54	0.00	0.00	0.44	-0.09	-0.10

Table 8.15: A table to show the E-I index measure for each type of knowledge use and each knowledge exchange (Key - CS = Career stage, JR=Job role, Based = Where Based)

### 3.9 Driving force

#### 3.9.1 Self-created drive

There is a limited amount mandated from CLAHRC at this point. As above interaction and involvement with CLAHRC tends to be more around updating and/or asking for advice and support when needed. The driving force essentially comes from the knowledge transfer network itself. It has become reiterative.

### Summary

The network has become reiterative. It is able to 'cycle' around the process under its own volition. It is able to cross boundaries itself by bringing in to the core network

new representatives as and when required. The network has sagacity i.e. it has the wisdom to be able to continue to transfer knowledge into practice. It also has the ability to recreate and enact its hierarchy as and when required in order to bring new knowledge and change into practice. Interaction and reciprocity remains high, however the connections are looser as demonstrated by their ability to bring in others to the network and spread further afield. Across the boundaries within the network there is cooperation and the relationship with the CLAHRC organisation is supportive and advisory. A particular aspect of this stage is the network's ability to disseminate knowledge to a wider sphere. Tacit knowledge is the predominant knowledge exchange both within the knowledge transfer network and with the CLAHRC organisation. Finally, the knowledge that is received is predominantly used instrumentally if received explicitly and used symbolically if received tacitly. In other words action at this stage predominantly comes from explicit knowledge exchange and from tacit it is more a confirmation of a position or stance. The key to the network being reiterative is the ability to continue moving knowledge into practice. For this to be the case the network needs to 'cycle' perpetually around the process. It needs to have the ability to contract down, reduce hierarchy and focus inwardly on purpose and practice and then relax out, recreate and enact hierarchy and focus outwardly. In the next section I outline this organic ability to sustain.

## 8.4 PERPETUATING CYCLE

Within this section I am going to discuss the process by which the knowledge transfer boundary network demonstrates the inherent ability to cycle through the framework as and when required. The ability to do that is driven from the ability to recognise the need and the ability of the hierarchy to be re-enacted and for the group to move forward.

The table below highlights the theme and sub-themes which underpin the process theme of perpetuating cycle. The discussion of the findings below are organised with reference to each.

3. Sustainability				
Framework concepts	Theme		Sub-themes	
Perpetuating cycle	3.10	Organic ability	3.10.1	Organic iteration
			3.10.2	Network tie formation
			3.10.3	Completion of 'time in' CLAHRC process
			3.10.4	Interaction reduced
			3.10.5	Boundary crossing
			3.10.6	Hierarchy in network
			3.10.7	Additional aspects of sustainability

Table 8.16: A table to show the framework concept, theme and sub-theme for 'Sustainability' – 'Perpetuating cycle'

### 3.10 Organic ability

#### 3.10.1 Organic iteration

The network is reiterative and a part of that is the ability to keep 'cycling' around the process as and when necessary. There is a distinction here as to what happens with the network in terms of its 'cycle' around the process. It essentially depends on whether or not the next 'knowledge transfer' to occur is including solely the people already convened and who are now loosely tied together or if they are widening it to

include a broader network. In both cases it is the outward focus and hierarchy that drives it.

If the next 'knowledge transfer' includes bringing other representatives into the network it is necessary to go back to inception and bring the new convened representatives into the team and go through the same process of mandated use of tools and learning the shared knowledge (CLAHRC methodology and other representatives' component knowledge) as outlined above. A good example of this on-going sustainability and essentially 'cycling' around the process comes from a quote below that demonstrates the incorporation from another location from the wider care network. It highlights the project team engaging outwards from the group. They do this by bringing the 'outsider' into the project team and also going out to their location.

*'So somebody from the care home joins the project team, and the then core project team go and work with.'* (10094)

If, however it is the same network looping round it effectively goes back to the stage of 'development' where the focus of the network again becomes inward and on the new project.

In summary, the network needs to have the ability to contract down, reduce hierarchy and focus inwardly on purpose and practice and then relax out, recreate and enact hierarchy and focus outwardly and so on. It is the ability to perpetually do this organically that defines the network as a reiterative knowledge transfer network that is characterised by having developed at various network boundaries.

### **3.10.2 Network tie formation**

One aspect that became evident from the findings across the process was regarding the type of ties that were created and enabled the network to move forward in the process. It appears from the findings that a part of the ability of a network to develop and reiterate depends on the type of ties that are formed. For example, I have demonstrated above that the ties were strong within the team as it moved across the early part of the process however the ties reduced in strength but were still valuable ties toward the end of the process.

On the other hand in each of the sections 7.2, 7.4, 8.1 and 8.3 above when outlining the findings under 'outside the UoA' there were a variety of ties evident that was difficult to classify as there was more to them than simply weak or strong. The findings indicated that in some cases there was a value to be gained from the tie despite it being weak or transient.

It was therefore clear from the analysis that there was a more nuanced situation evident both in terms of strength of the tie and the value gained. As a result I tentatively propose an ontology of different types of ties found across the process that if developed could offer further insight into how the right type of ties can be useful to developing and creating a sustainable network. I am going to describe the ontology below.

Across the framework constructs outlined above there were four types of interactions that were different in terms of level of contact and traction and value perceived from it. These were outlined in sections x, y, z above. These ties could not be defined as weak ties judging on the definition offered for a weak tie by Granovetter (1973) i.e. that of a nodding acquaintance as the results did not necessarily 'fit' this concept and there was a link between contact and value that is not implicitly defined elsewhere.

Here, I draw together the four conditions found across the process into a quadrant that offers a schema for identifying the type of ties found at certain parts across the process. It incorporates; interaction, length of interaction and perceived value of interaction. As an overarching description of these distinct ties I have used the term 'footprint ties'. I use this term as a footprint is defined as 'an impression that is left', which encapsulates this broader granularity regarding types of ties.

In order to fully understand the proposed quadrant delineated below I will briefly describe each type of 'footprint tie' found across this process and highlight the point in which the process it could be discerned. The quadrant in essence links level of contact and value perceived from that contact.

#### *Quadrant 1 – Footprint 'Etched' (High contact/Low traction)*

This quadrant relates to where individuals have a high level of contact, for example, in this study where the individuals had extended interaction at a collaborative

learning event but they did not necessarily perceive they gained any value from it. This was at the 'self-organising' stage in the process.

*Quadrant 2 – Footprint 'Cast' (High contact/High traction)*

There were in some cases people who met at a CLD event for example and continued to follow up afterwards. This was at the 'reiteration' stage.

*Quadrant 3 – Footprint 'Mark' (Low contact/High traction)*

In this case I found interaction tended to be between attendees at, for example, a CLD event. They may have met between presentations or over the lunch break and through conversation found something useful generally around information over how they dealt with a particular problem or CLAHRC tool. This was at the 'activity' stage.

*Quadrant 4 – Footprint 'Trace' (Low contact/Low traction)*

The final quadrant represents the brief encounters where nothing really sticks or was more general interaction than specifically useful take away information. This was at the 'development' stage.

Figure 8.2: The matrix below delineates the four proposed conditions of a 'footprint tie' observed within this study.

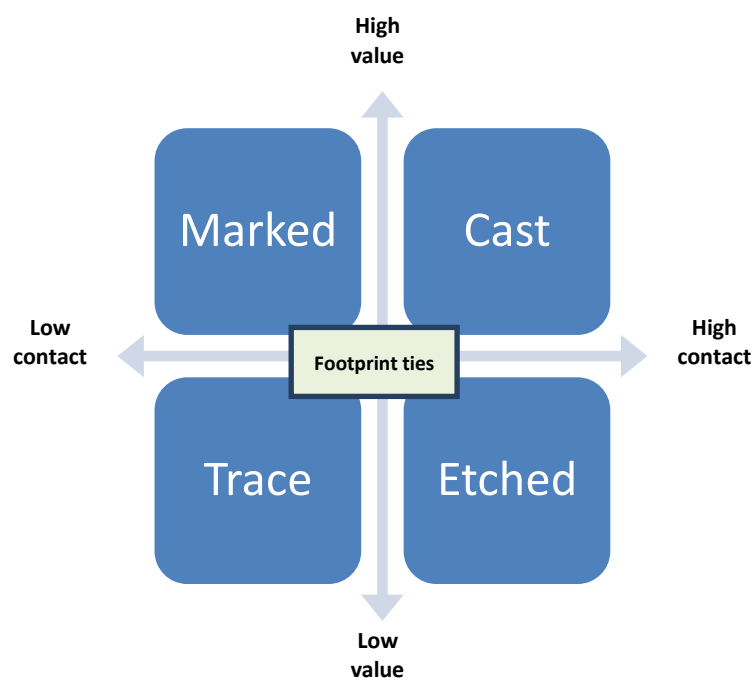


Figure 8.2: The four proposed conditions of a 'footprint tie' observed within this study

### **3.10.3 Completion of 'time-in' CLAHRC process**

Within my study I was able to characterise what aspects of the process moved the UoAs along past the stage of 'activity' partly by analysing those UoAs that finished their time with CLAHRC having only reached that point in the process. At the time of my study there were three UoAs that were no longer part of CLAHRC and had completed the process or at least the timeframe for the project or fellowship. These were the alcohol project, and the two fellows groups f1 and f2.

Firstly, I draw upon the quantitative results where I had analysed three UoAs that had completed their time within CLAHRC and I was therefore able to take a look at how the connections had sustained or otherwise.

### **3.10.4 Interaction reduced**

From the quantitative perspective I note that in all cases the level of interaction within the UoAs falls off after active involvement with CLAHRC. In other words when the UoAs was no longer part of the CLAHRC process and therefore no longer had the shared purpose and interest and no longer had CLAHRC acting as a facilitator, the network did not remain cohesive i.e. in close contact. Alongside the drop off in interaction levels there was a drop off in reciprocity. For example, the level of reciprocity reduced from 100% during the process to 60% after for the fellows' group f1. Table 8.17 below highlights the change in density of the networks between during and after being part of the process. For example, a fellow responded '*to be honest with you, none of them. So for now, it's practically zero for the group*' when asked if there was any on-going interaction.

The other aspect I looked at was any difference between prior to being part of the process and after. In most cases the level of interaction after was less than before being part of the process. As an example, please see table 8.17 below for the density of the frequency networks before, during and after the process. I am unable to draw very strong conclusions from this in itself however due to the nature of the three UoAs that had completed the process whilst conducting the study. All of the UoAs were subject to a number of contextual changes after the process such as job

relocations, other service reconfigurations and jurisdictions in terms of the care pathways being represented.

UoA	Before	During	After
Alcohol	1.75	2.8	0.90
F1	0.23	2.4	0.60
F2	0.37	2.6	0.28

Table 8.17: A table to show the densities of each UoA before, during and after the CLAHRC process

So, on the face of it, it appears that the created networks/teams do not sustain without being part of the CLAHRC process if they do not progress through the entire framework discussed above. There was, however, an important notion I gleaned from the UoAs that had completed their time in CLAHRC and that was the suggestion from the participants that they felt comfortable and able to recreate that relational tie and make contact if necessary.

*'I feel that I could ring any of them up'. (10090)*

*'I'd like to think that if I ever, I could very easily drop them an email'. (10076)*

Interestingly, the same was iterated with regard to contacting the CLAHRC organisation again. Unsurprisingly, there was little contact with the organisation after being part of the process however it was definitely clear that there was a sense of being able to contact them if necessary.

*'I suppose I might go back go back, because I kind of know the people if they haven't changed, you know, and they're always very supportive and friendly and you know'. (10084)*

### **3.10.5 Boundary crossing**

Within the quantitative data analysis I analysed the level of heterophily/homophily within the network based on three pre-determined boundaries – 'job role, 'career stage' and 'where based'. I outline the results comparing during the process and after and before and after in order to describe what happens to the networks that did not complete the process framework but had completed their time in CLAHRC.

Firstly, with regard to 'job roles'. Having completed the process the alcohol project team results indicate a retraction to more internally focused i.e. interaction continues but between the same job roles. F1 and F2, the fellows' network, moves to a more



external focus, which is interesting as it could mean that the interactions that remain after the CLAHRC involvement is between job role types.

Secondly, 'where based'. Having completed the process both the alcohol project team UoA and the fellow teams UoA results indicate a retraction to being more inward interactions i.e. hospital to hospital based interactions.

Finally, having completed the process the alcohol project team (UoA 6) results indicate a move toward a more heterophilous state i.e. they interact more with those of a different level of seniority. F1 (UoA 7), however retracts to more internally focused i.e. interaction continues but predominantly with those at the same level of career advancement i.e. junior doctor to junior doctor. Equally, one of the fellows F2 (UoA 8) also demonstrates a move toward heterophily.

If I compare the before and after figures I can see that in each UoA there is a retraction to homophily after being part of the process with regard the 'job role' partition. This is also the case for the alcohol project team (UoA 6) for the partition of where individuals are based i.e. community or hospital. In other words in each of these cases there has been a change toward individuals within the network interacting 'like with like'. The two fellow UoAs 7 and 8, indicate a move toward a more heterophilous state with regard to the 'where based' partition and all of the UoAs (6, 7 and 8) studied after completing the process demonstrated this move toward heterophily with regard the 'career stage' partition. In other words after having been part of the CLAHRC process the network retains some boundary crossing regarding career stage (interactions with those at a different stage in their career) and in the case of the fellow UoAs 7 and 8 boundary crossing regarding where they are based (interactions with those based in a different part of care i.e. hospital/community). I should highlight again that the 'after' results were impacted by context and circumstance changes.

Partition	UoA	B4 E-I	During E-I	E-I After
JR	Alcohol	-0.49	-0.21	-0.89
JR	F1	1.00	0.58	0.81
JR	F2	0.34	-0.01	0.07
Based	Alcohol	-0.54	-0.39	-0.89
Based	F1	-0.62	-0.05	-0.23
Based	F2	-0.58	-0.08	-0.53
CS	Alcohol	0.54	0.21	0.89
CS	F1	-0.62	-0.01	-0.50
CS	F2	-0.52	-0.46	-0.40

Table 8.18: A table to show the calculated E-I index measure for pre-defined partitions (Job Role, Based and Career stage) before, during and after the CLAHRC process

### 3.10.6 Hierarchy in network

In terms of hierarchy within the network after the process I analysed this with regard to three levels of centrality and in terms of structural hierarchy (krackhardt's graph theoretical dimensions).

The alcohol project UoA 6 increased in centrality after the process both in terms of any level of interaction and above interaction that was mandated within the process. There was a slight drop off in centrality in the frequency network, although this was slight. It is interesting to note that this drop off in centrality between during the process and after was also seen in the frequency network of the fellows' networks (UoAs 7 and 8).

The fellows networks (UoAs 7 and 8) reduced in centrality after the process in terms of any interaction above that which was mandated through the CLAHRC process and f2 showed the same for any interaction at all. F1 (UoA 7) increased significantly in terms of centrality for any type of interaction after the process.

Finally, if I compare the before and after centrality measures there is a mix in the results. With UoA 6, the alcohol project UoA in each case demonstrated less centrality than prior to the process. UoA 8 (F2) showed the same decrease. UoA 7 (F1), however, showed an increase for each when comparing before and after the process. The table below outlines the centrality results for before, during and after the process for the alcohol project and the two fellows' groups.

Type	%	Before	During	After
		Degree of centralisation	Degree of centralisation	Degree of centralisation
AI	Alcohol	62.50	0.00	12.50
AI	F1	14.80	0.00	61.70
AI	F2	19.40	61.70	19.40
AMI	Alcohol	43.80	0.00	37.50
AMI	F1	9.90	66.70	27.20
AMI	F2	17.40	55.60	15.30
F	Alcohol	38.40	26.30	25.00
F	F1	12.00	22.90	21.60
F	F2	18.60	31.30	17.20

Table 8.19: A table to show the degree of centralisation for each level of interaction before, during and after the CLAHRC process

Key: AI – any interaction, AMI – Above mandated interaction , F - frequency

From a structural perspective each of them shows a more hierarchical structure, across each of the measures when comparing during the process and after the process. UoAs 6 and 7 show less of a hierarchical structure when comparing the results before and after the process. UoA 8 shows a slightly higher level of hierarchy. The table below outlines the centrality results for before, during and after the process for the alcohol project and the two fellows' groups.

UoA	Alcohol	F1	F2	Alcohol	F1	F2	Alcohol	F1	F2
Stage	B4	B4	B4	During	During	During	After	After	After
Connectedness	1.00	0.20	0.60	1.00	1.00	1.00	1.00	1.00	0.80
Hierarchy	0.40	0.40	0.80	0.00	0.00	0.00	0.60	0.00	0.90
Efficiency	0.80	1.00	0.90	0.00	0.00	0.00	1.00	0.70	0.90
LUB	1.00	1.00	1.00	1.00	1.00	1.00	0.50	1.00	0.90

Table 8.20: A table to show the Krackhardt hierarchical measures for before, during and after the process

### 3.10.7 Additional aspects of sustainability

The other aspect I looked at specifically with regard to these three UoA was that of the projects themselves – did they sustain? The results showed that the UoA 6 i.e. from the projects programme did have some sustainability with regard to the change to the care pathway. Part of this project (primary care) sustained due to national guidance and was not really relevant to the CLAHRC process. The secondary care part, however, was continuing although the same people were controlling it so in

reality it had not been tested. There was, however, no intention of spreading the change out anywhere else now no longer part of CLAHRC.

*'So it was a national target, so do the alcohol screening in the way that we were doing. That's not because of us... that wasn't because we rolled it out; it was a national decision'. (10096)*

The fellowship projects were smaller and often a delivery of a report or the like. The main issue that I found to some of the projects sustaining was the changing environment of the NHS context. For example, one fellow's project was around the incorporation of a database between secondary care and social care. It eventually got cancelled due to a political change in direction and the database that was being built to coordinate was disbanded.

*'Yes, in some ways what a shame [that the project change didn't sustain], but in other ways not too surprised because I have a more cynical view of NHS culture, which is very short term. And the research projects often take time to register, and they're not embedded'. (10090)*

A final aspect that impacted sustainability of the projects themselves was that the project had not necessarily generated the outcome that was necessary for it to become sustainable as the quote below highlights:

*'But then, going on to meeting the teams and reading the reports, I've not been able to identify enough outcome to show that actually, what we've done has made a change. There's been some quality improvements, but I always say, it wouldn't survive the dragon's den moment, it's not a sustainable business'. (10159)*

I found that predominantly individuals that had been involved in a project or a fellowship and gone through the process that there was evidence to suggest that they went on to do other projects and utilised the CLAHRC methodology. There were, however, some aspects of the methodology that clearly came out as stronger in terms of continued use after being involved with CLAHRC such as PDSA cycles. It should also be noted that there were detractors with regard to the use of the methodology again away from the CLAHRC process. The quotes below highlight these contrasting viewpoints.

