Embeddedness & the Institutionalisation of New Practices among Healthcare Professionals

By

Emily Melissa Rowe

A thesis submitted in partial fulfilment of the requirements for the degree of

Doctor of Philosophy in Business and Management

University of Warwick, Warwick Business School

March 2021

Embeddedness & the Institutionalisation *of New Practices among Healthcare Professionals*

By

Emily Rowe

Abstract

In institutional theory, there is a long-standing puzzle regarding embeddedness and the microprocesses of institutional change. One main argument is that actors are constrained by their embeddedness and are unable to enact change. However, this wrongly portrays actors as over-socialised and subject to institutional norms without question and not purposive agents who re-evaluate institutional practices. Therefore, this research aims to examine actors' attempts to institutionalise new practices by interrogating the link between embeddedness and micro-institutional change. Such a study is important as traditional views of embeddedness are conflated and do not explain this process, even though we know it occurs. This research shows that embeddedness serves as a foundation to support micro-institutional change, rather than a mechanism that constrains it. This research draws data from five National Health Service (NHS) organisations where actors actively learn and engage with new practices to facilitate micro-institutional change. The NHS is a highly institutionalised medical context and provides an appropriate setting to draw on healthcare professionals' social networks to explore embeddedness and its association with the institutionalisation of new practices.

This research's methodological approach was novel as Exponential Random Graph Models (ERGMs), an emerging social network analysis method, were used to examine joint effects between actor roles and relationships to understand institutional embeddedness and interactions among change agents. The findings provide evidence that forms of embeddedness contribute to the institutionalisation of new practices differently. Two forms of embeddedness, non-collaborative and non-institutional, decrease the likelihood of micro-institutional change, whereas collective institutional embeddedness increases the likelihood of micro-institutional change. The main conclusion is at odds with and contributes to the existing literature by illustrating that the lack of embeddedness among institutional actors constrains micro-institutional change, and the presence of both structural and institutional embeddedness enables this process.

Key Terms: Social Network, Embeddedness, Micro-Institutional Change, Practices, Institutionalisation, Structural Embeddedness, Institutional Embeddedness

Thesis Supervisors:

Charlotte Croft, Associate Professor Organisation and Human Resource Management, Warwick Business School, University of Warwick

Leroy White, Professor of Management and Head of the Management Department, University of Exeter Business School

"In the case of superior things like stars, we discover a kind of unity in separation. The higher we rise on the scale of being, the easier it is to discern a connection even among things separated by vast distances."

Marcus Aurelius

Acknowledgements

Although writing a dissertation is an individual endeavour, and many people support this journey along the way, some ought to have a special mention in this work.

I am deeply grateful to my supervisors, *Charlotte Croft & Leroy White,* for their time, patience, expertise and understanding. It has been a long road, with many hills and valleys, and I have finally made it to the end.

I want to thank *Eivor Oborn* for inviting me to an Organising Healthcare Research Network seminar, where I met *John Richmond* and *Nicola Burgess*, who were instrumental to the completion of research; without them, this dissertation would not have been possible.

I must give special thanks to the University of Warwick and Warwick Business School for allowing me to pursue my goals at their prestigious institution. My time there has provided me with many lessons and experiences, which extend beyond professional growth.

My special thanks go to Camilo Arciniegas, my office mate. We spoke at length about different theories and perspectives in organizational, management and sociological studies, and I am thankful that he could share his thoughts and ideas with me. Our debates greatly influenced my thinking and ability to navigate the social and organizational sciences' theoretical jungles.

I want to thank my peers *Kyriaki Hadjicosta, Nishika Bhatia, Jacintha Odonye and Chengcheng Kang* for their friendship during this journey's highs and lows. I thank them for lending an ear, getting me out of the office and finding things for us to celebrate. I will always remember the mutual support we gave each other over these years.

I want to thank my parents, *Curtis Rowe,* and *Deborah Marshall,* for always encouraging me. My mum always told me that I am a leader and that I could do anything I set my mind to. These words became a constant reminder to endure and gave me strength when times were challenging. I want to thank my dad for his weekly Sunday calls to let me know that everything was ok.

Finally, I would like to thank *Renaldo Campbell*; without him, I would have given up in the early stages, and because of him, I had the motivation to make it to the end. Your love and support made me who I am today.

Declaration

I, ***Emily Rowe***, declare that the work presented in this thesis is my original work. I confirm that this work was written by me without assistance, that I have clearly referenced and organised this thesis in accordance with the University of Warwick requirements and that this work has not been published or co-authored. I confirm that all data and findings presented follow the procedures provided and have not been fabricated. I also confirm that this work has not been previously used or submitted for other theses, projects or other examinable processes, within the University of Warwick or at another university.

I understand that any false claim regarding this work will result in disciplinary action following the University of Warwick's regulations. I understand that my work will be checked electronically for plagiarism and stored on external servers for future comparison.

Table of Contents

Table of Figures

Table of Tables

Abbreviations

Abbreviation	Description
NHS	National Health Service
VMI	Virginia Mason Institute
NHSi	National Health Service Improvement
VMPS	Virginia Mason Production System
CQC	Care Quality Commission
TGB	Transformation Guiding Board
TGT	Transformation Guiding Team
KPO	Kaizen Promotion Office
L4L	Lean for Leaders
RPIW	Rapid Process Improvement Workshops
ERGM	Exponential Random Graph Models

Chapter 1: Introduction

In institutional theory, there is a long-standing puzzle regarding embeddedness and the microprocesses of institutional change. One main argument is that actors are constrained by their embeddedness and are unable to enact change. Therefore, this research aims to examine actors' attempts to institutionalise new practices by interrogating the link between embeddedness and micro-institutional change. This aim brings us to the research question, which seeks to understand *how actors' embeddedness influences the institutionalisation of new practices in organisations?* By answering this question, this research sheds light on *the structural and institutional features of embeddedness among institutional actors who seek to introduce and integrate new practices within their organisation.* Such a study is important as traditional views of embeddedness are conflated and do not explain this process, even though we know it occurs. This research offers three contributions to existing research on micro-institutional change by showing that embeddedness serves as a foundation to support change micro-institutional change rather than a mechanism that constrains it.

Accordingly, four research objectives are specified to answer the research question and contribute to existing literature. The first objective seeks to c*larify* and discuss the importance of embeddedness regarding micro-institutional change. The second objective *critically evaluates* the notion of embeddedness from a social network perspective to understand new practices' institutionalisation within an organisational context. The third objective seeks to explore the role of structural and institutional embeddedness empirically, and the fourth aims to *advance* institutional perspectives by illustrating the role of actors' embeddedness with respect to the institutionalisation of new practices in organisations.

The findings provide evidence that structural and institutional forms of embeddedness contribute to the institutionalisation of new practices in different ways. Based on these findings, three collective accounts of micro-institutional change are produced. The first account, non-collaborative embeddedness, lacks structural embeddedness among actors and the second account, non-institutional embeddedness, as its name suggests, lacks institutional embeddedness among actors. The findings show that these two forms of embeddedness diminish actors' efforts to enact micro-institutional change. The third account, collective institutional embeddedness, involves high degrees of structural and institutional embeddedness among actors and increases the likelihood of micro-institutional change. Therefore, this research's main conclusion is at odds with existing literature by illustrating that the lack of embeddedness among institutional actors constrains micro-institutional change, and the presence of both structural and institutional embeddedness enables this process.