*'Plan Do Study Act I would use, um, and I would encourage patient/public involvement. Yes'. (10134)*

*'So I definitely use it [CLAHRC tools] when I'm thinking about doing a project'. (10153)*

*'So the sustainability score is the big one that I just think it's just an absolute waste of time'. (10133)*

*'I would not give them a glowing review. You didn't find their approach good? No'. (10134)*

Another aspect that came out around sustainability and in relation to the theme of the CLAHRC approach was that of the cost of the initiative. It was questioned a number of times the cost of their approach and whether or not it was being spent in a manner that would offer the most value. For example, one project member stated:

*'I think they [CLAHRC] are spending a lot of money on, ah, on things that could be done without spending 300,000.....you could spend research money a lot better. I think is a terrible way to spend 300,000'. (10134)*

It was clear, however, that at the very least the message regarding the inherent need for healthcare to do more for less, whilst maintaining quality via closing the second translational gap was understood and invested in. This was tested to the extent of asking would the participant be happy for their own personal tax money to go to the initiative and interestingly in general they were happy to fund it. Even if they were not happy to fund the initiative CLAHRC they had bought in to the idea and need to fund the concept of closing the second translational gap and were therefore happy to fund related initiatives.

*'the second transactional gap, I think there probably should be a body that tries to push this research'. (10134)*

*'Well, as a taxpayer I would certainly recognise that there was an issue in second translational gap, I think most people would get that, and I would get that as a taxpayer'. (10115)*

*'Yes [happy for tax money to go to CLAHRC], but I think it needs to change a little bit and make sure that it doesn't repeat itself'. (10161)*

A final point to note from the findings was that of recommendation from those that had been part of the CLAHRC process i.e. would they recommend to others to apply to be involved and go through the process? Equally, would the participant be involved again with CLAHRC if an opportunity arose? There was a strong consensus that they would recommend it *'I would thoroughly recommend the experience'* (10086) and actively wish to be involved again *'Oh, definitely [I would apply again]'* (10153).

## 8.5 Conclusion

The process outlined above describes my findings with regard to the evolution of knowledge transfer networks specifically created across a number of different network boundaries. It is clear that throughout the process there are aspects that move the development of the networks forward and create different network characteristics along the process. I have characterised these into stages ranging from 'start-up', through 'development' and 'activity' phases and eventually reaching the stage of 'reiteration'. From the above results, I can see that the network structure changes across the process, relations across professional and organisational boundaries alter, the driving influences change and the network changes in terms of types of knowledge exchange, knowledge use and the interaction between the two.

Clearly, the process is not as arbitrarily defined as this and the evolution of the networks does not necessarily move forward solely in a linear manner. However, the characterisation does represent broadly the stages the UoAs progressed through in order to create a sustaining knowledge transfer boundary network (KTBN). Within the next chapter I will discuss these results with reference to extant literature and outline how these results answer the research questions.

# Chapter 9: Discussion

## 9.1 Introduction

Within the previous chapters I outlined the findings of the study. Within this chapter I discuss the findings in the context of extant literature and highlight the contributions of the study to theory, practice and policy, its limitations and possible areas for future research.

How do knowledge boundary networks develop over time and how do they become self-sustaining? This is the overarching question explored in this study. It was explored using a multi-method approach and by specifically studying the following sub-questions: 1) What were the developmental processes underlying network inception? 2) How do knowledge boundary networks evolve from inception to sustainability? and 3) What factors are needed to create sustainability? The results from the study addresses each of these aspects as I was able to characterise the process through which the knowledge transfer network progressed and study it in a number of different ways from inception through to completion of the process (successfully or otherwise). Below I elaborate on the significance of the findings under each sub-question. First, I discuss the developmental process with reference to the literature. From the results section we know the specifics of the process, however I elaborate here on how this relates to theory. Second, I take four broad areas that run across the process – Network, Boundaries, Knowledge and Process – and develop insights into how each area develops through the process and where appropriate how this extends the literature. Third, the relevance of the findings in order to create a reiterative knowledge transfer network, how this opens up a new area of research into knowledge transfer networks that are specifically located and aimed at spanning network boundaries and how they can sustain if required.

## **9.2 What were the developmental processes underlying network inception?**

In chapter 5 of the findings I outline the Collaboration for Leadership in Applied Health Research and Care (CLAHRC) process. Briefly, a group of individuals representing various aspects of a care pathway come together and receive funding to create a change in their care pathway, one that draws on current knowledge. In other words they enter and go through the CLAHRC process to bring research into clinical practice and in doing so address the second translational gap, as defined in policy. The process through which they travel includes facilitated interaction, use of web reporting tools and improvement methodology tools such as PDSA cycles. The aim of the process is to make the relevant change and also to create cross-boundary interaction e.g. between doctors and nurses or between primary and secondary care. The focus of this study was on the latter – the creation of the cross-boundary interaction. As a result the discussion relates to the impact of the reported perception in terms of the developing network and not the impact of the projects themselves.

Therefore, the aim is to improve knowledge transfer across various boundaries. Within the literature there are a number of areas that touch upon collaboration across boundaries. One particular area is that of boundary bridging processes ‘activities that weave systems more tightly together’ (Wenger, 2000). According to Wenger (2000) these boundary bridging processes can be classified into Interaction, People and Boundary objects. Literature has focused, to date, on reporting skill sets, characteristics and experiences. It has not, however, fully dealt with the organisational structures and practices that enable them (Ferlie et al, 2010). Through this study I am able to offer an empirical example of how these boundary bridging processes can be enacted. If I characterise the various aspects of the CLAHRC process with reference to the literature I can outline an example of how these boundary bridging processes can be structured and enacted in practice.

The first aspect of the process that I can characterise with reference to the literature is that of CLAHRC as an organisation. North West (NW) London CLAHRC acts as an organisational broker, when viewed with reference to the definition detailed within the literature. An organisational broker, according to the literature is an organisation



that is distinct from either of the other organisations/entities being brought together in order to share knowledge (Currie et al, 2010). NW London CLAHRC meets this description as it is distinct from any of the entities it is bringing together to share knowledge. CLAHRC, as an organisational broker, utilises a number of mechanisms aimed at improving knowledge transfer across boundaries.

These mechanisms can be characterised by the three boundary bridging processes highlighted above – interaction, people and boundary objects. Figure 9.1 below outlines these categories and examples of the CLAHRC mechanisms they relate to. Essentially, with regard to interaction, CLAHRC provides and creates facilitated interaction i.e. monthly meetings, collaborative learning events, improving people skills on a number of different levels but in particular, improvement methodology. As a result of the approach either a group level broker or an individual level broker is created depending on which programme (project or fellows) followed (see below for more discussion regarding brokerage). Finally, boundary object includes the use of a web reporting tool. An online repository designed to share knowledge amongst the networks and improve communication.

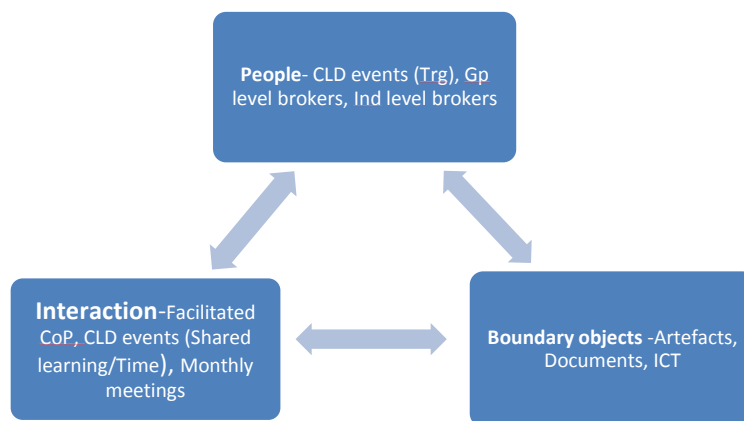


Fig. 9.1 Categorisation of mechanisms employed within the case study

CLAHRC acting as an organisational broker initiates the network located at the juncture of a number of different boundaries. As outlined in the literature review the fundamental constituents of a network are the individuals and the relationship between them (Goodwin et al, 2004). CLAHRC offers a programme (project and/or fellows programme) that brings together the individuals and then actively facilitates the creation of the relationships between them. Literature indicates that informal interaction is probably the most useful although it also acknowledges that this is not

always an option. An alternative suggestion is that of facilitated interaction (Williams and Dickinson, 2008). The findings from this study indicate that the facilitation does enable the inception of the network as it actively creates the 'relationship' between the 'individuals' thereby creating the fundamental constituents of a network (Goodwin et al, 2004).

Alongside the inception via facilitated interaction the individuals that are collated at the start are representatives of various professions. For example, a doctor, a nurse, a physiotherapist. These individuals undergo various training in order to create the skill set within the knowledge transfer boundary network to be able to broker across boundaries either on an individual level in the case of the fellows programme or as a group in the case of the projects programme. At the 'start-up' stage the brokering occurs by CLAHRC. As discussed above it acts as an organisational broker by offering mediation, training and facilitating the interaction. It is also within a position to connect what is otherwise disconnected, which is a part of the definition of an organisational broker (Hargadon and Sutton, 2000, Verona et al, 2006, Burt, 1992). The influence of CLAHRC with regards the inception of the process was found to be significant as it created the interaction, delivered learning to the individuals that created further interaction and provided tools to also interact through. As discussed in the literature review the typology used here is useful for structuring the discussion although in practice they are not necessarily mutually exclusive (Williams and Dickinson, 2008). For example, within the literature review I discuss the importance of human capital i.e. an individual's skill set and capability. This can fit across all three categories as I highlighted in the literature review for an individual to be able to use a boundary object, build a relationship and/or act as broker certain skills are required.

The figure below delineates the overall conceptual developmental process characterised with reference to literature.

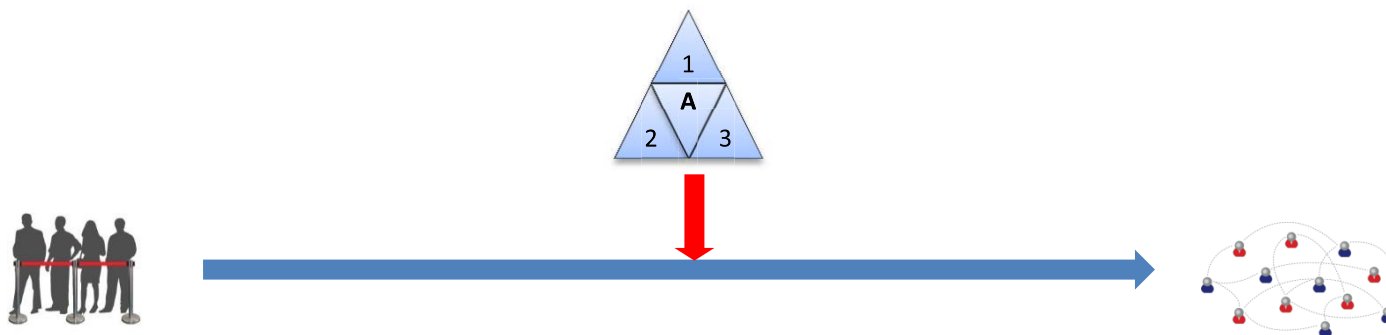


Figure 9.2: Overall conceptual developmental process characterised with reference to literature

Key: 1 – Interaction, 2 – People (brokerage and skills), 3 – Boundary objects, A – Organisational broker (CLAHRC)

The CLAHRC programme outlined above with reference to theory combines together to instigate the formation of the knowledge boundary network. The processes continue throughout the network's evolution however it is clear that it is through entering the CLAHRC programme the knowledge boundary network is conceived.

### 9.3 How do knowledge boundary networks evolve from inception to sustainability?

Across chapters 4,5,6, 7 and 8 I have outlined the process through which the participants progressed. There were five identifiable points within the process ranging from 'start-up', 'development' and 'activity' through to 'self-organising' and 'reiteration'. Equally, between each point I identified the process that moved the group or knowledge transfer network along. There are a number of aspects from this study that make a contribution to the current literature base, which will be discussed below. However, there is a methodological approach that underpins this study and that makes an important contribution: the longitudinal nature of it and the combination of Social Network Analysis (SNA) with qualitative fieldwork. There are limited studies that analyse knowledge network development *over time* (Su et al, 2010, Phelps, 2012, Demirkan et al, 2012) and also there are few studies that utilise *SNA alongside qualitative work* and in some specific areas of literature the focus on qualitative work alone has been highlighted. For example, Kimble and Hildreth in 2005 highlight the prevalence of Communities of Practice (CoP) research being predominantly based on qualitative studies.

These two aspects are important to healthcare research in a number of ways. The healthcare environment is well known for its complexity and dynamic nature and in particular as highlighted within the literature review there is a perspective that taking evidence in to practice is 'complex and multi-factorial' and that it is important to adopt

a longitudinal perspective (Rycroft-Malone and Burton, 2010, Rycroft-Malone and Burton, 2011). As a result of this complexity it appears that it would be a valuable addition to literature to conduct a study over time. When relating the findings from this study to the literature and detailing the contribution that this study offers there is a key overriding point that runs through all of it and that is the implication that key theoretical concepts from the literature are not one-dimensional and static, rather they are dynamic and changeable. Importantly, building further on this, this dynamism to the process and therefore the theoretical concepts over time is useful and beneficial to the evolution of the knowledge boundary network.

Having conducted the study both longitudinally and by utilising both SNA and qualitative work (interviews and field observation) I am able to discuss four different aspects – Network, Knowledge, Boundaries and Process – and how they evolve across the process. I will discuss each one of these in turn below, with reference to the literature.

### **9.3.1 Network**

The focus of this study was on the evolution of a knowledge network, situated at the juncture of various boundaries. As a result I relate back to the literature on networks and their development. The literature on network development is limited (Phelps, 2012). I was interested in both how the networks developed on a structural level i.e. interaction, level of hierarchy and on how the individuals worked together in pursuit of a common aim through that network and a community. This is an approach outlined within the literature (Williams and Dickenson, 2010). Community of Practice can also be an important approach of understanding bridging boundaries as per the bridging mechanisms described above (Wenger, 2000).

Within this section I look at the network properties over time i.e. network composition structurally (interaction and hierarchy) and community of practice (domain, community and practice).

#### ***9.3.1.1 Network properties over time***

As highlighted above the fundamental constituents of a network are the individuals and the relationship between them (Goodwin et al, 2004). Sociometric accounts tend

to define it as 'any system of linkages between nodes'. The findings outline the linkages between nodes over time. At the start of the process, termed 'start-up', in the findings the individuals who come together to take part in the CLAHRC process are convened and there is limited, if any interaction between them. Each individual is a representative of an aspect within their care pathway e.g. a doctor, a nurse. Interaction is facilitated within the process. The convened representatives have to meet at least once a month and attend a quarterly collaboration learning day (CLD) event. This approach of facilitated interaction is interesting as it is largely unexplored in the literature (Williams and Dickenson, 2010). Here, I found unsurprisingly that the facilitation created interaction. The interesting part was how this developed over time. As the network moved from 'start-up' to 'development' the interaction had increased. However, it had not increased above that which was facilitated by CLAHRC. In other words the interaction had increased to the monthly meetings and CLD events but nothing in addition. This altered as the network progressed through the process. The network from the point of 'activity' onwards demonstrated an increase in interaction above and beyond that which was facilitated by CLAHRC. This was evident through to the network reaching the stage of 'reiteration'.

For the networks that had completed the CLAHRC process the level of interaction reduced, possibly indicating that without the structure, guidance and requirement of CLAHRC the network does not continue even after having been brought together in collaboration. These networks reached the point of 'activity' within the conceptual framework presented in the findings. It is therefore an interesting point to draw upon in terms of moving the network past the point that the CLAHRC organisational broking role needs to be in place. I look at this further when discussing the third research question below.

As the overview of this study's findings in relation to network properties over time above highlights within this study I found that facilitated interaction by the organisational broker CLAHRC was fundamental to the inception (as described above) and evolution of the knowledge boundary network. The facilitation created the relationship ties and alongside this reduced hierarchy between the ties.

### ***Creation of relationship ties***

Within the literature review I indicated that informal interaction is particularly useful in terms of overcoming boundaries but not always possible. Facilitated interaction has been suggested as a solution, although there is not enough research to establish to what extent this may be the case (Williams and Dickenson, 2008). The facilitated interaction within this study created direct interaction which is reported as capable of enhancing the sharing of information (Burnett et al, 2005). The findings from this study appear to support the literature in that the facilitation did create collaboration across boundaries and therefore it is potentially an alternative if informal interaction is not possible. It also indicates the potential usefulness of actively facilitating interaction in order to share knowledge.

The literature does indicate that boundary spanning and brokerage at the organisational level can create a social-integrative function and produce collective action (O'Mahony and Bechky, 2008, Currie et al, 2010). It also, however, highlights that there can be problems relating to the legitimacy of the third brokering party. For example, Shi et al in 2009 indicated the potential importance of the affiliation of the knowledge broker to the brokered groups i.e. legitimacy is important. This, in fact, was supported to some extent within this study. The legitimacy of CLAHRC was questioned in the early parts of the process, after inception but in the early part of its evolution, with concerns raised regarding its awareness and knowledge of the context.

### ***Impact on hierarchy***

The literature indicates that there are different types of networks in terms of horizontal and vertical forms. This is well characterised with regard to the professional groupings inherent within healthcare. For example, doctors tend to be a part of horizontal networks and nurses more formal, vertical networks (Williams and Dickinson, 2010). It is also suggested within the literature that vertical networks are superior with regard to explicit knowledge transfer; horizontal networks are more effective at 'spreading peer influence and supporting the construction and reframing of meaning' (Greenhalgh et al, 2004). The literature, however, is limited in its perspective as to what happens when these network types cross in some way. So, for example, a representative from a horizontal network becomes part of a network that includes representatives from a vertical network. Although literature generally

indicates that a network can move away from a hierarchy and flourish if people at different levels of the organisation are involved (Williams and Davidson, 2008). Other aspects of the literature focuses on effects of network structure over time, for example, reciprocity, however there is a limited focus on hierarchy evolution (Doreian, 1994).

Within this study I found that the hierarchy of the network altered over time. The level of structural hierarchy i.e. based on Krackhardt's theoretical graph dimension calculation and freeman's centrality measure broadly indicated a reduction in hierarchy across the process to 'activity'. At the point of 'development' hierarchy reduced and it reduced further when the network reached the stage of 'activity'. The hierarchy begins to show again at 'self-organising' and at 'reiteration'. Alongside the SNA findings of this study, whilst not specifically investigating the validity of vertical vs horizontal network types in reference to the professions, the findings did essentially agree with the literature in terms of the representatives coming from these different types of networks. This was demonstrated through a reported benefit of the process, being the ability to interact as a peer between professionals i.e. pharmacists and doctors, where normally this was considered more an interaction based on hierarchy.

Reflecting back on the facilitation provided by CLAHRC it appears it effectively ensured there was an equal involvement, there were interactions between hierarchically based roles in the medical profession and it kept iterating the tie over and over until it reached a point that the relationship tie had evolved and was sustained by the individuals themselves.