1.1 Background

Institutional scholars have generated a tremendous body of literature that highlight "the origins, mechanisms, and unfolding of change" within institutions (Smets et al., 2012, p. 878). Several models detail institutional change processes based on temporal developments (Hargrave & Van De Ven, 2006; Beckert, 2010a; Scott, 2010). However, even with the plethora of models, scholars agree that institutionalisation is a crucial process that underpins institutional change (Maguire & Hardy, 2009). Of particular interest is the institutionalisation of new practices where attempts to drive change within professional organisations are seen as a complex phenomenon. This process refers to the emergence, acceptance and adoption of new practices that are not entirely accepted or utilised among the actors in an organisational or institutional setting (Barley & Tolbert, 1997; Greenwood et al., 2002). This complexity emerges from an institution's nature, where enduring rules, norms and practices are not easily set aside because they become deeply ingrained within organisations, which make some organisations resistant to improvement initiatives and other change-oriented and developmental endeavours (Greenwood & Suddaby, 2006; Kennedy & Fiss, 2009; Smets et al., 2012).

Hence, the microfoundations agenda sought to explore the links between institutions and individuals, to understand "patterns of behaviour in a collectivity and individual-level cognitions and behaviours that produce and change those collective patterns (Tolbert & Zucker, 2019, p. 4)." Therefore, in addition to representing enduring social structures that embody normative activities and practices; institutions denote general patterns of behaviour within a collectivity, and one of the aims of this agenda is to understand the processes and social interactions that produce changes in shared cognitions and patterns of behaviour, that result in new and transformed institutions (Barley & Tolbert, 1997; Tolbert & Zucker, 2019; Zucker & Schilke, 2019). This process is known as micro-institutional change, where change emerges from the micro-level of institutions due to actors' interactions and behaviours.

However, there has been a long-standing puzzle regarding the paradox of embedded agency which questioned how actors change institutions, as traditional institutional perspectives have acknowledged that is it unlikely for them to do so, since institutional mechanisms tend to replicate, rather than change, existing arrangements (Powell & DiMaggio, 1991; Garud et al., 2007). From an institutional perspective, embeddedness is the degree to which actors and their actions are linked to or shaped by their social and institutional context (Reay et al., 2006; Hinings & Tolbert, 2008; Schneiberg & Lounsbury, 2008; Godwyn & Gittell, 2012). However, there are many different forms of embeddedness, which complicate whether it would be an opportunity and constraint for change; and these perspectives are not discussed or presented in much of the institutional discourse. This puzzle establishes this work's theoretical positioning and aims to

understand how actors embeddedness is associated with the institutionalisation of new practices. This work begins by highlighting inconsistent explanations within the literature and shows how traditional views of embeddedness are conflated, resulting in a limited understanding of the role of embeddedness in micro-institutional change. Since the traditional institutional perspectives were ill-equipped to frame embeddedness as a mechanism to support change, this work presents an alternative conceptualisation of embeddedness. This view of embeddedness is drawn from social network theory which has an established body of work showing how social interactions and relationships give rise to social structures which shape and explain organisational outcomes and processes. Therefore, a social network view of embeddedness is adopted to understand how institutional actors' interactions and embeddedness by investigating the structures and configurations of relationships that support or constrain new practices' institutionalisation among organisational actors.

1.2 Purpose of Study

This study's background yielded the research aim which sought to examine actors' attempts to institutionalise new practices by interrogating the link between embeddedness and micro-institutional change. This aim brings us to the research question, which seeks to understand *how actors' embeddedness influences the institutionalisation of new practices in organisations?* By answering this question, this research sheds light on *the structural and institutional features of embeddedness among institutional actors who seek to introduce and integrate new practices within their organisation.* Such a study is important as traditional views of embeddedness are conflated and do not explain this process, even though we know it occurs. Four specific research objectives were derived to address this aim and answer the research question:

1. *Clarify and discuss the importance of embeddedness with regards to micro-institutional change.*
2. *Critically evaluate the notion of embeddedness from a social network perspective to understand the institutionalisation of new practices within an organisational context.*
3. *Explore the role of structural and institutional embeddedness with respect to the institutionalisation of new practices among institutional actors.*
4. *Advance institutional perspectives by illustrating the role of embeddedness with respect to the institutionalisation of new practices in organisations.*