To understand the requirement of a constant facilitation from an external source is useful as it is well cited that healthcare would benefit from improved collaboration leading to improved spread of research knowledge and practice change (Oborn et al, 2010, Williams and Dickenson, 2008). A key point resulting from this study with regard to health related implementation approaches is the constancy of the facilitator. It is not 'one-off' facilitation; it is constant throughout the process with it only dropping off as the network becomes self-organising toward the end of the process.

### **9.3.1.2 Communities of practice**

Networks are structure and process, a part of that process is the relationships and community that animates the network structure (Edwards, 2010). The perspective that networks are structure and process indicates that they are not static. Networks are dynamic and in the same manner I expect the structure of a network to change, so can its community (Doreian, 1994, Edwards, 2010, Li et al, 2009). This is, however, not the perspective taken within the majority of CoP related literature (Li et al, 2009). Literature often discusses CoP as if it is a specific definition and then it argues that the definition should be different, for example, focused on purpose rather than practice, the discussion tends to centre on a static 'either/or' manner. Equally, as highlighted within the literature review there are a number of criticisms within the literature indicating that discussion with regard to CoPs fail to recognise the complexity of interactions, power relations and the formation and evolution of CoPs (Bentley et al, 2010, Omrod, 2007, Hildreth and Kimble, 2004, Ardichvilli et al, 2003).

Within this study, due to the longitudinal nature of it, I was able to analyse the network and any community developments. As described above hierarchy diminished during the process, which potentially offers a suggestion of a more even, distributed 'power' within the community. This has been demonstrated within literature as collaborative learning is purported to move ownership away from management and the traditional hierarchy (Bentley et al, 2010). This, as described in the literature review, has resulted in a sense of ownership and autonomy, which is effectively supported by this study.

The findings do, however, indicate that the hierarchy and therefore power can be re-enacted when required and therefore it might be more accurate to indicate that the 'power' becomes latent as opposed to being directly enacted all the time. The community and network at inception and throughout the process is supported and in the early stages directed by the CLAHRC organisation. Within this study, I found that this support was necessary in order for the network and community to develop connections across the various boundaries present and to create a system of knowledge sharing. It was also evident that the consistency of interaction – facilitated and otherwise – moved the group to become a community of knowledge sharing as the process moved along. This concept is supported within the literature as



Ardichvilli et al in 2003 describes how a supportive environment is important to create knowledge sharing and interestingly highlights multiple face to face meetings as an important aspect. Equally, as highlighted within the literature review formal connections are indicated as enabling permeability of boundaries between CoPs (Ferlie et al, 2005).

An interesting aspect of this study's findings relates to the concept that CoPs have inherently such strong ties that they form a clique (Bentley, 2010). The findings did demonstrate the development of strong ties within the group and yet they also demonstrated a clique or closure of the group at the point of 'activity' within the conceptual framework and a relaxing or an openness as the group moved past that point. This leads to a reflection as to why the CoP did not become a clique as suggested occurs within the literature. The findings indicate that this might have been due to three aspects – a CLAHRC representative actively a member of the community, a requirement from CLAHRC to deliver outside of the immediate grouping and a tight timeframe in which to do it. These combined to create a position where the group could not remain closed and clique like it was driven to look outwards in a timely fashion and consistently reminded of this requirement by the presence of a CLAHRC member.

As detailed within the literature review and highlighted above there is criticism regarding the ambiguity of terms utilised to describe a CoP and the specifics of how a CoP is defined (Hildreth and Kimble, 2004, Bentley et al, 2010). Within this study I suggest it is evident that it is not a case of 'either/or' static type of grouping. CoPs, in the same manner as a network structure, are dynamic and through the evolution of the network and CoP, different types of CoP can develop at different time points.

This finding is important to healthcare literature and practice as, whilst the journey of a CoP and network development may be different in different organisations or contexts, it does highlight the point that there needs to be room given for the developing network to be able to travel through different community states in order to evolve. I discuss below the CoP literature with reference to this study. I highlight the different CoP forms described within literature as they relate to the various transient forms of a CoP I propose this study demonstrated.

Wenger (2011) outlines a community of practice as consisting of a domain i.e. the identity of the community defined by a shared interest, a community in which the members interact and learn and practice. Within the literature review in chapter 2 I outline a number of criticisms that are levelled at the literature around CoPs, for example, the terminology, definition, impact of power and their development (Li et al, 2009). This study does not seek to address or resolve all the criticisms and gaps within the literature. It does, however, inform broadly on definition, development and multiple communities, with a key point that CoPs are not static. This study suggests that there is not one form that is reached; rather different forms of a CoP can emerge and develop.

The literature debates at length the definition of a CoP in terms of the difference between a CoP and other formal and informal groups (Li et al, 2009). Within chapter 2 I outline a snapshot comparison of the groups that Wenger and Snyder delineated in 2000. It is argued by Li et al (2009) that the distinction between the groups is vague and contradictory. Another criticism is that of the groups' focus being on practice. This has led to suggestions that it should be termed a 'community of purpose' or even a 'network of practice' (Barab et al, 2004, Brown and Duguid, 2001). There is also the concept of epistemic communities of practice, which is defined slightly differently. An epistemic communities of practice is similar to a CoP in that it is focused on common knowledge sharing and creation, however it is distinct due to there being an authority governing how it is run, i.e. a procedural authority (Cohendet et al, 2001).

My findings add to this debate in the literature. The networks I analysed have aspects that can define them as a community of practice and aspects that do not. For example, the purpose of the networks was to develop members' capabilities and to build and exchange knowledge. They also reached a stage where they were held together with passion and commitment, a part of the definition of a CoP according to Wenger (2011). Equally, the network can be defined in terms of domain, community and practice (Wenger, 2011). The networks were not, however, self-organising, which is a part of the definition of a CoP (Wenger, 2000). Interestingly, however, the network does reach a point when it is self-organising. The ability to be self-organising developed across the process as did the passion and commitment. So, alongside the 'community' aspect of it developing over time i.e. the interactions (see

above re how interactions of the network developed over time in the process) I found that the domain, i.e. the shared interest, and the practice, i.e. the focus, also develops. The findings therefore suggest that the distinction is not arbitrary, i.e. that it is a community of practice or a community of purpose, and that there is a more nuanced perspective that actually a network can be all of them at different points in time as it develops across the process. There is some agreement with this within the literature as some of the studies that have looked at evolution of a CoP indicate a development process occurs from loosely connected to more mature phases (Ranmuthugala et al, 2011)

The findings indicate this if I compare some of the results across the process. Above I outlined how the community developed over time i.e. interaction increased. If I look at the 'domain', I can see that findings indicate that the networks at inception are brought together due to funding predominantly. At this level the interest is shared in terms of deciding to enter the process and also around a specific task i.e. the project which they had come together to achieve, although the details of the how, what and where of this task were not necessarily in place. The group itself had not developed an interest around which they were all focused in terms of building and exchanging knowledge and they had not developed a passion and commitment at this point. As the network moved to 'development' interaction had increased and the network had developed a shared perspective including a shared accountability (they felt they had to deliver something now that they had received funding for it), a shared knowledge (they had learnt the CLAHRC improvement methodology) and a shared purpose (they were focused on mapping out the project change). The focus of the group had moved from being on CLAHRC the organisation to them being internally focused on the community itself.

I would argue that the network at 'start-up' was by definition (Wenger and Snyder, 2000) a project team. Its purpose was to accomplish a specified task. The project's milestones and goals were what held it together, people were assigned to it and it was deemed by the participants to be in existence to deliver the project. Learning at this point was a planned mechanistic process of cognitive learning as opposed to situated learning that is purported to occur within a CoP (Lave and Wenger, 1991). At 'development' I would argue that in line with the proposed definition within the literature i.e. the group has a shared agenda and interest in a particular project, the

network had moved to an 'epistemic community of purpose' (Barab et al, 2004, Cohendet et al, 2001). This definition is similar to a 'project team' and therefore would suggest that it should be defined as including some level of action and that action surrounds the purpose i.e. the process of deciding what the actual practice will be.

As the networks moved on to 'activity' a shared identity developed, a sense of ownership and learning was more situated in that the community worked increasingly away from the CLAHRC's facilitated structure. The situated nature of the community is a part of the definition of a community of practice (Lave and Wenger, 1991). Importantly, the network remained focused inwards on the group but at this point it was focused on practice i.e. the actual 'doing' of the project. So this would include aspects such as the Plan-Do-Study-Act cycles as they test out their changes. It was at this point that the network was demonstrating the classical definition of a CoP i.e. the interest of the team was focused on building and exchanging knowledge and they had developed a passion and commitment together. There was, however an important distinction at this point which defines the network at 'activity' as opposed to 'self-organising'. At the point of 'activity' the network is still driven and facilitated by CLAHRC. In other words I would argue that the network had moved from an 'epistemic community of purpose' to an 'epistemic community of practice' (Barab et al, 2004, Cohendet et al, 2001 and Williams and Dickinson, 2008).

Here I need to highlight a difference between the evolution of the project knowledge transfer network and the fellows' knowledge boundary network. The fellows' network were brought together in order to do individual projects but as a group learn the improvement methodology and create support and a forum to share experiences. The fellows' network progressed through the conceptual framework to the 'activity' stage. However, the community that developed here was not centred around practice, rather it was around support and shared discussion. As such the community was centred round 'the process of acquiring knowledge and understanding through thought, experience', which is defined as cognition (Oxford dictionary, 1996). I would argue, therefore, it was an 'epistemic community of cognition' that had developed. This is a concept that has arisen from the findings of this study. As described above epistemic and community relate to the

characterisations already given, however, the data indicates an alternative to those definitions described within the literature (Cohendet et al, 2001, Wenger, 2011).

At the point of 'self-organising' the participants had increased their skill set and there was a sense of legitimacy having been built with regard to the process, improvement methodology being used and of the network itself. They developed common experiential knowledge and as a result had become self-sufficient and self-organising. Therefore I suggest at this point it had become a community of practice as it fulfils the self-organising part of the definition (Wenger, 2000). The network at this point does however start to lift its focus away from the community itself and take the 'practice' to others within the care pathway in order to embed the practice change. There is no longer the procedural authority in place and therefore the epistemic preface is no longer required (Cohendet et al, 2001).

Finally, by the time the network becomes 'reiterative' the network becomes less tightly bound. Interaction is still high but the network's focus is outward from the group now. It is at this stage the practice spreads wider still and it has the ability to recreate a previous stage if required. At this point I would argue the network had moved to a 'network of practice'. Brown and Duguid (2001) distinguished between networks of practice (NoPs) and communities of practice (CoPs). A NoP, according to Brown and Duguid in 2001, had the same characteristic as a CoP in that it had practice and knowledge in common but the members were not so well known to one another and do not initiate collective action. A CoP, however, it was suggested, consisted of a set of strong ties linking those who are engaged in a shared practice and which do initiate collective action.

The findings suggest this difference in the definition in terms of the strength of ties. With regard to my findings this is not meant in terms of frequency rather more in terms of earlier in the process action is collective. The level of contact is necessary as individuals 'work out' what to do. At this point they still interact at a heightened level. However, they are all working independently and the spread is therefore wider. In that way the connections are looser. So, I would suggest the network is a NoP, based on the looser connection and that they do not initiate, as a whole, collective action. Here, the collective action comes from the enactment of hierarchy. Hierarchy creates the collective action and the network can retract, or bring in others to go

through the community of purpose, facilitated practice, CoP stages as above. The table below relates the stage within the process framework, the CoP descriptive term and characteristics.

<b>Framework concept</b>	<b>Descriptive term</b>	<b>Characteristics</b>
<b>Start-up</b>	Project team	Purpose to accomplish a specific task and people assigned to it
<b>Development</b>	Epistemic community of purpose	Shared perspective, focus on purpose (project) and an authority (CLAHRC) in place facilitating
<b>Activity</b>	Epistemic community of practice	Stronger association developed – shared identity and ownership, focus on practice (action), focus inward and an authority (CLAHRC) in place facilitating
<b>Activity (Fellows)</b>	Epistemic community of cognition	Stronger association developed – shared identity, focus on cognition, focus inward and an authority (CLAHRC) in place facilitating
<b>Self-organising</b>	Community of practice	As above but now no authority (CLAHRC) facilitating community is self-directed and focus outward.
<b>Reiteration</b>	Network of practice	Looser connection between the community and action instigated by hierarchy as opposed to collective action above. Focus outward.

Table 9.1: A table to show how the stages within the process framework, the CoP descriptive terms and characteristics relate. Please note sources are in the text.

So, above I have drawn on literature to characterise the findings throughout the process. I have therefore proposed that the network structure 'animation' as described in the literature review occurs and evolves across the process. Within the literature review I also highlighted that the constituents of social capital – understanding, trust and reciprocity are relevant and important to the development of a CoP (Nahapiet and Ghoshal, 1998). The findings demonstrated the building of understanding both toward the CLAHRC process and its methodologies and with regard each other's perspective and knowledge. Equally, the data indicated an increase in reciprocity across the process. The data does not specifically address trust across the process, however, I suggest that on an intuitive level as the group demonstrated a shared identity, shared accountability and ultimately a shared legitimacy it relates to some extent to the development of trust. As discussed in the literature review the development of these three aspects have been shown to be related to behavioural change which can result in improved knowledge transfer, which it appears my findings agree with as below I discuss how knowledge transfer is created across the network as it evolves (Nahapiet and Ghoshal, 1998, Lesser and Storck, 2001).

This study had a focus on the coming together of multiple communities or at least representatives of them. From literature, empirically and from policy we know that in healthcare it is necessary for multiple CoPs to come together in order to harmonise their practice (Ferlie et al, 2005). However, the literature also indicates that the practice of one CoP does not necessarily fit another CoP (Yanow, 2004). Within this study I have been able to analyse a representative of multiple CoPs coming together in order to create a change and harmonised practice, within healthcare. The study found and characterised above the changes across the process regarding, for example, participation levels and the formation of identity, which according to Li et al in 2009 has received limited attention within the literature. As discussed in the literature review whilst the studies are limited with regard the evolution of a CoP the studies that are published indicate that a CoP develops from being loosely connected, discovering common ground through to more mature stages such as a stewardship CoP. These studies indicate to some extent the findings in this study – that the stages vary and that the outcome of interest is the relationships that are

being formed as opposed to a specific change in work practice (Ranmuthugala et al, 2011).

Equally, there are some reports that multiple CoPs brought together can hinder learning and create conflict (Ferlie et al, 2005, Currie and Suhomlinova, 2006). This study did not, in general, find that bringing together multiple CoPs hindered learning or created conflict. The only time within the process where this was borne out was as the practice that was developed within the community was implemented in the wider care pathway i.e. 'self-organising'. Here I noted some problems around engaging other individuals, possibly as a result of the perception that the 'practice' was coming from another CoP (the team going through the CLAHRC process) and did not really fit in their day to day working environment.

Within the healthcare literature where there are studies where CoPs are established, there is a large variation in terms of how and why they are established. The common aspect in healthcare implementation is the objective to facilitate learning and the exchange of knowledge to improve practice. Early healthcare CoP research did not commonly evaluate the outcome in terms of improvement, however, more recently this has been focused upon more and it has been suggested that a CoP could have a role in improving healthcare performance (Ranmuthugala et al, 2011, Oborn, 2010). As a result, it is important for health implementation research to understand how to cultivate a CoP to benefit the organisation as suggested by Ranmuthugala et al in 2011. The majority of the diversity of CoPs literature sits within the organisational body of literature. There are opposing views with regard the requirement to include or exclude literature from other sectors due to the importance of the social and cultural context in the effectiveness of interventions such as CoPs, some view the findings as not applicable from other sectors and hence the interesting implications of this study (Ranmuthugala et al, 2011).

### **9.3.1.3 Knowledge**

There are four main findings from the work on knowledge within this study. First, as the network evolves, a significant part of its evolution is the development of a shared knowledge; second, that the process of transferring knowledge changed as the network evolved; third that there is a dynamic interchange between tacit and explicit



knowledge within healthcare as suggested by Nonaka (1994) and Kothari et al (2012) respectively; and fourth the complexity of knowledge use. The knowledge use results were mixed across the process and between UoAs. Instrumental knowledge was more often associated with explicit knowledge exchange and it was clear that symbolic use was the most often reported predominant use of knowledge i.e. to confirm a stance or position. As highlighted within the literature review the discussion around knowledge use within the literature highlights the complexity of it ranging from when utilisation is deemed to have occurred through to contextual and individually related factors (Landry et al, 2001, Cammer et al, 2013). This study clearly confirms the same perspective that knowledge utilisation is complex and multi-faceted. In other words, the only definitive outcome was the complexity of knowledge use both in terms of its definition, how it relates to the exchange itself and how that changes over time within networks and across boundaries. This is a clear area where further research is required.

An interesting aspect of this study is its approach to knowledge transfer. As highlighted in the literature review a number of knowledge transfer research and particularly that research based in the healthcare setting relates to the implementation of specific pieces of research knowledge as opposed to a broader view of knowledge transfer via ongoing interactions (Belkhodja et al, 2007, Innvaer et al, 2002, Elliott and Popay, 2000). This study focuses on the broader view via the interactions instigated and the networks that evolve.

The first aspect I will consider here is that of the knowledge transfer process model. There is extensive literature regarding the process of moving knowledge (Sudsawad, 2007). Literature initially suggested that the model was that of a one-way linear 'push' or 'pull' model. However, the view is predominantly that it is complex and multidirectional and that one size does not fit all despite the numerous attempts to establish 'the model' (Phillipson and Liddon, 2007, Sudsawad, 2007).

Within this study the findings did not demonstrate any one particular knowledge transfer model. Rather the process of knowledge transfer altered across the time within the CLAHRC process. For example, from 'start-up' through to 'development' the transfer of knowledge was one-directional. It was reminiscent of the early linear push and pull knowledge transfer process models. The CLAHRC organisation

delivered knowledge to the networks in a 'push' manner. They also demanded knowledge back in a 'pull' manner.

As the network progressed between 'development' and 'activity' interactions developed further and importantly with regard the knowledge transfer process model it became more reciprocal. Network members would start to feedback thoughts and comments and deliver information to the CLAHRC organisation without it being demanded (pull). As a result it was evident that the process of transferring knowledge changed to a multi-directional one. The final aspect around this surrounds the usefulness of the process models. The literature generally deems a multidirectional model as the supreme method for transferring knowledge (Ward et al, 2009). I would suggest that this study indicates that actually there may not be an optimum model for knowledge to be transferred rather an optimum model in a particular context. For example, there was a need for the linear 'push' and 'pull' approach early on in the process. The CLAHRC approach is fundamentally based on the use of specific improvement methodology tools. In order to meet this requirement the participants had to learn about it and they had to learn about it in a short timeframe. Multiple discussions on each aspect at that point would have stalled the progress. Within the data set it was evident that this 'push' and 'pull' approach was not particularly well liked, whilst at that point in the process, but there was a strong opinion that they could see the value in it afterwards. Another aspect of the 'push' and 'pull' approach was that it provided the 'kick start' to the journey the networks were to go on. It provided focus and a structure.