Based on the current literature's inconsistencies, the first objective seeks to c*larify* and discuss the importance of embeddedness regarding micro-institutional change. By addressing this objective, theoretical views are dissected to understand which mechanisms and aspects of actors embeddedness require clarity and specification. Next, institutionalists and social networks theorists draw on embeddedness concepts to understand outcomes, but there has been little

development in this camp, despite the clear synergies between them. Therefore, the second objective *critically evaluates* the notion of embeddedness from a social network perspective to understand its relevance and association to new practices' institutionalisation. After clarifying and evaluating the link between embeddedness, social network theory, and institutional processes, the third objective seeks to empirically explore the role of structural and institutional embeddedness. The connection between these domains presents an apparent assumption that social relationships are the building blocks of institutions and networks, as they are concerned with the influence of embeddedness and social structures among actors (Owen-smith & Powell, 2008; Powell & Oberg, 2018). When discussed in this way, institutions' social networks provide insight into the micro-level processes that influence institutional change (Owen-smith & Powell, 2008; Gibson & Vom Lehn, 2018; Hallett & Hawbaker, 2019). Therefore, this empirical investigation's findings address the fourth objective, which aims to *advance* institutional perspectives by illustrating the role of actors' embeddedness regarding the institutionalisation of new practices in organisations.

1.3 Significance of Study

Most research examines attempts to drive change at the macro-level; however, existing research lacks a micro-level perspective. Although the micro-level tends to be overlooked in institutional studies, this is seen to be the more pertinent level of analysis to truly gain the most insight and enhance our understanding of institutions (Barley, 2008; Powell & Colyvas, 2008; Hwang & Colyvas, 2019). This research explicitly attends to the micro-level of analysis by accepting that actors are responsible for embodying and enacting institutional practices and play a significant role in micro-institutional change (Hallett & Hawbaker, 2019; Zucker & Schilke, 2019). However, it is unclear the role that actors' embeddedness plays in shaping institutional processes. This gap addresses the call to explore how actors shape institutional change (Burns & Nielsen, 2006; Tolbert & Zucker, 2019). Specifically, we do not know how relationships among actors influence or underpin micro-institutional change.

In this case, this research explores how actors' social relationships are associated with attempts to institutionalise practices within their organisations to support institutional change initiatives. It does this by first decomposing embeddedness into two forms and then re-aligns it with the expectations around the institutionalisation of new practices among institutional actors. Theoretically, this also provides an alternative view of understanding the paradox of embedded agency (Powell & DiMaggio, 1991; Garud et al., 2007), since existing views do not question the many forms of embeddedness or agency that exist among and between social actors. This traditional perspective results in viewing embeddedness as a constraint, when it can also be viewed as a compass that guides actors and empowers them (Cardinale, 2018).

Embeddedness is important to understanding institutions as it provides the micro-macro link to relate micro-level processes to the macro-level traditional theoretical debates that aim to explain the process through which new practices are shared and accepted within and across institutional domains (Boxenbaum & Jonsson, 2008; Beckert, 2010b; Smets et al., 2012; Roulet et al., 2019). This notion is consistent with the view that individual actions and behaviours amplify (Gray et al., 2015), accumulate (Smets et al., 2018) or trickle up (Haack et al., 2019; Hwang & Colyvas, 2019) to the organisational and field level, supporting the notion that macro-level phenomena are both the consequence and result of individuals and organisations affecting institutions (Coleman, 1986; Udehn, 2002). Overall, these processes are aligned with the microfoundations agenda, where change amplifies from the micro to macro levels through the process of enacting, sharing, supporting and participating in the practice itself (Smets et al., 2012).