This is not to say the transfer process model that is multi-directional was not valuable within the CLAHRC process. It clearly was, as the networks interacted more amongst themselves and with the CLAHRC organisation this enabled a more fruitful exchange of knowledge. For example, the development of the interaction led to the stopping of using some aspects of the methodology. This, however, would not have been possible if the building blocks had not been learnt early on in the process. As a result I suggest that the findings from this study concur that there is not a one size fits all model and that there are probably different models and approaches that would suit different agendas and contexts. The interesting aspect I suggest as a result of this study is that it is not necessarily always multi-directional and that there is

potentially some value in harnessing a linear approach in some circumstances. An interesting approach potentially for health research to look further into the contexts and circumstances that are important for different priorities. This is not too dissimilar from a call within the literature for further research into contexts and relevance of knowledge transfer models and interventions (Ward et al, 2009, Mitton et al, 2007).

Alongside this change, in terms of the process of knowledge transfer across the CLAHRC process, there was an alteration with regard to the professionally-defined knowledge and that of common knowledge across the network. In other words, with reference to the literature, these two types of knowledge can be classified as component and architectural knowledge respectively (Balogun and Jenkins, 2003, Henderson and Clark, 1990). At inception the component knowledge was clearly in place, however there was little architectural knowledge i.e. routine or schema for co-ordinating knowledge. The networks in this study essentially create two levels of architectural knowledge – improvement methodology and the new routine or practice resulting from the project. The first architectural knowledge is created as the network learns the improvement methodology and is therefore in place by the ‘development’ stage. This is created via a process of linear ‘push’ and ‘pull’ knowledge transfer. Across the first three stages the component knowledge i.e. professionally-defined knowledge becomes less defined as it is shared. Finally, at the point where the second layer of architectural knowledge is in place i.e. ‘activity’ the network is transferring knowledge in a multi-directional manner. This is an important aspect of the process as it is this second layer of architectural knowledge that becomes the actual change within the care pathway and is spread out to others. This brings me back again to the point that the findings suggest there is an optimum model in different contexts.

There is also another part of the literature that is directly applicable to this study and that is the interaction of networks and the influence on knowledge transfer i.e. knowledge networks (Phelps, 2012). There are many aspects to this in the literature and many different ways that have been utilised to investigate explicit transfer and tacit sharing. Within this study I characterised the network in both forms i.e. an explicit transfer network and a tacit sharing network. As a result of this I was able to analyse the type of knowledge transfer that was used at different points in the

process both within the UoA's network and also between the UoA's network and the CLAHRC organisation.

Once a part of the CLAHRC process at an early stage within the UoA network tacit knowledge was more predominant. Tacit knowledge also exhibited more reciprocity than explicit knowledge exchange. This was essentially the case across the entire process within the developing knowledge networks. Within the literature it indicates that when there are shared goals the level of knowledge exchange is increased. It states that with increased levels of trust there is a higher tacit knowledge exchanged. Trust was not a measure *per se*, however, the way in which the UoAs progressed, interacting more, reduced hierarchy and the development of shared goals and experiences it would follow that this may be one of the reasons that tacit knowledge was higher than explicit knowledge within the network. This is more marked if I compare it to the predominant knowledge exchange between CLAHRC and the knowledge network.

The knowledge exchange demonstrated a different profile across the CLAHRC process between the developing knowledge network and the CLARHC organisation. It was predominantly explicit knowledge that was exchanged until the final stage 'reiteration'. At this point it was tacit knowledge that was the predominant exchange. Interestingly, at the 'self-sufficiency' stage whilst explicit knowledge was still the most predominant type of exchange it had moved to a more even split between the two. So, the findings here demonstrate a shift from explicit transfer to tacit transfer between the networks and the CLAHRC organisation i.e. as there is less need for CLAHRC's input the tacit knowledge becomes more evident. This shift is interesting if I relate it back to the literature highlighted above. It may be that as trust built up between CLAHRC and the knowledge networks the exchange moved to more of a tacit knowledge sharing (Li et al, 2010). Literature also indicates that formal contracts enhance explicit knowledge exchange, which is effectively what was in place between CLAHRC and the knowledge networks. It also states that a formal contract can enhance the effects of 'relational mechanisms and tacit and explicit knowledge acquired' (Li et al, 2010). It is difficult to state from this study that the 'contract' between the network and the CLAHRC organisation caused the success of the

creation of the network or indeed that the knowledge received was more effective as a result but the formalisation of the approach did appear to contribute.

It is difficult to relate these findings to the literature as there is little on how these levels of exchange alter over time (Phelps, 2012). The study does, however, theoretically support the concept of a dynamic interchange between tacit and explicit knowledge as suggested by Nonaka (1994) within the context of healthcare (cf. Kothari et al, 2012). This was probably one of the reasons there were broad trends that could be concluded from the knowledge data analysis but there remained some anomalies. This clearly requires further research in order to clarify or dispute the trends portrayed.

It is the same situation with regard to knowledge use. Literature defines three types of knowledge use – conceptual, symbolic and instrumental (Estabrooks, 1999). It discusses use in relation to the need for it and attributes relating to it. There is, however, a lack of research looking at it in the context of how the knowledge is delivered i.e. explicitly or tacitly and indeed how this alters across a process of network development.

Within this study knowledge use was predominantly symbolic i.e. it was used to confirm a position or an approach within the knowledge network. This was with reference to knowledge that was received explicitly or tacitly. An interesting aspect within the knowledge network was at the end of the process once the knowledge network had become self-sustaining, explicit knowledge transfer resulted in instrumental knowledge use being the most predominant. The reason this is interesting is that the UoA at this point was ‘cycling’ around the process conducting another project and therefore acting on explicit information in the setting up of it.

The knowledge use demonstrated a different profile between the knowledge network and the CLARHC organisation. At the ‘development’ stage symbolic was the most predominant in both the case of explicit and tacit knowledge exchange and at the ‘activity’ stage explicit knowledge exchange resulted predominantly in instrumental knowledge use and tacit symbolic. This was in terms of knowledge received by the individuals within the knowledge network from the CLARHC organisation. In the latter stages it moves on to conceptual being the most predominant in both types of

exchange. This indicates that toward the end of the process the knowledge was not as practically useful, probably as it was not needed to be. It offers another indication that the knowledge network had developed a shared knowledge of the methodology and the project change.

There is another aspect that I will touch on briefly and that is which type of exchange, tacit or explicit, produces the highest conceptual, instrumental and symbolic knowledge use. At the early part of the process a higher level of instrumental knowledge use is produced by explicit knowledge transfer and conceptual by tacit. So, action at the early part is created from the explicit knowledge exchange within the network. Tacit knowledge exchange, which was the predominant type of exchange at this stage within the network, was more used for general enlightenment. This is not surprising maybe if one considers that at this point in the process practice was more limited. It was predominantly about learning and sharing information. There is not a clearly defined pattern to this across the process. This is also the case with regard to the use of knowledge between the UoA and the CLAHRC organisation. This area of considering type of knowledge exchange and its association with type of knowledge use might prove fruitful in health implementation research moving forward. It could enable the planning to consider in more detail the outcome required and the approach taken could be designed accordingly. The findings from this study, as described above, do not provide conclusive evidence with regard this.

Earlier I looked at vertical differentiation (hierarchy) in the knowledge network, however this was for interaction. I also looked at it with regard to the explicit knowledge exchange network and tacit knowledge exchange network. In general, across the process tacit knowledge exchange offered more centrality than explicit knowledge exchange. This could indicate that those with the most perceived experience are providing the knowledge network with information and therefore guiding it along. It could mean, however, that those with the most experience or tacit related knowledge are those that are comfortable sharing and/or have the time to do it. This study does not show this, however, it does show how centrality develops across the process.

Whilst tacit knowledge is more centralised in general, the difference between the explicit knowledge and tacit knowledge varies across the process. At the early stage the level of centrality is similar, at both the point of 'activity' and 'self-organising' the difference between them is high and then it becomes low again at the final stage 'reiteration'. It is difficult to draw strong conclusions as the reason for this change, although this study has identified there is a pattern. It would be interesting to look into whether or not tacit knowledge is more of a driver of action, although if I compare to my knowledge use results the explicit knowledge more often demonstrates a higher production of instrumental knowledge use than tacit knowledge. It could simply be because the network is now interacting more and through the increase in face to face contact tacit knowledge from the project manager or the lead consultant creates the centrality of the tacit network.

A final point to note is that Krackhardt's hierarchy measure indicated none in tacit and explicit knowledge networks. There was a hierarchical measure indicated for the explicit knowledge network at the reiterative stage, which is maybe not surprising considering my data indicated a return to hierarchy as the knowledge network cycles around the process. It is noteworthy, however, that it was within the explicit knowledge network that hierarchy was evident and not tacit knowledge. This may be due to explicit knowledge being the exchange that creates leadership and demand from the knowledge network.

The study also looked at explicit and tacit knowledge exchange with regard to how they were enacted between boundaries within the knowledge network – professional, location and seniority. Here, the pattern changes across the process, however it is a different profile for each boundary type. With regard to professional (job role) at an early stage it is tacit knowledge that is exchanged more across the boundary, although at the 'activity' and 'self-organising' stage it becomes explicit knowledge that is exchanged more across the boundary. This reverts back to tacit knowledge being more often exchanged across the professional boundary by the time it is at the point of 'reiteration'.

With regard to location throughout the process tacit knowledge was exchanged more across the hospital/community boundary than within until the 'self-organising' stage where it becomes explicit knowledge that is more predominantly crossing the

boundary. This may be because explicit knowledge is more in play as the next 'project' is set up and/or if the next cycle around incorporates those from further afield explicit knowledge exchange could be utilised more across the hospital/community boundary.

With regard to stage of career in the early and middle stages the tacit knowledge exchange is more heterophilous i.e. the tacit exchange is more often across the career stage boundaries than explicit knowledge exchange. This reverts to explicit knowledge exchange being more across the career stage boundaries in the latter stages of 'self-organising' and 'reiteration'.

These aspects above are important to healthcare practice and the design of interventions within the health system. A lot of the literature is focused on defining the model of knowledge transfer. It may be worth turning the question on its head in healthcare and understand the complexities of how and when a certain type of exchange should be employed. Equally, with regard to knowledge use, understanding the antecedents as to how to achieve a specific type of knowledge use could improve the design of healthcare interventions.

#### **9.3.1.4 Boundaries**

With regard to boundaries it is evident from this study that they alter over time. The process can change the nature of them and their position. The measures of homophily, for example, indicate that the interactions across different boundaries alter throughout the process. The literature from both a theoretical perspective and practical focuses on boundary crossing and the advantages of homophily, however the findings here indicate that there are times when a knowledge boundary network becomes homophilous i.e. those within the network interact more with those of the same job role. This may sustain or reverse as the network evolves. In the same manner as for the CoP contribution above, a main finding here is that the complexity of boundaries is not covered sufficiently within the literature. The view in healthcare that they need to be removed is not well evidenced and there has been no perspective of the usefulness of boundaries. In this study, I highlight that they are changeable relationally in terms of strained or cooperative and structurally in terms of the ties. The overriding argument here is not that there should be one type or the



other rather there is a complexity not understood here and that it is likely that different relations and structures are important and useful at different points in the process.

This perspective is of importance to healthcare practice because there are a number of interventions and changes aimed at creating a boundary-less system. These findings suggest that there needs to be reflection and a better understanding of the complexity otherwise there is a risk of losing something that has value to the process and to practice in general.

Literature clearly expresses that networks do not exist in isolation and that there are therefore a number of boundaries to be considered (Ferlie et al, 2005, Guthrie et al, 2010). Boundaries can arise in a number of different ways and can therefore be defined as such. Within healthcare predominant boundaries of interest are professional and organisational. Within each of the units of analyses studied within this thesis there was a representative of different professions and organisations within a particular care pathway. As such there was a conglomeration of representatives of other networks/CoPs brought together to create a network in itself. Literature does suggest that a boundary is a network in itself (Karafilidis, 2008). However, other than the suggestion of it, there is a paucity of studies relating to boundary networks *per se*.

This study offers an interesting perspective in that it studies a boundary network. Using the categorisation developed by Ferlie et al (2005) the boundary networks within this study included boundaries such as cognitive (knowledge and skills), technical (clinical guidelines) and social (day to day interaction). Alongside these individually constructed boundaries are those resulting from the institution (Smircich and Stubbart, 1985) – organisational boundaries – these were also present within the boundary networks of this study. I also know from literature that knowledge transfer can ‘stick’ at these boundaries and therefore there is a need to create ‘fluid’ boundaries (Ferlie et al, 2005). The study here specifically looked at networks that were created to transfer knowledge across boundaries, those outlined above.

There are two other aspects within this study relating to boundaries and that is an analysis across the boundary from the UoA to the CLAHRC organisation and from

the UoA to a wider sphere such as the care pathway from which the individuals are representative. Within this section I will discuss the findings with regard to boundaries drawing on three aspects of the literature. These are relational boundaries, network composition (interaction and reciprocity) and spread.

Prior research has studied re-organising work amongst different professional groupings including the changes in roles and relations in diverse work contexts, disputes, renegotiations and change in interactions (Gendron and Barrett, 2004, Barrett et al, 2012). These studies focused on the tensions and strains that arose between the diverse groups (Barrett et al, 2012). It is suggested that these strains may be more evident and more intense in healthcare due to the nature of the context (Ferlie et al, 2005). The gap in the literature, relevant to this study, is primarily around the lack of accounts relating to multiple occupational groups coming together and how their work and relations become restructured. When discussing the boundary relations I draw on Barrett et al, 2012 work on reconfiguring boundaries. Within this study I utilise the three different types of boundary relations defined by Barrett et al (2012), cooperation, neglect and strain. I identified each of these types across the process.

Within this study the results indicate that the relations across boundaries alter as the network progresses through the CLAHRC process – they are dynamically re-enacted. I consider first the boundary relations between the convened representatives at the stage of ‘inception’. Here, the boundaries were effectively convened together within the UoA network. As the network progressed through the process there was the introduction and use of the CLAHRC methodology, firstly learning and then interaction and activity. This created an increase in interaction, reciprocity, across the professional and organisational boundaries, and importantly a decrease in the hierarchy within the network. The CLAHRC process required each individual to acquire the knowledge of the methodology and knowledge of each member’s domain. Those within the network who were in a traditional hierarchical position and those who were not cooperatively negotiated the activity. In other words the shift in skills and roles did not threaten those who were in a traditional hierarchical position as has been seen in previous studies (Barrett et al, 2012). This led to a relation of ‘boundary cooperation’ that was beneficial to all parties and was

demonstrated alongside the network becoming increasingly united by their shared interest. In a sense it created within the boundary network what Levina and Vaast (2005) would term a new joint field, where jurisdiction and a new form could preside.

There was, however, evidence of neglect at the boundary relational level within one UoA. During analysis I determined that this UoA network reached 'activity' in the process. Within this network the members, traditionally in a hierarchical position, i.e. manager or late stage career did not liaise with the others in terms of the problems or decisions with regard the project itself. It had been decided by those in authority that this project would be done and it would be done through CLAHRC. Following this there was a lack of attentiveness to the interests and concerns of the members 'on the ground' doing the work. The incorporation of this project to the work duties of the members 'doing the work' meant there were a number of changes that they needed to make in terms of their daily duties. It was evident that the CLAHRC project work became difficult and frustrating. However the hierarchical members were indifferent to it. This was essentially boundary neglect, caused by the lack of attentiveness, which ultimately 'reinforces social structures of domination', and indifference to another professional group (Barrett et al, 2012).

The study also demonstrated evidence of neglect for similar reasons between the UoA network and the CLAHRC organisation. There was at one point in the process ('activity') a perceived lack of attentiveness from the CLAHRC organisation. An interesting part of this study was again the longitudinal nature of it. It therefore demonstrated how these boundary relations altered over time and this was well demonstrated between the UoA network and the CLAHRC organisation.

At inception, interaction between the UoA network and the CLAHRC organisation was unsurprisingly low. Throughout the process the interaction was raised across this boundary, although it tended to be at the required level as opposed to significantly above. The first boundary relation that emerged across this boundary was that of strain. By the time the network had undergone the mandated learning of the CLAHRC methodology there was an interesting dichotomy of need and loss of control. The network needed CLAHRC. It needed the funding, the direction and help with various aspects such as stakeholder engagement and understanding the methodologies. However, the process was strongly mandated at this point and as a

result there was a sense of loss of control. Individuals not necessarily used to being told what to do, and when to do it by, found it difficult to take the mandated direction. This combination of lack of control alongside increased dependency is termed boundary strain (Barrett et al, 2012).

Boundary strain was found between the UoA network and the CLAHRC organisation at 'development' and at 'activity'. There was evidence of it still at the point of 'self-organising'. However, interestingly at this point it was significantly reduced. The relationship had moved to a more responsive and supportive one. Then finally at the stage of 'reiteration' there was little or no evidence of strain only support. The relations that developed across this boundary between the network and the CLAHRC organisation would be categorised as cooperation. The relationship had become more responsive and therefore reciprocal and it was supportive. Participants had got to the stage where they felt they could contact CLAHRC for assistance and were willing to do so. Earlier in the process when there was strain across the boundary this was something that the participants were less reluctant to do. I would suggest that despite it being categorised as cooperation there is a difference between the relationships developed between the network and CLAHRC organisation and that found within the network. In the latter the concept was much more related to working together to achieve a goal, whereas with the former it was more based on support. It may be therefore that this study suggests a need for further categorisation with regard to boundary relations than the literature currently employs.

Above I highlighted that within the network the distinct boundaries present became cooperative as it developed. A part of this was through the increase in interaction. In addition to the boundary relations that developed within this study I also looked at how the boundaries were crossed, or otherwise throughout the process, in terms of interaction. This specifically draws upon a part of literature that essentially confers that similarity breeds connection or in more colloquial terms 'birds of a feather flock together' (Peng and Mu, 2011, Fleming and Waguespack, 2005). In order to investigate this I looked at who was interacting with whom in the network i.e. how much homophily or heterophily was present. I look at this across professional

boundaries, location and seniority. For clarity, homophily indicates that individuals are interacting 'like with like' i.e. with those of the same profession.

At the start of the process 'start-up' the networks where there was interaction was with those from other job roles. This is not necessarily surprising due to the each of the representatives being from distinct professions and therefore if there was any interaction prior to the process it would be with someone from another profession. At this point both seniority and location tended to interact like with like. So, those in a senior position interacted with others in a senior position and those in the same location (hospital based or community based) interacted with others in the same location.