The institutional entrepreneurship literature sought to provide micro-level explanations of institutional change. However, narratives are focused on the organisation's upper levels and ignore the actors responsible for enacting and engaging with new practices. This criticism was further supported since even within the context of institutional entrepreneurship; institutional entrepreneurs must engage with and interact with other members of the field to bring about change (Dorado, 2005; Garud et al., 2007; Hardy & Maguire, 2008; Battilana et al., 2009). Therefore, the embeddedness and interactions of actors become an essential component of micro-institutional change. However, we have little understanding of how actors use their embeddedness to influence changes within their organisational environment when new practices are introduced.

Therefore, this research draws on social network concepts, such as structural embeddedness to reconceptualises embeddedness so that social relationships among actors are associated with the institutionalisation of practices. By doing so, this research studies the link between structural embeddedness and the institutionalisation of practices by examining the specific and structures that emerge within the social networks among diverse actors. Existing empirical work that applies social network analysis draws on simple descriptive measures to understand the social network (Battilana & Casciaro, 2012), but social relationships are complex, both theoretically and practically. Therefore, this work adds another layer to theory by examining the specific social structures and patterns of interaction present within the networks. This approach also allows us to theoretically extend our understanding of which social processes are present when institutionalising new practices. Together, these generate insights regarding the interplay of structural and institutional embeddedness and the institutionalisation of new practices among actors. This also supports the examination of specific social dynamics that are present when actors attempt to drive change and address the call to critically confront how relationships among

a broad array of actors can shape institutional change processes and possibly result in micro-institutional change (Lounsbury & Crumley, 2007; Alvesson & Sandberg, 2011). Further, this examination would shed light on the collaborative notions of institutional agency where patterns of agents' interactions among groups of actors are responsible for micro-institutional change (Bridwell-Mitchell, 2016).

In general, this study addresses the call for research that examines social interaction and "on the ground" activities of what is happening within the organisation and between actors in their attempts to institutionalise practices (Smets et al., 2018; Hallett & Hawbaker, 2019). It is important to note that this research is not examining institutional change in the sense of developmental theories that examine the life cycle, dialectical, evolutionary or teleological aspects of change (Seo & Creed, 2002; Koene & Ansari, 2013; Micelotta et al., 2017). Instead, this work seeks to investigate the relational aspects of a specific stage in the institutional change process, the institutionalisation of new practices. Overall, these points advance the microfoundations agenda, which assumes that institutions and, by extension, institutional change materialise through the mechanisms and microprocesses of institutional actors. Similarly, this research delivers a new understanding of embeddedness by using a social network lens by providing a fine-grained and realistic account of collective actors in institutional analyses (Roulet et al., 2019).

1.4 Context & Findings of Study

1.4.1 Philosophical View

Taking a social network view of institutions and embeddedness promotes an alternative philosophical view as it holds social relationships among multiple social actors as the primary lens to understand institutional change processes. From a social network perspective, research on embeddedness views social actors and organisational outcomes as reciprocally influenced by their ties and relationships. Social network studies have been traditionally associated with positivist dispositions due to their focus on the mathematical tools and methods to analyse complex social relations. Therefore, this research adopts a critical realist approach to understanding the social world by explaining and examining mechanisms between actors relationships and social outcomes (Bhaskar, 2008; Buch-Hansen, 2014). Critical realism is a philosophical perspective in social research that falls between positivism and constructionism (Fleetwood, 2014). This perspective draws on elements from both positions and is flexible in terms of methodology, as it acknowledges both quantitative and qualitative approaches to empirical investigation (Hallebone & Priest, 2008; Kincaid, 2012). This view accepts that social life is both produced by and influenced by the actions of individuals and also provides a more

balanced approach to examining social problems, as it assumes that specific features of the social world such as power, class or wealth exist within our social reality and have varying effects whether they are observed or not (Easterby-Smith et al., 2018). Overall, a critical realist approach complements the social network perspective and this research as quantitative methods can be applied to understand social relationships and draw conclusions about the social processes in organisations.

1.4.2 Research Context

This research addresses these points by conducting a comparative social network study of five healthcare organisations in the United Kingdom to understand how healthcare professionals attempt to institutionalise new practices within their respective organisations. The empirical sites selected are five NHS hospital trusts that are partnered with the Virginia Mason Institute (VMI) to introduce and integrate the Lean methodology within these organisations, where new practices are expected to enhance the quality and provision of patient care, generate operational efficiencies and to create a culture of continuous improvement. This empirical setting is an appropriate context for examining embeddedness and institutional practices for three key reasons. First, healthcare is dominated by clinical professionalism and is deemed a highly institutionalised setting, which fits this study's theoretical basis. Second, the lean method and new practices deviate from the conventional approaches to daily work within these organisations, thereby indicating an institutional change initiative. Third, this initiative's nature is actively geared towards making functional, operational and cultural changes that we acknowledge are socially influenced. Therefore, data gathered from relevant professionals in these organisations qualify as appropriate for this research.

1.4.3 Research Methodology

This research design has four elements as it is comparative, cross-sectional, non-experimental and quantitative. This research adopts an egocentric network design to collect data. It was the most appropriate method to sample network data from large organisational networks by asking participants to self-report their networks and describe their relationships with their most important contacts. In this case, well-defined group boundaries exist; therefore, egocentric sampling methods were used to capture the relationships of persons engaged in improvement work in an organisational context rather than relationships with respect to the change initiative. This sample includes clinical and non-clinical healthcare professionals at most levels of the organisation, including senior executives, clinical managers, consultants, matrons, nurses, pharmacists, radiologists, dieticians, physiotherapists and non-clinical management professionals. The study uses two self-reporting socio-metric survey instruments to gather data

to measure structural embeddedness and collect actor attribute data to measure actor-relation effects within each organisation. The study applied a novel social network analysis method, Exponential Random Graph Models (EGRM), which have supported fine-grained examinations of social network structures and processes. ERGMs examine actors' structural embeddedness, as it isolates distinctive structural motifs and simultaneously considers its influence on the overall network. This approach enables the simultaneous examination of relational mechanisms such as reciprocity, centrality, brokering and closure. The use of ERGMs allows researchers to explicitly model the observed organisation's networks against theoretically informed and supported network configurations to estimate their effects.

1.4.4 Key Findings

The findings of the analysis revealed several structural variations within and between the five organisational networks. Four networks displayed high levels of structural embeddedness; however, only three also displayed high levels of institutional embeddedness. In this study, structural embeddedness is associated with a high presence of both bridging and closure among institutional actors. Closure is associated with social cohesion and collective action among professionals, and it promotes shared understandings, engagement, and adoption of new practices among closely connected groups of professionals. Bridging structures and brokering are associated with searching, acquiring, and sharing information and advice about improvement work and new practices in general. In this case, closure generates consensus about new practices and brokering allows professionals to inform their understanding of new practices by sharing and receiving information with colleagues. This research found that a high degree of structural embeddedness is more likely to be associated with greater progress when institutionalising new practices; however, these effects varied due to the degree of institutional embeddedness among actors.

Three classifications are specified to understand institutional embeddedness among actors. The first classification ***enactors*** represent the broad group of institutional actors who are professionals or practitioners within an institutional setting and apply new and established practices in their everyday work. The second classification is ***applied change agents,*** and this category represents institutional actors who are practitioners that have been trained in new practices and led change initiatives in their work environments. The third classification is ***strategic change agents***, and this label represents actors in this study who are actively involved in training enactors and planning or coordinating change initiatives but are not enactors of new practices in their everyday work. The distinction among these professional groups is critical to understand embeddedness as a foundation that supports the institutionalisation of new practices, as varying degrees of interactions among these groups act as mediators for micro-

institutional change. Based on these classifications, High, Low and No Institutional Embeddedness is observed among enactors, applied or strategic change agents. The key finding here is that new practices' institutionalisation was less likely in networks associated with Low and No Institutional embeddedness.