As the networks move across the process the level of homophily changes and it changes differently depending on the boundary in question. Interactions that were between different professionals at 'start-up' became more homophilous at the 'development' stage. The results showed a mix at the 'activity' stage and heterophilous at 'self-organising' and 'reiteration'. This is interesting as it appears that at an earlier stage the network became more aligned in terms of job role. This interaction relaxed across the boundaries as the network moved through to being self-organising. Interaction with regard to the location boundaries also contracted to become more homophilous in the early stage and then move toward heterophily in the latter stages of the process. Seniority (stage of career) showed more changes across the process in that it was more heterophilous at the early stage, moved to a more homophilous interaction at 'activity' and then in the latter stages became heterophilous again. There is little I can draw on or relate to this within the literature as this type of measure has had limited application in terms of characterising homophily/heterophily within healthcare. Homophily is discussed fairly frequently in healthcare literature as studies have shown that it is a strong presence within this setting and it draws on innovation literature and the diffusion of innovations being superior within homophilous settings (Braithwaite, 2010, Rogers, 1995). Extant literature is limited in terms of studying identity and changes in homophily / heterophily over time.

A final aspect that is specific to crossing boundaries relates to the reach of the UoA network. As the network reaches the latter phases the network starts to engage

others with the project change. This is within the wider care pathway they are all representatives from. So, for clarity, a representative of each care professional and organisation have convened to go through the CLAHRC process. The project change has been defined, tested, refined and now is at the stage it needs to be embedded in the overall care pathway. The members of the UoA network engage the overall care pathway in the alteration and new approach. Literature has a plethora of studies that discussed the problems inherent with engagement of others to a new practice or the like (Walshe and Rundall, 2001, Dobbins et al, 2002, McCormack et al, 2013). This study concurs with this. There were issues surrounding engagement of the wider networks and there was no clear approach as to how to solve the issue, which is again in line with the literature. The overriding method that created engagement within this study was that of persistence in reminding others to do whatever the change was differently and to some extent ensuring the benefits were perceived by the wider network.

Within the literature both homophily and wider engagement or spread has been discussed with reference to the strength of ties (Bae et al, 2013). Strong ties are found, for example, between 'like for like' and the varying benefits of engagement and spread via weak ties (Granovetter, 1973). Granovetter outlined a significant sociological theory based on the strength of weak ties. He related a strong, covalent chemistry bond to a strong tie between dyads and a weak hydrogen one to a weak tie between dyads and then suggested the most value was to be gained from the weak ties.

It is this lens through which I look at the UoA networks spread and crossing of boundaries within this study. Across the process the networks attend facilitated networking events called collaborative learning days. This is a significant part of the process, which is intended to create wide spread interaction and knowledge exchange across boundaries outside the network itself. The results indicate a trend across the process. For instance, at the early stage of the process there was little contact away from the UoA network and there was little value perceived from any interaction that was had away from the team itself.

Once the network had moved to focusing on the activity there was still low contact at these events but the contact there was had was deemed as valuable. The reason for

both these scenarios I suggest is that at the early 'development' stage the network has just learnt all the methodologies and approaches. The focus is to continue to collaborate and bond with their respective network and their capacity for further contact or to take in further information is limited. By the time the network has moved through to the 'activity' stage they have interacted more, they are focused on activity in terms of the actual project they will deliver as a team.

At this point, whilst focused predominantly on the UoA network itself there is a capacity to be able to understand more as the knowledge has been attained at this point and therefore aspects such as the use of jargon or the reasoning behind something no longer fill the individual's capacity to engage. Contact remains low at this point, primarily I found due to the UoA networks finding the time useful to convene and were more interested in that than networking on a wider basis. However, there was value found in the interactions that occurred away from the team, even if they were brief. The reason for this was the ability to compare, learn and relate to what they themselves as a team were doing.

As the network moves to the latter stages of the process contact at the wider networking events becomes more extensive. This occurred in line with them having to take the project change to their immediate wider network within the care pathway. There was still a distinction that could be made here. When the network was at the stage of 'self-organising', whilst contact was high there was not a lot of value perceived in that contact. The members of the network felt that the interaction was too weak to be able to act on. This altered by the point of 'reiteration' where there was high contact and high value perceived from it as the network was now using these extended networking events to spread the outcome of their project further and they felt that they were gaining a wider network and engagement from it.

Underpinning this discussion regarding changes to cross boundary relations is that of the relational ties. A well-known theory was proposed by Granovetter in 1973 indicating that weak ties were more important i.e. there was more strength than in strong ties. The view was generally held that strong ties were between those who were similar and closely connected, whereas weak ties were between disconnected parts of a network and therefore able to bring access to new information (Krackhardt, 1994). The proposal was that very weak ties were of no use, weak ties gave the

maximum benefit and with strong ties the usefulness starts to diminish again. This perspective of value from the type of tie led to the perspective that there was ambiguity around the definition of a weak and strong tie (Krackhardt, 1994).

Literature discusses tie strength in a number of different ways. For example, Granovetter utilised frequency of interaction. Granovetter states a weak tie is a 'nodding acquaintance' and in more detail considers more often a tie that was once strong and had become weak. In other studies tie strength has been determined by the 'closeness' of a relationship i.e. a close friend is a strong tie, an acquaintance a weak tie. There are other suggestions such as source of a relationship (relative a strong tie, neighbour a weak tie), reciprocal perspective (strong tie acknowledged both sides of the dyad), support, and memberships (Marsden, 1984). As a result it has led to some proposed terminology regarding ties and their strengths or characterisation. For example, acquaintance ties, philos ties, simmelian ties (Marsden, 1984, Krackhardt, 1992, Tortoriello and Krackhardt, 2010).

There are two aspects with regarding tie strength which this study draws upon. The first relating to the ties developed within the evolving network and the second with regard to those ties outside the evolving network. As described during the CLAHRC process the network becomes closely tied together. Based on frequency of interaction as in Granovetter's approach this means the network is composed of strong ties. According to the literature strong ties are beneficial when there is change or uncertainty (Krackhardt, 1994).

Within CLAHRC and the evolution of the knowledge boundary networks there is change and uncertainty and therefore according to the literature it would appear strong ties would enable this process. I would argue judging from the findings of this study that this is the case. As the network evolves from 'start-up' through to 'activity' the closure of the network i.e. the development of strong ties create a sense of shared perspective and belonging i.e. shared identity, sense of ownership. In other words, with reference to the literature, the network moves toward closure. Closure is associated with trust and alignment (Burt, 2009).

The creation of strong ties were therefore important during the evolution of the knowledge boundary network, however, the findings demonstrated the ties becoming



weaker as the process moved along after the 'activity' stage. From a theoretical perspective the ties moved back toward brokerage i.e. looser connections after the 'activity' stage.

This 'loosening' of the connections was an important aspect in terms of the evolution of the network. For example, it has been suggested that a CoP can develop strong ties that ultimately create a barrier (Bentley et al, 2010). It is therefore an important part that the network does not become hermetically sealed. The findings indicate that the move to weaker ties prevented the network from becoming hermetically sealed and therefore able to continue along the process. Reflecting this back to the literature the weakening of the ties would enable access to information, which was from the findings an important part of the network being able to sustain i.e. reiterate the process.

The key regarding this discussion on tie strength leads to the concept of value in the type of ties created in terms of how to create the right ties to move forward and remain embedded. A tentative proposal from the findings relate to this in that ties that were created outside the knowledge boundary network, on the basis of the definitions and characterisations of a weak tie, would suggest that none of the ties created in this study, albeit briefly in some cases, would be considered a weak tie and probably not even for the case where some value was perceived from the interaction. The Granovetter concept, however, would indicate that there would be strength in the weak ties created within these wider networking CLD events.

The findings of this study indicate that whilst there was contact created at these networking events the tie was too weak to act upon afterward to make it meaningful.

Equally, however, the tie does exist to some extent, particularly in the latter stages where there was a relatively high level of contact. At the higher contact stages it could possibly be argued that at this point the individuals may be 'nodding acquaintances'. However, at the point where it is deemed of value it could be argued that the tie is more than 'nodding acquaintances'. I would argue that simply using the terms strong and weak ties is insufficient here and in a similar manner to Krackhardt in 1994 I propose three conditions to describe the ties created outside the UoAs within this study. These are interaction, length of interaction and perceived

value of interaction. I suggest that I can classify the ties that were observed at these wider networking events as 'footprint ties'. This definition and term was synthesized from the analysis of the results and not an applied term and definition from literature.

Here, I draw together the four conditions found across the process into a quadrant that offers a schema for identifying the type of ties found at certain parts across the process. The ties within the networks were all strong ties, it was the ties that were made outside the knowledge transfer boundary networks via the CLAHRC process that on analysis became clear that there was limited nomenclature within the literature by which to define and describe the results. The scheme proposed here from the results incorporates; interaction, length of interaction and perceived value of interaction. As an overarching description of these distinct ties I have used the term 'footprint ties'. I use this term as a footprint is defined as 'an impression that is left', which encapsulates this broader granularity regarding types of ties.

In order to fully understand the proposed quadrant delineated below I will briefly describe each type of 'footprint tie' found across this process and highlight the point in which the process it could be discerned. The quadrant in essence links level of contact and value perceived from that contact.

*Quadrant 1 – Footprint 'Etched' (High contact/Low traction)*

This quadrant relates to where individuals have a high level of contact, for example, in this study where the individuals had extended interaction at a collaborative learning event but they did not necessarily perceive they gained any value from it. This was at the 'self-organising' stage in the process.

*Quadrant 2 – Footprint 'Cast' (High contact/High traction)*

There were in some cases people who met at a CLD event for example and continued to follow up afterwards. This was at the point of 'reiteration'.

*Quadrant 3 – Footprint 'Mark' (Low contact/High traction)*

In this case I found interaction tended to be between attendees at, for example, a CLD event. They may have met between presentations or over the lunch break and through conversation found something useful generally around information over how they dealt with a particular problem or CLAHRC tool. This was at the 'activity' stage.

#### Quadrant 4 – *Footprint 'Trace' (Low contact/Low traction)*

The final quadrant represents the brief encounters where nothing really sticks or was more general interaction than specifically useful take away information. This was at the 'development' stage.

Figure 9.3: The matrix below delineates the four proposed conditions of a 'footprint tie' observed within this study.

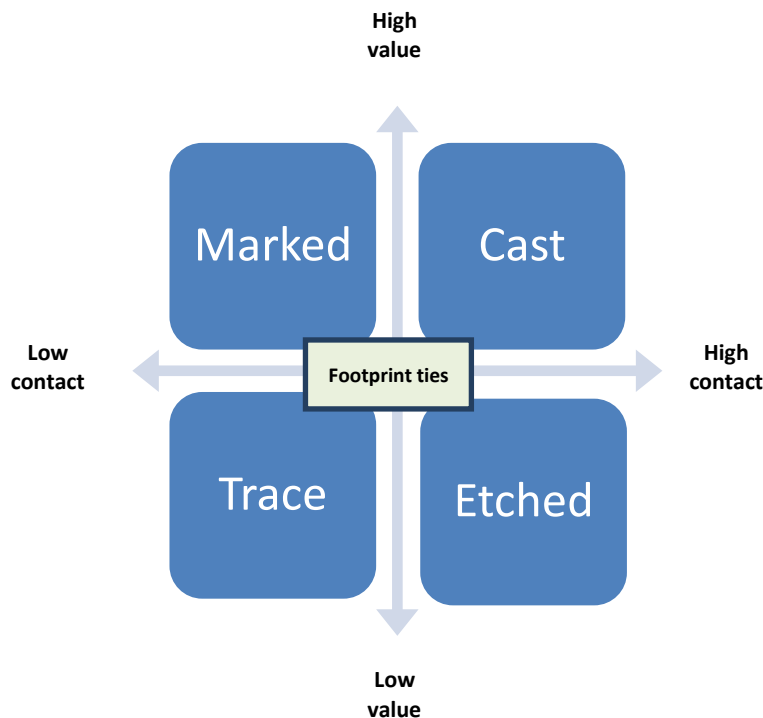


Fig 9.3: A quadrant to delineate the difference in 'footprint ties'

This is a tentative proposal and it is clear that this is an area where further research is required in order to validate and understand the proposal better, including whether all nuances have been delineated and the impact of these different types of tie. It essentially demonstrates the complexity around network ties. In the same manner as boundaries the complexity of ties, how they are created, defined, sustained and at what point each type of tie is useful or detrimental are not well covered in the literature. The understanding of the complexity of ties has a direct relevance to the sustainability of the right kind of tie and therefore a network. They are often dealt with in a simplistic manner and healthcare is an environment where a simplistic view can fail to offer the required nuance to create sustainable change. By understanding

the levels of complexity in terms of tie formation and the value that can be gained from them can aid how practitioners consider setting up collaborations in healthcare, how to spend their resources and how to evaluate actions and resource spend.

### **9.3.2 Process**

The framework that was outlined in the findings chapter highlight four process themes i.e. the parts that move the network forward in its evolution. The first part, the point that the knowledge network is focused on practice, i.e. 'activity', is the process that is driven by the CLAHRC organisation and a set of mandated aspects – learning, interaction and activity. This gave the networks focus and structure with which to actually move forward as a group. It was clear from the findings that this was not always a popular approach. However, as the networks progressed there was a view that it may have been difficult but it was worth it. In other words there was a realisation that they were further along with their project and with an improved set up as a result of the mandated approach the network had been through. Following 'activity' there were three key aspects that enabled the knowledge network to continue to evolve. I identified these as being the inclusion of a CLAHRC member in the project team, the requirement of the project change to embed in a wider network and the strict timescale within which the network had to achieve the change.

This study suggests that these three aspects combine to prevent the knowledge network from becoming hermetically sealed i.e. complete closure a risk according to the CoP literature as discussed above (Bentley et al, 2010). The strict timescale and the requirement to include others ensured that the group did not become only focused inward. The impact of a CLAHRC member to the core network offers some interesting insight. There are two aspects that this achieved during the process. These are the prevention of a hermetically sealed network and the facilitation as an organisational broker.

With regard to the facilitation as an organisational broker the incorporation of a CLAHRC member ensured the requirement for spread and embedding the project change is kept high up in the agenda, as is the awareness of a strict timetable to deliver on. The inclusion of a CLAHRC member attempted to overcome one of the traditionally criticised aspects of an organisational broker in that they are not actually

part of either of the two aspects being brokered. This inclusion did work to some extent as over time the CLAHRC member became more identified with as part of the project team and it enabled members of the knowledge transfer network to perceive there was a dialogue with the CLAHRC organisation. This inclusion of a CLAHRC member is probably one of the reasons that I was able to identify the boundary relation between the UoA network and the CLAHRC organisation as altering over time from that of 'strain' to 'support'.

Moving on to the prevention of the knowledge network becoming hermetically sealed it is my view that the member essentially prevents complete closure. Literature indicates there are benefits to diversity and/or brokerage and benefits to closure. For example, closure of a network can offer superior learning, diffusion of ideas and innovations (Barab et al, 2004, Burt, 2009). It can, however, if too closed become stale and not open to new ideas and advances. The opposite is suggested with regard to diversity (Barab et al, 2004). Too much diversity does not encourage coming together in order to share or learn (Barab et al, 2004). It appears therefore that the three aspects that I outline above essentially combined to prevent complete closure and the networks that during the course of this study successfully passed the 'activity' stage were able to reap the benefits of closure and then move to the benefits of brokerage.

The final aspect of moving forward was the process of moving from 'self-organising' to 'reiteration'. Within this study this movement resulted from a combination of a capacity within the network to look outwards and recognise other opportunities and the re-enactment of a hierarchy within the network. These two combined to create activity and essentially enable the network to 'loop' back around the process. This aspect is discussed more fully in the section below.

#### **9.4 What factors are needed to create sustainability?**

Within the literature review I highlighted the acknowledgement within literature of the need for a clearer definition and further characterisation of sustainability. The majority utilise 'the continuation of the programs and practices that were implemented within organizations, systems, or communities after initial implementation efforts or funding ended' (Stirman et al , 2012). With this definition as

the backdrop within this study I looked at the factors that were in play leading to whether the knowledge transfer boundary networks that had been created by going through the CLAHRC process sustained i.e. did they continue after they were no longer part of the CLAHRC process and funded to be so.

This study indicated that the factors needed to create a sustainable knowledge boundary network include the active convening of representatives from each network, a mandated and structured approach to instigate it and drive it forward, a sufficient period of time that allows development to occur but not too much time that it stagnates and the allowance of emergent action as the network itself comes to a point of self-management.

These factors are all important according to this study. However, there is an overarching factor that is evident in each aspect of the study discussed from inception and through its evolution and that is the point that there are different aspects that are important at different points in the process to drive the network to sustainability.

According to this study in order for the knowledge transfer network to become self-sustaining it needs to get to the point where it can when necessary 'cycle' around the process. In the knowledge network studied that had this ability we noted that the network cycled around the process to differing points. By this I mean that in one instance it went on to implement another change but with the same team of individuals and as such cycled round the process but actually went back to the 'development' stage. This was because everyone in the network was already skilled up in the CLAHRC improvement methodology and therefore could start at the stage of focusing on the purpose i.e. sketching out and deciding how to enact the new project change in more detail. In another instance, the knowledge network cycled around to spread a change to other locations and contexts. This required the knowledge transfer network to cycle back to the 'start-up' stage. This was because they had to bring in new individuals to the network and go through the initial process of skilling them up in the CLAHRC improvement methodology, again bringing the network to a state of common knowledge, shared accountability and shared purpose. Then the 'new' knowledge transfer network continues through the process as before. Essentially, the network is an iterative process of learning and changing identity of

the group. For the successful network any involvement with CLAHRC has become advisory and supportive, the network is not driven by CLAHRC from 'self-organising' onwards.

All the factors outlined above are important in creating a sustainable knowledge transfer network. However, I propose that the key aspect regarding the ability to perpetually cycle around the process is the ability of the network to contract and expand as and when required. For example, from 'start-up' to 'activity' the network contracts inwards, then from 'activity' through to 'self-organising' the network expands, is less tightly bound together and the focus moves outward. When the next opportunity arises the hierarchy within the network is re-enacted and this instigates the cycle around the process framework. In doing so the network contracts again. It is the ability to alter when required that I would argue creates a functioning group level broker as described in the literature review (Long et al, 2013).

The knowledge transfer network created in the fellows' programme goes through the same process and is similar in many ways. There are two key conceptual differences worth highlighting about the process the fellows' network goes through and that is with regard to the creation of a CoP (discussed above) and sustainability. As the fellows' network does not convene to create a change together, rather it is a cognitive knowledge network that shares experiences, support and learning. Therefore, sustainability for the fellows' knowledge network is different. Sustainability in this study with regard the fellows' network was two-fold: did the network continue to an extent where the shared cognition would stay in place and did the individuals act as individual level brokers (as described in the literature review) back in their care pathways? (Long et al, 2013).

The findings indicate that the interaction within the network drops off considerably when no longer part of the CLAHRC process. So, in that sense the network does not endure. I would however bring the discussion back to the concept I outlined above around the nature of weak and footprint ties. The ties within the fellows' network were all in the position of being reactivated if required. A number of fellows indicated that whilst they were no longer in active contact they were able to contact each other again if the need arose. I would argue that this meets granovetter's definition of a weak tie (Granovetter, 1973). In that way I would argue the fellows' network did

achieve sustainability. It is less clear whether the individuals truly became an individual broker back within their care pathway as there was no evidence of other changes being brokered in by the fellows and in many cases not even their original project created any change. The fellows' projects were used more as a tool for learning. However, as I have iterated before data was only collected regarding perceptions of impact not actual impact.

A final aspect that arose as an important factor in the process and the creation of self-sustaining knowledge transfer network was the incorporation of both a top-down mandated approach and the emergent bottom-up approach. The project UoAs were subject to a top-down mandated approach that initially caused problems within the programme. This was resolved as more was allowed to emerge from the network itself. Equally, however, the fellows' network was only subject to the emergent bottom-up approach and there were misgivings over the lack of design and direction. There is discussion around the merits or otherwise of a top-down approach vs a bottom up approach (mandated vs emergent) within the literature (Ferlie et al, 2011).

I have highlighted throughout this thesis that within literature there are limited longitudinal studies and therefore it is difficult to relate the above fully to extant literature. Organisational research generally has focused on the antecedents of superior network performance, however, there is value to investigating how social structures evolve and the processes that contribute to them (Zaheer and Soda, 2009). For example, Zaheer and Soda (2009) state 'awareness of the entire chain clarifies the temporal sequencing and causal linkages behind network emergence and outcomes.' There are some aspects related to evolution touched on within the literature, for example, network sustainability including the re-enactment of ties, leadership and shared interest (Phelps, 2012). As I suggested previously, when referencing the debate about which knowledge transfer process model was correct or which definition of a CoP was correct, the optimum or correct theory or approach is not necessarily a one-dimensional panacea. On the contrary, I argue that there are different optimum approaches and/or theories depending on the context at any given time. So, for example, a mandated linear transfer of knowledge may if thrust upon the self-sustaining network be prohibitive to its functioning. If, however, it is at the



inception of the process it is an integral part to create function and evolve the network forward.

There are, however, other aspects to sustainability. For example, the sustainability of the change in the care pathway the project created and the skills learnt around CLAHRC improvement methodology. These aspects were not the main thrust of this study. It does, however, lead me to highlight a problem with the current literature around sustainability. Sustainability is a term that can be interpreted and defined in a number of ways. If a researcher is judging sustainability there needs to be a clear view of what that sustainability is with regard to the study in question. For example, is it that the change is sustainable, that the skills learnt are sustained, organisational processes, relationships, the network or wider engagement? It is this clarity that is often lacking in sustainability literature (Banerjee, 2011 and Stirman et al, 2012).

The discussion around the creation of sustainability and the definition of what sustainability is in healthcare is an important one. There are a large number of interventions within healthcare that are evaluated in a number of different ways. An inherent problem is how to know when an intervention is a success or a failure. There are some studies that clearly define this, however this problem relates partly to the use of the term sustainability without the definition of what that means in a particular case. If it is not defined in the context of that study, how can it be deemed as being achieved or not? (Stirman et al, 2012). Within this study the definition used was 'the continuation of the programs and practices that were implemented within organizations, systems, or communities after initial implementation efforts or funding ended'. The use of the term sustainability in this study did not relate to the sustainability of an intervention in terms of a new set of guidelines implemented or a new tool to be used rather it is focused on the organisational processes and relationships which included the relational ties that develop or otherwise via an intervention aimed at creating these knowledge networks.

## CHAPTER 10: CONCLUSION

The antecedents of knowledge boundary networks include a facilitator that can instigate the inception of the network and then drive its evolution along. The research indicates that a push and pull of knowledge transfer is required to instigate the network in order to create the shared knowledge and shared perspective. There is a danger in this mandated push and pull approach, however the results indicate this was mitigated by the outcome of the shared base within the community and the allowance of the network to move toward a more reciprocal state. Also key was the space to develop and experience the transient stages of development. This enabled the community to develop and eventually reach the point of being self-driven and sustaining.

There are a number of contributions that this study offers to the body of research in healthcare. In a broad sense it offers a focus on knowledge networks in healthcare an area of growing importance and a need for further studies (Currie and White, 2012, Su et al, 2010, Schilling and Phelps, 2012), it incorporates a quantitative and qualitative approach, which is also highlighted as limited with regard to CoP research (Kimble and Hildreth, 2005) and it reports on a multi-faceted knowledge transfer intervention, of which few studies report on (Ward et al, 2009).

More specifically, the study offers a conceptual framework for the evolution of a knowledge transfer boundary network (KTBN). The framework is an iterative process of learning and changing identity of the group. It highlights the changes as the network goes through the process and the antecedents and consequences throughout. In doing this it takes steps to address the gap in the literature relating to the inception, evolution and sustainability of such knowledge networks. For example. as highlighted in the literature review it starts to address the need for the development of a framework to guide the establishment and facilitation of CoPs in healthcare (Ranmuthugala et al, 2011). It also offers a process theory that can potentially be used to guide the planning and scheduling of implementations in healthcare and/or in future research enable the development of hypotheses about how implementation activities will create or otherwise specific outcomes.

Another interesting gap this study addresses relates specifically to the Knowledge network and CoP literature. The study demonstrates that as a knowledge boundary network evolves it achieves a number of different transient states both at a community and structural level. As a result this study adds to the discussion regarding definition of various groupings in relation to the CoP definition.

The study also addresses the discussion relating to relational ties and the varying strengths and value attained from differing levels of contact and gain. It demonstrates that the development of network ties is more complex than currently proposed particularly when developing them over a wider sphere. The proposal of a footprint tie and resulting quadrant draws together the discussion on tie strength and value although clearly this is an early stage proposal and further research is required.

Finally, the study addresses a gap around the role of facilitation in terms of interaction and interventions. It is an area highlighted within the literature review as being under researched and this study demonstrates that a facilitator is important to instigate and drive the process and that the boundary bridging processes do assist in creating a functioning knowledge boundary network.

### **10.1 Application of findings to practice and policy**

There is an important final part of the study to highlight and that is the importance of the findings to healthcare practice. The premise of the study was initiated by an interest in a government policy i.e. that it was important to healthcare for the second translational gap to be addressed (Cooksey, 2006). The second translational gap is essentially the delay between research moving into clinical practice effectively and efficiently. It became a focus at the policy level due to the increasing need within healthcare to do more for less cost whilst maintaining quality. The rising cost of healthcare is a global problem and therefore the findings of healthcare research to practice and policy has an international and national implication.

The case study, CLAHRC, was set up as a result of the policy aimed at addressing the second translational gap (Cooksey, 2006). There were nine CLAHRCs set up across the UK and this study focused on the North West London CLAHRC. Whilst the study was focused on a specific research area it feeds in to an evaluation of the

approach taken and the value of the policy led creation of CLAHRCs. As a result the findings have an immediate implication to practice and policy.

North West London CLAHRC created a specific process that two programmes – projects and fellows – had to follow. CLAHRC specifically made a requirement that the networks that were brought together at the inception stage were multi-disciplinary. It was this requirement that was instrumental at the start for instigating the cross-boundary network. The network was then subjected to facilitated interaction, learning the CLAHRC improvement methodology, utilising various ‘objects’ to improve communication such as the web reporting tool. CLAHRC remained a driving force and facilitator throughout the majority of the process until the final stages when the network had evolved sufficiently to be self-organising.

This approach is of interest as the mechanisms used did create interaction across the boundaries and ultimately demonstrated that once followed through successfully could create a sustainable change both at the network level and project level. This is useful moving forward for healthcare practitioners or indeed at the government policy level to consider initiatives that follow this approach.

Specific aspects of the approach a practitioner or policy maker could consider are the introduction of an organisational broker. In other words a facilitator that is not from any of the parties that it is brokering. This would need to be in conjunction with some kind of motivating adherence such as funding. However, the facilitation, according to this research could create the drive and collaboration to instigate and evolve.

This research also offers an evaluation of the mechanisms used. So, for example the sustainability tool did not receive good feedback, however, PDSA, stakeholder mapping and the CLD networking events did. The implication of these at the individual practitioner level is clear but there is also an implication at the macro level. Tools such as PDSA cycles and stakeholder mapping are readily available to use and the education and usefulness of this approach could be brought in at the education level of medical personnel in order to create the culture of improvement from the bottom up.

In addition to the specifics around the North West London CLAHRC approach there are some broader implications for practice and policy. It is well understood that to collaborate across boundaries is useful and beneficial to healthcare practice. It is not, however, understood how to make this happen. This is particularly difficult in the healthcare environment as the context can be changeable, there are traditional roles that have a hierarchy and influence attached to them e.g. doctors and nurses and there is the issue of time availability. This study identifies the process in a manner that can be re-created and highlights the negative and the positive. An important part of this study is the concept that the negative is not always necessarily a factor that should be re-acted to by abolishment. For example, there was negative rhetoric around the 'push' from CLAHRC and the demands at the early stage of the process. This 'push' of CLAHRC, however, was deemed as valuable to the participants with hindsight and importantly for practitioners and policy makers it was necessary to instigate and evolve the network to a point of sustainability.

The practical implications of the work relate to the 'how to' for practitioners and policy makers. There is another important implication for healthcare practice and policy that is based on the method of research and development of theory.

The healthcare environment is well known for its complexity and dynamic nature. To conduct a study in a snapshot fashion is contradictory to the context. When relating the findings from this study to the literature and detailing the contribution that this study offers there is a key overriding point that runs through all of it and that is the implication that key theoretical concepts from the literature are not often presented as one-dimensional and static, rather they are dynamic and changeable. This study identified a number of transient changes that would have been missed if the study had not been longitudinal. It therefore highlights that there is a requirement within healthcare to conduct evaluations and empirical research longitudinally (Robertson and Jochelson, 2006).

With regard to theory, by applying different theories to healthcare research it will enable a richer understanding of the theory itself but also importantly for healthcare practice. It can be utilised to inform design and evaluation, which can offer improved description and understanding. The more research can understand the different issues and barriers, what causes and shapes them, the better placed practitioners

will be to increase the impact of their practice and design better interventions or programmes.

Finally, there is an important implication of this study at the policy level. The study effectively evaluates a policy borne approach to addressing the second translational gap. This study can therefore be utilised in further policy decisions, interventions and proposals aimed at healthcare with a particular reference to moving research into clinical practice more effectively and efficiently.

## **10.2 Limitations of the study**

Although this research makes a number of important contributions it is necessary to consider them alongside the limitations of the study.

This study was set solely within North West London CLAHRC. There is a potential that the results are relevant to this case study only. To increase generalisability of the new concepts proposed within this study it needs to be researched in other contexts.

There was also some restriction placed on the research in terms of the units of analysis chosen. It would have been preferable to have been able to conduct the analysis on more units of analysis across the timeframe. This could impact the significance of the results as where there were anomalies within the data the conclusions drawn were broad.

The problem with this piece of research, as is often the problem in healthcare research is the contextual difficulties. The backdrop to the study was by its very nature changeable and therefore I cannot rule out impacts from the context within which each UoA was embedded. Equally, there is a risk that any comparisons drawn between the UoA may suffer from not fully comparing like with like. For example, they are from different disease indications, different locations, different personal attributes and different project changes. However, this was negated as much as possible due to the longitudinal nature of the study as each UoA was followed for a period of time. Where comparisons were drawn from a quantitative perspective between the UoAs at different stages any patterns were extensively reviewed alongside the qualitative data in order to be able to draw conclusions.

There is the possibility of bias in the results resulting from non-respondents. Not everyone contacted responded to be a part of the study. This also gave rise to the problem of missing data. Within the study I was able to make informed decisions as to how to treat the missing data e.g. when asking about a relational tie to make an assumption if person a states there is an interaction with person b then there is one. It remains a limitation nonetheless.

As posited above network analysis can be done at different levels. Within this study the analysis was done at the level of the whole network. There are some aspects that may benefit from combining with an analysis at the micro and meso level.

The network measures used became very complex with regard to the number of variables in some parts of the study, for example, knowledge use in relation to knowledge exchange. As a result the outcome was more aligned to further study than concrete conclusions. For example, it may be fruitful to study the knowledge use separately and simplify it to level of exchange rather than knowledge type. The use of Krackhardt's theoretical graph dimension measure was utilised to calculate hierarchy in the network. It has not been used extensively and a recent article from Everett and Krackhardt (2012) re-examined it and posed a change to one aspect of it (terminology rather than a material difference) and also that it might be useful to multiply the four measures together to create a single measure of hierarchy. In this study I found that this approach enabled a single zero for any of the four measures to have an uneven impact on the outcome. It may be that this is an important finding in itself, however, with no other research around this I had to refer back to the four measures of hierarchy.

Another limitation arising from the SNA data collection was that of measurement. Whilst the decision was made to conduct the sociometric questionnaire face to face to enable a fuller explanation and understanding there were concepts such as explicit vs tacit knowledge and different kinds of knowledge use that required explaining. There is the possibility of respondents misunderstanding the constructs being questioned on.

Alongside the understanding of the respondents there is discussion within the literature regarding the conceptualisation and operationalisation of knowledge use, which has essentially led to a call for the establishment of a sound measure.

Knowledge use was operationalised in accordance with a well-known approach that is well-defined and intuitively understandable. Also, within the data collection I conducted the questionnaire verbally with respondents and provided definitions and examples as the literature suggests in order to enable an unambiguous understanding of the concepts being explored. Whilst the aim of the study was not to establish and create a measure for knowledge use or tacit and explicit knowledge it should be noted that there is this concern surrounding knowledge use measurement and that there is the potential for the instruments used were not valid and reliable.

The data that was collected were about a respondent's perception of each measure. It should be noted that the data collected was not about actual impact. Whilst this was a deliberate part of the study design it is a potential limitation of the study as it is relying on an individual's judgement and perspective which may translate differently in reality. As a result the framework needs to be viewed with this in mind.

An additional potential limitation that should be highlighted relates to the nature of the data collection and some of the restrictions placed in terms of frequency of contact of participants. As a result there were a number of SNA questions reliant on recall. Finally, the relational data did not include more sensitive questions such as level of social contact and therefore the implication of other factors to the reported data cannot be ruled out. Finally, as with all SNA studies, there is a need to be cognisant of the fact that the boundary of the network was specified. This was a purposive decision made based on theoretical and practical considerations, as discussed in chapter 3. It should be noted, however, that boundary specification can impact the scope and structure of a network purely based on who is counted within and outside the specified boundary (Van der Hulst, 2009).

### **10.3 Implications for future research**

The first concept this study has proposed is that of a boundary network, second that of a knowledge transfer boundary network (KTBN) and third a framework for the evolution of a knowledge transfer boundary network (KTBN). It has demonstrated that the sustainability of that network can take different forms i.e. the difference between the project and fellows' programme described above. It therefore also raises the question of the number of different types of boundary networks that could



be created. Another aspect the study has highlighted is the changing nature of the boundary relations across time. There is a need in future research to consider what other types of boundary relations can be defined and then when and how they arise or dissolve. For example, the literature indicates three types, cooperation, neglect and strain with reference to boundary re-configuration around a technology (Barrett et al, 2012). It has not been applied in a wider field and this study suggests that supportive is different to that of cooperation. The question is what other types of boundary relations can be distinguished.

The study has also drawn on the CoP literature and has taken steps to resolve the debate around the definition of a CoP and proposes rather than there being an overriding definition, instead there are different CoPs that can be identified during the course of a network's development. Within this study it has suggested that there is an epistemic community of purpose, epistemic CoP, CoP, NoP and an epistemic community of cognition. It also indicates that one form is not necessarily superior to the other rather it is a question of circumstance and timing. This is an interesting direction for research and would clearly benefit from further study in to the different contexts, timing and constituents that combine to create the requisite type of community.

The study indicates the evolution of the knowledge exchange used, process of transfer and knowledge use. It would be interesting to develop this further in future research. For example, if the aim is to create symbolic knowledge use within a process, what factors does the facilitator need to implement? There are some suggestions resulting from this study i.e. instrumental knowledge at stage 'x' was predominantly created by explicit knowledge transfer, knowing this could assist interventions and programmes to be planned around it. This does, however, require further research in order to build a body of evidence and to refine it further. In the same manner as with the other aspects from this study, literature discusses which type of knowledge is more valuable, whereas in fact again this study shows there could be an optimum time for each. It is by understanding this further and the factors that go in to creating it that would be useful in future research. There are also other aspects around the knowledge exchange including how individual attributes relate to levels of explicit or tacit knowledge exchange.

This study was conducted within the CLAHRC case study. It was therefore the approach that CLARHC used that was investigated. It would be interesting to compare the evolution of KTBNs from this approach to KTBNs developed from another approach. This would help understand in more detail some of the nuances within the process and the factors that achieve the objective. Areas that future research could focus on include the enactment of the process i.e. top-down vs bottom-up, mechanisms used, resource availability and context.

An important part was the incorporation of SNA into the methodology of this study. The usefulness of the incorporation of this particular method has been cited previously in recent literature (Currie and White, 2012). The incorporation of the SNA method is particularly useful as it enables the researcher to investigate the research question from different angles. It enables a focus on dynamics and the analysis at an individual, meso and macro level, thereby enabling the computation of trends in network structure over time. For example, it not only enables the structure of the network to be defined in a simple 'who interacts with who' way, but also enables a multi-level view. It enables details to be gleaned at an individual level (ego networks), a dyad level, triad and whole network levels. It enables more granular investigation at each of those levels such as the horizontal differentiation and vertical differentiation of the network. As a methodology it links well with qualitative research as it can provide pointers for the qualitative data collection to delve further into from a contextual perspective. In particular, within this study it enabled the use of quantitative data analysis for aspects such as homogeneity, traditionally investigated via qualitative data collection alone (Factor et al, 2012). Finally, it also demonstrates particularly well change over time as it can identify pattern and characteristics (Lurie et al, 2009). Future research would benefit from an increased use of mixed methodology and in particular the use of SNA.

Finally, there are a few studies within literature that discuss the different levels of analysis in healthcare. Ferlie and Shortell (2001) describe four levels, individual, group, organisation and system wide; others describe micro, meso and macro (Legare et al, 2011). A good deal of research focuses at the one level and in doing so loses some of the complexity that is integral to the system being investigated (Legare et al, 2011, May, 2006). This study straddles between the macro level and

the meso level. Further research to bring in the micro level and then compare between the levels would add another dimension to the framework proposed.

This study represents an important start to the concept and research of a KTBNs and its development. Whilst it is in its infancy and there is more work to be done this study creates a number of different suggestions for further research.

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# APPENDICES

## APPENDIX 1: Quantitative Tables

As outlined within the methodology chapter we conducted a sociometric questionnaire. The results were collated and processed separately. As outlined in chapter 2 we analysed the results in an inductive manner by specifically analysing it in two ways – Network composition and Knowledge mobilisation (include knowledge transfer, knowledge sharing and knowledge use).

In order to characterise the UoAs network appropriately over time we specifically chose appropriate measures in order to look at both network composition and knowledge mobilisation.

For network composition we used; network connection (density and reciprocity), horizontal differentiation (E-I index) and vertical differentiation (centrality and Krackhardt's graph theory). We also, analysed the connection between the UoAs and the CLAHRC organisation in terms of network connection (density) and differentiation (centrality).

For knowledge mobilisation we used; knowledge transfer (KT), knowledge sharing (KS) and knowledge use (KU) connection (density and reciprocity – EK and TK only), horizontal differentiation (E-I index) and KT and KS vertical differentiation (centrality). We also, analysed the connection between the UoAs and the CLAHRC organisation in terms of knowledge mobilisation (density) and differentiation (centrality).

For details of the measures please see chapter 2. Each table of results includes the relevant framework stage, the UoA id and calculated measures.

### 1.0 Network Composition

#### 1.1 Network Connection – Interaction

Interaction was calculated by using the density measure. The density measure provides a degree of dyadic connection in the networks.

### 1.1.1 Within UoAs

Density was calculated from two data manipulations:

- *Cutpoint 1* – data manipulated to produce a matrix of any level of interaction and above is 1, otherwise 0
- *Cutpoint 3* – data manipulated to produce a matrix of an interaction above monthly (mandated by being part of the CLAHRC process) is 1, otherwise 0

Stage	UoA	B4	During	After
B	COPD	39.00%	77.00%	
B	IMPE H	28.00%	67.00%	
C	Anaes	8.30%	100.00%	
C	Halc	33.00%	100.00%	
C	Stroke	80.60%	97.00%	
C	Alcohol	45.00%	90.00%	30.00%
C	F1	7.80%	100.00%	35.60%
C	F2	12.00%	100.00%	13.50%
D	Jaundice	62.00%	94.60%	
E	IMPE	20.50%	93.00%	

Table 1: Density measures at cutpoint 1

Stage	UoA	Difference
B	COPD	38.00%
B	IMPE H	39.00%
C	Anaes	91.70%
C	Halc	67.00%
C	Stroke	16.40%
C	Alcohol	45.00%
C	F1	92.20%
C	F2	88.00%
D	Jaundice	32.6%
E	IMPE	72.50%

Table 2: A table to show at cutpoint 1 the density % difference – before vs during the process

UoA	B4	During	After
<b>COPD</b>	42.40%	42.40%	
<b>IMPE H</b>	9.90%	9.10%	
<b>Anaes</b>	8.30%	50.00%	
<b>Halc</b>	26.70%	53.30%	
<b>Stroke</b>	80.60%	91.70%	
<b>Alcohol</b>	35.00%	45.00%	20.00%
<b>F1</b>	2.20%	23.30%	5.60%
<b>F2</b>	5.80%	26.30%	1.90%
<b>Jaundice</b>	50.90%	69.00%	
<b>IMPE</b>	10.60%	35.60%	

Table 3: Density measures at cutpoint 3

Stage	UoA	Difference
<b>B</b>	<b>COPD</b>	0.00%
<b>B</b>	<b>IMPE H</b>	-0.80%
<b>C</b>	<b>Anaes</b>	41.70%
<b>C</b>	<b>Halc</b>	26.60%
<b>C</b>	<b>Stroke</b>	11.10%
<b>C</b>	<b>Alcohol</b>	10.00%
<b>C</b>	<b>F1</b>	21.10%
<b>C</b>	<b>F2</b>	20.50%
<b>D</b>	<b>Jaundice</b>	18.10%
<b>E</b>	<b>IMPE</b>	25.00%

Table 4: A table to show at cutpoint 3 the density % difference – before vs during the process.

### 1.1.2 Between UoAs and CLAHRC organisation

Stage	UoA	Cutpoint 1			Cutpoint 3		
		Before	During	After	Before	During	After
		<b>C(o)</b>	<b>C (o)</b>	<b>C (o)</b>	<b>C(o)</b>	<b>C (o)</b>	<b>C (o)</b>
<b>B</b>	<b>COPD</b>	0.07	0.71		0.00	0.29	
<b>B</b>	<b>IMPE H</b>	0.09	0.55		0.00	0.00	
<b>C</b>	<b>Anaes</b>	0.00	1.00		0.00	0.00	
<b>C</b>	<b>Halc</b>	0.00	1.00		0.00	0.20	
<b>C</b>	<b>Stroke</b>	0.38	1.00		0.38	0.88	
<b>C</b>	<b>Alcohol</b>	0.50	1.00	0.50	0.50	0.50	0.50
<b>C</b>	<b>F1</b>	0.22	1.00	0.00	0.00	0.22	0.60
<b>C</b>	<b>F2</b>	0.17	1.00	0.08	0.17	0.33	0.00
<b>D</b>	<b>Jaundice</b>	0.10	1.00		0.00	0.30	
<b>E</b>	<b>IMPE</b>	0.09	1.00		0.00	0.18	

Table 5: A table to show each UoA density of interaction with the CLAHRC organisation

## 1.2 Network Connection - Frequency

### 1.2.1 Within UoAs

Density was calculated from:

- Valued data – Collected data matrix.

Stage	UoA	Before	During	After
<b>B</b>	<b>COPD</b>	1.56	2.78	
<b>B</b>	<b>IMPE H</b>	0.74	1.39	
<b>C</b>	<b>Anaes</b>	0.42	3.67	
<b>C</b>	<b>Halc</b>	1.80	3.30	
<b>C</b>	<b>Stroke</b>	5.07	5.74	
<b>C</b>	<b>Alcohol</b>	1.75	2.80	0.90
<b>C</b>	<b>F1</b>	0.23	2.42	0.58
<b>C</b>	<b>F2</b>	0.37	2.59	0.28
<b>D</b>	<b>Jaundice</b>	2.45	3.73	
<b>E</b>	<b>IMPE</b>	0.73	2.70	

Table 6: Table of before, during and after densities valued data matrices



Stage	UoA	Difference
B	COPD	1.22
B	IMPE H	0.65
C	Anaes	3.25
C	Halc	1.50
C	Stroke	0.67
C	Alcohol	1.05
C	F1	2.19
C	F2	2.22
D	Jaundice	1.28
E	IMPE	1.97

Table 7. A table to show the increase in density between the before and during networks

### 1.2.2 Between UoA and CLAHRC organisation

- Valued data – Collected data matrix.

Stage	UoA	Before	During	After
		C(o)	C (o)	C (o)
B	COPD	0.14	1.93	
B	IMPE H	0.09	0.91	
C	Anaes	0.00	2.00	
C	Halc	0.09	2.00	
C	Stroke	1.50	4.13	
C	Alcohol	2.25	3.50	2.00
C	F1	0.33	2.22	0.67
C	F2	0.58	2.92	0.17
D	Jaundice	0.20	0.73	
E	IMPE	0.18	2.00	

Table 8: Densities between UoA and the CLAHRC organisation for valued data, before, during and after the process

## 1.3 Network Connection – Reciprocity

Reciprocity is the measure of the extent to which the dyadic ties are reciprocated.

### 1.3.1 Within the UoAs

The results for before, during and after the process are outlined in the table below.

Stage	UoA	Before	During	After
B	COPD	0.78	1.00	
B	IMPE H	0.76	0.90	
C	Anaes	0.00	1.00	
C	Halc	1.00	1.00	
C	Stroke	1.00	1.00	
C	Alcohol	0.80	0.80	0.50
C	F1	0.75	1.00	0.60
C	F2	0.58	1.00	0.24
D	Jaundice	1.00	1.00	
E	IMPE	0.50	0.90	

Table 9: Reciprocity within the UoA before, during and after the CLAHRC process

## 1.4 Horizontal Differentiation (Heterophily vs Homophily)

When outlining the findings when we utilise the term homophily we are referring to a higher level of interaction occurring internally i.e. within the defined partition. Heterophily is interaction occurring externally i.e. outside the partition. We calculated the E-I index for each partition. The E-I index is 'the sum (valued data) of ties external to the groups minus the number of ties that are internal to the group divided by the total number of ties' (Borgatti et al, 2002, Krackhardt and Stern, 1998). The resulting value can range from 1 to -1. The value indicates homophily (-1) and heterophily (1) respectively i.e. the extent to which a group interacts within their predefined partition or outside of it. The partitions I defined were job role (medical, allied profession, nurse, management or patient), where based (hospital or community) and stage in career (Early career [up to 5 years], late career [over 5 years]).

The table below outlines the results for the measure of homophily relating to the job 'role partition', before, during and after (where appropriate).

Stage	UoA	B4 E-I	During E-I	E-I After
<b>B</b>	<b>COPD</b>	0.58	0.45	
<b>B</b>	<b>IMPE H</b>	0.45	0.43	
<b>C</b>	<b>Anaes</b>	1.00	0.50	
<b>C</b>	<b>Halc</b>	0.04	0.19	
<b>C</b>	<b>Stroke</b>	0.21	0.30	
<b>C</b>	<b>Alcohol</b>	-0.49	-0.21	-0.89
<b>C</b>	<b>F1</b>	1.00	0.58	0.81
<b>C</b>	<b>F2</b>	0.34	-0.01	0.07
<b>D</b>	<b>Jaundice</b>	0.07	0.28	
<b>E</b>	<b>IMPE</b>	-0.46	0.31	

Table 10: Table to show before during and after E-I index scores – job role partition

The table below outlines the results for the measure of homophily relating to the 'where based', before, during and after (where appropriate).

Stage	UoA	B4 E-I	During E-I	E-I After
<b>B</b>	<b>COPD</b>	0.43	0.37	
<b>B</b>	<b>IMPE H</b>	0.12	-0.21	
<b>C</b>	<b>Anaes</b>	-1.00	-1.00	
<b>C</b>	<b>Halc</b>	0.33	-0.01	
<b>C</b>	<b>Stroke</b>	-1.00	-1.00	
<b>C</b>	<b>Alcohol</b>	-0.54	-0.39	-0.89
<b>C</b>	<b>F1</b>	-0.62	-0.05	-0.23
<b>C</b>	<b>F2</b>	-0.58	-0.08	-0.53
<b>D</b>	<b>Jaundice</b>	-0.15	-0.08	
<b>E</b>	<b>IMPE</b>	-0.73	-0.15	

Table 11: Table to show before during and after E-I index scores – where based partition

The table below outlines the results for the measure of homophily relating to the 'career stage', before, during and after (where appropriate).

Stage	UoA	B4 E-I	During E-I	E-I After
B	COPD	-0.11	0.05	
B	IMPE H	-0.90	-0.39	
C	Anaes	1.00	0.32	
C	Halc	0.19	0.07	
C	Stroke	-0.28	-0.29	
C	Alcohol	0.54	0.21	0.89
C	F1	-0.62	-0.01	-0.50
C	F2	-0.52	-0.46	-0.40
D	Jaundice	-0.97	-0.71	
E	IMPE	-0.42	-0.09	

Table 12: Table to show before during and after E-I index scores – stage of career partition

## 1.5 Vertical Differentiation (Hierarchy)

### 1.5.1 Freeman's degree centrality

Centralisation was calculated from two data manipulations:

- Cutpoint 1 – data manipulated to produce a matrix of any level of interaction and above is 1, otherwise 0

Stage		Before	During	After
	%	Degree of centralisation	Degree of centralisation	Degree of centralisation
B	COPD	30.60	22.40	
B	IMPE H	44.60	31.40	
C	Anaes	22.20	0.00	
C	Halc	32.00	0.00	
C	Stroke	21.90	3.10	
C	Alcohol	62.50	0.00	12.50
C	F1	14.80	0.00	61.70
C	F2	19.40	61.70	19.40
D	Jaundice	31.00	6.00	
E	IMPE	39.70	1.70	

Table 13: Freeman's degree centrality measure on cutpoint 1 matrices

- Cutpoint 3 – data manipulated to produce a matrix of an interaction above monthly (mandated by being part of the CLAHRC process) is 1, otherwise 0

Stage		Before	During	After
	%	Degree of centralisation	Degree of centralisation	Degree of centralisation
B	COPD	33.20	28.60	
B	IMPE H	26.40	26.40	
C	Anaes	22.20	22.20	
C	Halc	40.00	56.00	
C	Stroke	21.90	9.40	
C	Alcohol	43.80	0.00	37.50
C	F1	9.90	66.70	27.20
C	F2	17.40	55.60	15.30
D	Jaundice	30.00	32.00	
E	IMPE	14.90	52.90	

Table 14: Freeman's degree centrality measure on cutpoint 3 matrices

- Valued data – Collected data matrix.

Stage		Before	During	After
	%	Degree of centralisation	Degree of centralisation	Degree of centralisation
B	COPD	31.40	24.70	
B	IMPE H	16.30	16.30	
C	Anaes	22.20	15.90	
C	Halc	30.90	25.10	
C	Stroke	21.90	17.20	
C	Alcohol	38.40	26.30	25.00
C	F1	12.00	22.90	21.60
C	F2	18.60	31.30	17.20
D	Jaundice	20.00	17.30	
E	IMPE	25.30	25.30	

Table 15: Freeman's degree centrality measure on valued matrices

### 1.5.2 Krackhardt's theoretical dimension

In order to analyse this from a more structural perspective we utilised a second measure - Krackhardt's graph theoretical dimensions of hierarchy. This measure derived from a need to create indexes in order to measure the degree of hierarchy in a population. The measure creates a numerical output to each of four component dimensions of hierarchy as identified by Krackhardt in 1994. The measures work by comparing the observed network to an 'ideal typical' hierarchy i.e. an out-tree graph.

The four measures are connectedness, hierarchy, efficiency and least upper boundedness.

Our first step was to multiply the four measures together, as suggested as a possibility in a recent publication by Krackhardt and Everett (2012). We did this in order to provide one figure to measure the level of hierarchy present in each population. The table below outlines the combined hierarchy measure before, during and after the process.

UoA	COPD	IMPE H	Anaes	Halc	Stroke	Alcohol	F1	F2	Jaundice	IMPE
Stage	B	B	C	C	C	C	C	C	D	E
Before	0.07	0.35	0.00	0.00	0.00	0.33	0.08	0.40	0.00	0.26
During	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
After						0.29	0.00	0.59		

Table 16: Hierarchy measures before, during and after process

We can analyse this in more detail. We can look at the granular detail of each measure calculated and gain a perspective as to how the interaction increase or decrease impacts hierarchy. The three tables below show all measures for each UoA before, during and after the process.

Before	COPD	IMPE H	Anaes*	Halc	Stroke	Alcohol	F1	F2	Jaundice	IMPE
Stage	B	B	C	C	C	C	C	C	D	E
Connectedness	0.90	1.00		0.70	1.00	1.00	0.20	0.60	1.00	0.70
Hierarchy	0.10	0.40		0.00	0.00	0.40	0.40	0.80	0.00	0.50
Efficiency	0.60	0.80		0.80	0.30	0.80	1.00	0.90	0.50	0.80
LUB	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 17: Hierarchy measures for each UoA before the CLAHRC process \*Not connected at all before the process

During	COPD	IMPE H	Anaes	Halc	Stroke	Alcohol	F1	F2	Jaundice	IMPE
Stage	B	B	C	C	C	C	C	C	D	E
Connectedness	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hierarchy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Efficiency	0.20	0.30	0.00	0.00	0.40	0.00	0.00	0.00	0.10	0.00
LUB	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 18: Hierarchy measures for each UoA during the CLAHRC process

After	Alcohol	F1	F2
Stage	C	C	C
<b>Connectedness</b>	1.00	1.00	0.80
<b>Hierarchy</b>	0.60	0.00	0.90
<b>Efficiency</b>	1.00	0.70	0.90
<b>LUB</b>	0.50	1.00	0.90

Table 19: Hierarchy measures for each UoA during the CLAHRC process

## 1.6 Knowledge Mobilisation (Knowledge Transfer, Knowledge sharing and Knowledge Use)

### Knowledge Transfer (Explicit) and Knowledge Sharing (Tacit)

#### 1.6.1 Network Connection - Interaction

Density was calculated for both the reported explicit and tacit knowledge exchanges.

##### 1.6.1.1 Within the UoAs

The table below outlines the density of both the explicit and tacit networks for each UoAs.

Stage	UoA	EK	TK
B	COPD	4.10	4.70
B	IMPE H	3.30	4.60
C	Anaes	5.10	4.90
C	Halc	6.40	3.60
C	Stroke	4.50	5.50
C	Alcohol	5.10	3.70
C	F1	0.80	1.90
C	F2	2.90	3.00
D	Jaundice	4.40	5.10
E	IMPE	3.30	5.80

Table 20: Table to show the densities of each UoA explicit knowledge (EK) and tacit knowledge (TK) within UoAs



### 1.6.1.2 Between UoAs and CLAHRC organisation

The table below outlines the density of both the explicit and tacit networks when defined by two groups the project and CLAHRC organisation.

Stage	UoA	EK	TK
		C(O)	C(O)
<b>B</b>	<b>COPD</b>	4.21	2.93
<b>B</b>	<b>IMPE H</b>	1.73	3.73
<b>C</b>	<b>Anaes</b>	6.00	4.00
<b>C</b>	<b>Halc</b>	8.20	1.80
<b>C</b>	<b>Stroke</b>	8.88	1.13
<b>C</b>	<b>Alcohol</b>	8.25	1.78
<b>C</b>	<b>F1</b>	2.56	7.80
<b>C</b>	<b>F2</b>	5.50	1.00
<b>D</b>	<b>Jaundice</b>	5.10	4.90
<b>E</b>	<b>IMPE</b>	3.45	6.55

Table 21: Table to show the densities of each UoA explicit knowledge (EK) and tacit knowledge (TK) between the UoAs and the CLAHRC organisation

### 1.6.2 Network Connection - Reciprocity

The table below outlines the reciprocity of both the explicit and tacit networks for the UoAs.

Stage	UoA	EK	TK
<b>B</b>	<b>COPD</b>	0.92	1.00
<b>B</b>	<b>IMPE H</b>	0.68	0.80
<b>C</b>	<b>Anaes</b>	1.00	1.00
<b>C</b>	<b>Halc</b>	1.00	1.00
<b>C</b>	<b>Stroke</b>	0.79	1.00
<b>C</b>	<b>Alcohol</b>	1.00	0.80
<b>C</b>	<b>F1</b>	0.60	1.00
<b>C</b>	<b>F2</b>	0.72	1.00
<b>D</b>	<b>Jaundice</b>	0.96	1.00
<b>E</b>	<b>IMPE</b>	0.78	0.90

Table 22: Table shows the reciprocity measures for each UoA' explicit and tacit knowledge exchanges.

### 1.6.3 Horizontal Differentiation (Heterophily vs Homophily)

As above, for clarity when outlining the findings when we utilise the term homophily we are referring to a higher level of interaction occurring internally i.e. within the defined partition. Heterophily is interaction occurring externally i.e. outside the partition. We calculated the E-I index for each partition. The value indicates homophily (-1) and heterophily (1) respectively i.e. the extent to which a group interacts within their predefined partition or outside of it. The partitions I defined were job role (medical, allied profession, nurse, management or patient), where based (hospital or community) and stage in career (Early career [up to 5 years], late career [over 5 years]) delineated in respective tables below.

Stage	UoA	EK	TK
<b>B</b>	<b>COPD</b>	0.46	0.53
<b>B</b>	<b>IMPE H</b>	0.20	0.57
<b>C</b>	<b>Anaes</b>	0.68	0.65
<b>C</b>	<b>Halc</b>	0.28	0.01
<b>C</b>	<b>Stroke</b>	0.62	0.20
<b>C</b>	<b>Alcohol</b>	0.16	0.03
<b>C</b>	<b>F1</b>	0.66	0.55
<b>C</b>	<b>F2</b>	0.16	-0.07
<b>D</b>	<b>Jaundice</b>	0.40	0.16
<b>E</b>	<b>IMPE</b>	0.18	0.53

Table 23: Table to show the explicit and tacit knowledge exchange networks E-I index scores – job role partition

Stage	UoA	EK	TK
<b>B</b>	<b>COPD</b>	0.48	0.49
<b>B</b>	<b>IMPE H</b>	-0.47	-0.37
<b>C</b>	<b>Anaes*</b>		
<b>C</b>	<b>Halc</b>	-0.02	0.28
<b>C</b>	<b>Stroke*</b>		
<b>C</b>	<b>Alcohol</b>	-0.26	-0.15
<b>C</b>	<b>F1</b>	-0.61	0.12
<b>C</b>	<b>F2</b>	-0.09	0.08
<b>D</b>	<b>Jaundice</b>	-0.11	0.09
<b>E</b>	<b>IMPE</b>	0.11	0.01

Table 24: Table to show explicit and tacit knowledge exchange E-I index scores – where based partition \*N/A as no differentiation regarding where based

Stage	UoA	EK	TK
B	COPD	0.11	0.21
B	IMPE H	-0.46	-0.42
C	Anaes	0.11	0.58
C	Halc	0.17	0.28
C	Stroke	-0.29	-0.17
C	Alcohol	-0.02	0.33
C	F1	-0.15	-0.06
C	F2	-0.56	-0.38
D	Jaundice	-0.57	-0.65
E	IMPE	0.07	0.06

Table 25: Table to show explicit and tacit knowledge exchange E-I index scores – Career partition

## 1.6.4 Vertical Differentiation (Hierarchy)

### 1.6.4.1 Freeman's degree centrality

We utilise two measures in order to test this hypothesis – Freemans centrality measure and Krackhardt's graph theoretical dimensions of hierarchy measure.

Firstly, we utilised freeman's centrality measure. We calculated the degrees of centrality by symmetrising the data based on the average value of the dyad.

Stage	UoA (%)	EK	TK
B	COPD	13.90	18.70
B	IMPE H	43.40	36.10
C	Anaes	17.20	31.70
C	Halc	14.00	36.70
C	Stroke	48.80	32.10
C	Alcohol	31.90	42.50
C	F1	19.00	6.90
C	F2	28.10	19.10
D	Jaundice	10.40	26.40
E	IMPE	21.60	27.50

Table 26: Degree of centralisation within the explicit knowledge and tacit knowledge networks

### 1.6.4.2 Krackhardt's graph theoretical dimension calculation

Krackhardt's graph theoretical dimensions of hierarchy measure for both explicit and tacit knowledge exchange networks.

UoA	COPD	IMPE H	Anaes	Halc	Stroke	Alcohol	F1	F2	Jaundice	IMPE
Stage	B	B	C	C	C	C	C	C	D	E
EK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.05
TK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 27: Hierarchy measures for each UoA for explicit and tacit knowledge exchange networks

## 1.7 Knowledge Use

Within this section on knowledge use we specifically look at how the use of knowledge relates to whether the knowledge was transferred or shared in the previous section. For clarity, as outlined in the literature review this study draws upon three types of defined knowledge use: Instrumental, Conceptual and Symbolic. Estabrooks (1999) in broad terms characterised these as applying research results specifically, using it for general enlightenment and using it to confirm an approach/position respectively. In this section the tables delineate the types of knowledge use found in terms of proportions, horizontal differentiation and vertical differentiation via explicit or tacit knowledge exchange.

## 1.7.1 Network Connection (% Density)

### 1.7.1.1 Within UoAs

The table below outlines the relative percentages from the reported Knowledge use data. It outlines them for each type of knowledge use (instrumental, symbolic, conceptual) for each type of exchange (explicit and tacit).

Stage (%)		EK Use			TK use		
		1	2	3	1	2	3
<b>B</b>	<b>COPD</b>	27.10	49.20	23.70	36.10	47.50	16.40
<b>B</b>	<b>IMPE H</b>	12.20	53.70	34.10	12.50	54.20	33.30
<b>C</b>	<b>Anaes</b>	25.00	37.50	37.50	0.00	50.00	50.00
<b>C</b>	<b>Halc</b>	6.70	53.30	40.00	8.30	25.00	66.70
<b>C</b>	<b>Stroke</b>	3.80	30.80	65.40	2.60	53.80	43.60
<b>C</b>	<b>Alcohol</b>	20.00	20.00	60.00	16.70	66.70	16.70
<b>C</b>	<b>F1</b>	7.60	84.60	7.70	66.00	17.00	17.00
<b>C</b>	<b>F2</b>	32.90	38.60	28.60	38.10	45.20	16.70
<b>D</b>	<b>Jaundice</b>	33.30	40.00	26.70	28.60	48.60	22.90
<b>E</b>	<b>IMPE</b>	3.80	30.80	65.40	2.60	53.80	43.60

Table 28: Table of different types of knowledge use from explicit and tacit knowledge exchange within the UoAs. Key - 1= conceptual, 2= symbolic and 3 = instrumental

### 1.7.1.2 Between UoAs and CLAHRC organisation

The table below outlines the calculated densities between each UoAs and the CLAHRC organisation for each type of knowledge use (conceptual, symbolic and instrumental).

Stage	UoA	EK Use			TK use		
		1	2	3	1	2	3
		C(O)	C(O)	C(O)	C(O)	C(O)	C(O)
<b>B</b>	<b>COPD</b>	0.00	0.21	0.07	0.07	0.21	0.07
<b>B</b>	<b>IMPE H</b>	0.00	0.18	0.09	0.09	0.18	0.18
<b>C</b>	<b>Anaes</b>	0.33	0.33	0.00	0.00	0.67	0.00
<b>C</b>	<b>Halc</b>	0.00	0.60	0.00	0.00	0.00	0.20
<b>C</b>	<b>Stroke</b>	0.13	0.13	0.38	0.13	0.00	0.38
<b>C</b>	<b>Alcohol</b>	0.25	0.25	0.50	0.25	0.50	0.00
<b>C</b>	<b>F1</b>	0.11	0.33	0.11	0.44	0.11	0.00
<b>C</b>	<b>F2</b>	0.17	0.25	0.33	0.17	0.33	0.25
<b>D</b>	<b>Jaundice</b>	0.20	0.10	0.10	0.20	0.10	0.10
<b>E</b>	<b>IMPE</b>	0.45	0.09	0.09	0.45	0.45	0.00

Table 29: Table of different types of knowledge use from explicit and tacit knowledge exchange within the UoAs. Key - 1= conceptual, 2= symbolic and 3 = instrumental

### 1.7.2 Horizontal Differentiation (Heterophily vs Homophily)

As above, for clarity when outlining the results when we utilise the term homophily we are referring to a higher level of interaction occurring internally i.e. within the defined partition. Heterophily is interaction occurring externally i.e. outside the partition. The value indicates homophily (-1) and heterophily (1) (Borgatti et al,2002, Krackhardt and Stern, 1988). The partitions we defined were job role (medical, allied profession, nurse, management or patient), where based (hospital or community) and stage in career (Early career [5 years], late career).

Stage	Career stage	EK			TK		
		1	2	3	1	2	3
<b>B</b>	<b>COPD</b>	0.00	0.10	0.00	0.09	0.10	0.09
<b>B</b>	<b>IMPE H</b>	-1.00	0.00	-0.57	-0.67	-0.23	-0.50
<b>C</b>	<b>Anaes</b>	0.00	0.33	0.33	-1.00	0.50	0.33
<b>C</b>	<b>Halc</b>	1.00	0.25	0.00	1.00	0.50	0.00
<b>C</b>	<b>Stroke</b>	-1.00	-0.25	-0.53	-1.00	-0.05	-0.53
<b>C</b>	<b>Alcohol</b>	0.33	0.33	0.11	0.00	0.50	-0.33
<b>C</b>	<b>F1</b>	-1.00	0.27	-0.33	-0.14	0.56	-0.11
<b>C</b>	<b>F2</b>	-0.64	-0.41	-0.47	-0.30	-0.30	-0.62
<b>D</b>	<b>Jaundice</b>	-0.60	-0.80	-0.75	-0.60	-0.88	-0.78
<b>E</b>	<b>IMPE</b>	-0.20	-0.27	0.13	0.16	-0.14	0.17

Table 30: Table to show the E-I index scores for type of knowledge use over explicit and tacit knowledge exchange – career stage partition. Key - 1= conceptual, 2= symbolic and 3 = instrumental

Stage	Job Role	EK			TK		
		1	2	3	1	2	3
<b>B</b>	<b>COPD</b>	0.63	0.52	0.43	0.82	0.52	0.45
<b>B</b>	<b>IMPE H</b>	-0.60	0.73	0.29	0.00	0.69	0.38
<b>C</b>	<b>Anaes</b>	1.00	0.33	0.33	0.00	1.00	0.33
<b>C</b>	<b>Halc</b>	-1.00	0.50	0.00	-1.00	0.50	0.00
<b>C</b>	<b>Stroke</b>	1.00	-0.25	0.18	1.00	0.05	0.18
<b>C</b>	<b>Alcohol</b>	1.00	-0.33	0.11	1.00	0.00	-0.31
<b>C</b>	<b>F1</b>	1.00	0.82	1.00	0.54	0.78	0.33
<b>C</b>	<b>F2</b>	-0.09	-0.11	0.05	-0.07	-0.35	0.14
<b>D</b>	<b>Jaundice</b>	0.00	0.50	0.50	0.00	0.29	0.33
<b>E</b>	<b>IMPE</b>	0.66	0.00	0.13	0.53	0.49	0.17

Table 31: Table to show the E-I index scores for type of knowledge use over explicit and tacit knowledge exchange – career stage partition. Key - 1= conceptual, 2= symbolic and 3 = instrumental

Stage	Based	EK			TK		
		1	2	3	1	2	3
B	COPD	0.88	0.52	0.14	0.82	0.52	0.27
B	IMPE H	-0.20	-0.82	-0.71	0.33	-0.77	-0.63
C	Anaes	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00
C	Halc	1.00	0.25	0.33	1.00	0.00	0.50
C	Stroke	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00
C	Alcohol	-0.33	-0.33	-0.11	0.00	0.00	-0.33
C	F1	-1.00	-0.27	-0.33	0.09	-0.11	0.11
C	F2	0.27	-0.11	-0.58	0.26	0.12	-0.62
D	Jaundice	0.00	-0.50	-0.50	0.00	-0.18	-0.56
E	IMPE	0.54	0.00	0.00	0.44	-0.09	-0.10

Table 32: Table to show the E-I index scores for type of knowledge use over explicit and tacit knowledge exchange – career stage partition. Key - 1= conceptual, 2= symbolic and 3 = instrumental

### 1.7.3 Vertical Differentiation (Freeman's degree centrality)

Each knowledge use binary matrix was symmetrised under the maximum method and then the centrality measure was calculated for each.

Stage	%	EK			TK		
		1	2	3	1	2	3
B	COPD	75.50	70.90	25.00	69.40	70.90	28.10
B	IMPE H	41.30	39.70	57.90	19.80	51.20	54.50
C	Anaes	44.40	66.70	22.20	0.00	66.70	22.20
C	Halc	16.00	32.00	40.00	16.00	40.00	48.00
C	Stroke	10.90	45.30	62.50	10.90	42.20	62.50
C	Alcohol	6.25	56.30	50.00	6.25	37.50	25.00
C	F1	9.90	84.00	17.30	37.00	88.90	77.00
C	F2	77.80	29.90	30.60	47.90	45.80	35.40
D	Jaundice	35.00	33.00	30.00	35.00	25.00	28.00
E	IMPE	56.20	38.00	39.70	47.90	57.90	41.30

Table 33: Freeman's centrality measure for each type of knowledge use across explicit and tacit knowledge exchange Key-1=Conceptual, 2=Symbolic and 3=Instrumental



## **Appendix 2: Data collection scripts**

### **2.1 Semi-structured Interview script 1 (exploratory interview example)**

#### **Fellows – Benchmarking (First interview)**

**Date and time of interview:**

**Interview code no:**

**Name of Trust (where based):**

**Name of respondent:**

**Title of respondent:**

**Department/ speciality:**

**Duration of interview:**

The main objective of this interview is to obtain a description of your experiences of the Fellows programme implementation, overview of progress made and what you expect participation in it will achieve. The interview will last no more than one hour and with your permission will be tape recorded – just to help us remember what was said later on. To reassure you, all information obtained will be anonymised. Neither the organisation nor individual staff will be identified, when the research is written up, with all names and staff positions anonymised.

Before we begin, do you have any questions, anything I have not covered?

#### **1. Can you tell me about your professional background?**

Prompt: How you came to this role?

#### **2. Could you tell me why you decided to undertake the fellows programme?**

Prompt: What about the project you have decided to undertake within the fellows programme?

Prompt: How was the objective achieved before?

Prompt: How do you plan to change it?

Prompt: How do you expect the objective to be following the programme?

**3. How would you describe your role in terms of the fellows programme?**

Prompt: what are your main tasks and goals?

Prompt: how much time do you have dedicated to the programme?

Prompt: to what extent do you expect the programme to influence your day to day working practices/ your wider workplace?

**4. What is your understanding of CLAHRC – for example how would you describe CLAHRC to another person?**

Prompt: What do you think are the aims and objectives of CLAHRC?

Prompt: What do you know about the structure of CLAHRC?

Prompt: What are the implications of this structure for CLAHRC's activities or aims?

Prompt: Who is in charge of driving the CLAHRC programme forward?

**5. What is your relationship with CLAHRC members, such as other fellows/management/ theme leads?**

Prompt: who is your main point of contact within CLAHRC?

Prompt: How do you currently communicate with CLAHRC?

Prompt: How do you envisage relationships with CLAHRC changing over time?

**6. How would you describe the organisational structure of CLAHRC?**

Prompt: What are the implications of this structure for CLAHRC's activities or aims?

Prompt: What support do you receive and do you expect to receive?

**7. How are CLAHRC methodologies working?**

Prompt: How important do you think the methods you are learning are to your future?

Prompt: How do your colleagues perceive them?

Prompt: what tensions have derived from it or expect to derive from it?

**8. How do you expect involvement with CLAHRC will impact on your relationships with others?**

Prompt: In terms of your relationships with other professionals?

Prompt: In terms of engagement across the local health community?

Prompt: in terms of collaboration between health care staff/primary and secondary care/across localities?

**9. How is the knowledge or experience learned by the fellows shared on return to your departments?**

Prompt: What do you think this implies for sharing or transferring knowledge?

Prompt: How do you expect to apply the techniques and methodologies you learn back in the workplace?

**10. In being a CLAHRC fellow what do you think the key challenges you will need to address?**

Prompt: Do you expect it to change your day to day practice?

Prompt: How do you expect it will be influencing others?

**11. What do you feel are the major facilitators of implementing the project outcome?**

Prompt: How do you think these can be reconciled?

**12. For you, what is a successful CLAHRC fellow?**

Prompt: How can this success best be achieved?

**13. How likely is it that any outcomes will last / endure?**

Prompt: Personally/NHS perspective/departmental

**14. Thank you - Any other issues we haven't covered? Are there any questions I haven't asked that you expected to hear?**

## **2.2 Semi-structured Interview script 2 (Main data collection)**

1. Describe what you do in CLAHRC
2. Who else is involved in the project?
3. What skills do you bring to the project?
4. What skills have you acquired whilst being part of CLAHRC?
5. Is this what you expected?
6. Since you started on the project how many times have you attended a CLAHRC organised event?
7. Were you working with members of the project team before?
8. Has this involvement been what you expected?
9. Without CLAHRC how would the project have gone?
10. In terms of implementing your project what role has CLAHRC had?
11. How would you describe the CLAHRC approach?
12. What will happen to the project after CLAHRC involvement?
13. How do you balance the project responsibilities and your every day work?
14. What challenges are there?

## **2.3 SNA questionnaire and grids**

### ***2.3.1 Network data collection within project team***

1. Which people within the CLAHRC organisation do you have direct contact with regarding the project?
2. Here is a list of the project members and the CLAHRC organisational team (as a single entity). Is there anyone missing from the list in your opinion whom you deem as part of your project team?
3. What is each person's role within the project?
4. How many times do you typically interact with X during a workweek?

Scale – 0= Never, 1= Rarely, 2=Monthly, 3= Fortnightly, 4=1xweek, 5=2xweek. 6=3-5x week, 7=5+ times a week.

5. How many times did you interact during a typical workweek before being involved with CLAHRC?

6. For each interaction what percentage of it was explicit knowledge exchange vs tacit knowledge exchange?
7. For the explicit knowledge that you receive how useful do you find it?

Scale – 1 = immediately actionable, 2= To confirm or understand an approach, 3= General enlightenment

### ***2.3.2 Cognitive Social Structure Questions***

1. How often do you think person X and person X interact during a typical workweek?

Scale – 0= Never, 1= monthly, 2= 1x week, 3= 2x week, 4= 3-5x week, 5=5+ times a week

## Appendix 3: Consent form

### PARTICIPANT CONSENT FORM

Please complete the whole of this sheet after reading the information sheet	Initial	Please circle one
1. I have read <b>and understood</b> this information sheet (Version 1-01.10.10). Please keep a copy for your reference		YES/NO
2. I have had an opportunity to discuss this study and ask any questions		YES/NO
3. I have had satisfactory answers to all of my questions		YES/NO
4. I have received enough information about the study		YES/NO
5. I understand that interviews will be audio-recorded		YES/NO
6. I understand that details of my participation up to the time of withdrawal will be stored anonymously on file and may be used in the final analysis of data		YES/NO
7. I understand that my participation is voluntary and I am free to withdraw at any time, without giving any reason, without my employment contract or legal rights being affected.		YES/NO
8. I understand that sections of any of my study notes may be looked at by responsible individuals from Imperial College or from regulatory authorities where it is relevant to my taking part in this research. I give permission for these individuals to access my records that are relevant to this research		YES/NO
9. I have had sufficient time to come to my decision		YES/NO
10. I agree to participate in this study		YES/NO

#### PARTICIPANT

Signed .....

Date .....

Name (BLOCK LETTERS) .....

I have explained the study to the above participant and they have indicated their willingness to take part.

#### INVESTIGATOR

Signed .....

Date .....

Name (BLOCK LETTERS) .....