The classification of actor groups further adds to our understanding by showing that embeddedness variations have contrasting consequences regarding institutionalising new practices. These differences give rise to three forms of embeddedness when structural mechanisms are considered: ***non-collaborative, non-institutional, and collective institutional embeddedness***. Non-Collaborative and Non-Institutional Embeddedness were found to decrease the likelihood of micro-institutional change. In non-collaborative embeddedness, structures and interactions among institutional actors do not encourage sharing information or advice about new practices, nor support consensus among institutional actors to engage in new practices. Non-Institutional embeddedness, on the other hand, does have the structural foundation among actors to collaborate and generate consensus about new practices; however, it lacks an institutional frame to engender change among institutional actors in similar professions. Collective Institutional Embeddedness addresses the gaps observed in the Non-Collaborative and Non-Institutional Embeddedness as both structural foundations support collaboration and interaction that share information and generate consensus about new practices among actors who share similar institutional frames, and this increases the likelihood of micro-institutional change. These findings also underscored a key theme that similarities in structure do not equate to similarities in professional interactions and relationships. Most importantly, the findings revealed that a lack of social structure and embeddedness constrained actors' attempts to enact micro-institutional change rather than the presence of social structure and embeddedness.

1.6 Thesis Structure

Chapter 1: Introduction

This chapter provides the reader with background information on the puzzle around the institutionalisation of new practices and embeddedness among actors. It illustrates some of the key debates and highlights their inconsistencies and the need for further examination to better understand the relationship between embeddedness and micro-institutional change more generally. The focus of this research is discussed, and the overall aim and research objectives are identified.

Chapter 2: Literature Review

The second chapter positions this research into the micro-foundations of institutions to clarify and discuss the role of embeddedness and the institutionalisation of new practices. It highlights inconsistencies in the traditional perspectives of embeddedness and proposes an alternative lens, social network theory, to bolster institutional explanations about micro-institutional change. By adopting a new frame, the notion of embeddedness is unpacked, and this new conceptualisation justifies the need for empirical examination.

Chapter 3: Research Context

The third chapter discusses the research setting and aligns the context with the theoretical position presented in Chapter 2. In this research, actors' embeddedness in five National Health Service (NHS) organisations is examined. The NHS is a highly institutionalised medical context that provides an appropriate setting to draw on healthcare professionals' social networks to investigate embeddedness and the institutionalisation of new practices empirically.

Chapter 4: Research Methodology

The fourth chapter discusses and justifies the research design (a comparative non-experimental quantitative research design) and data collection techniques (socio-metric surveys) used to collect data for this study. Further details regarding the sampling strategy are discussed and the framework to analyse social network data. In this chapter, the limitations and methodological considerations are also discussed to address the findings' reliability and validity to explain the institutionalisation of practices among actors.

Chapter 5: Empirical Findings

The fifth chapter reports the findings of this study by first presenting the descriptive and univariate results. It then reports the inferential results produced from the Exponential Random Graph Models (ERGMs), which examine statistical interdependencies in networks to understand

social relationships and actor roles. A synthesis of the univariate and inferential findings is provided to highlight similarities and differences among the five networks investigated. The findings highlight that the combined presence of structural and institutional embeddedness have varying effects on the institutionalisation of new practices. This chapter focuses on describing and synthesising the results to generate focused conclusions to evaluate in the discussion.

Chapter 6: Discussion

The sixth chapter synthesizes the empirical findings with the theoretical framework established in Chapter 2. It relates the core findings to studies and debates to determine their relevance and alignment with existing literature. Most importantly, this research's contributions to knowledge on the microfoundations of institutions and micro-institutional change are clarified. Therefore, this chapter discusses, analyses and aligns the empirical and literature review findings to advance knowledge in this debate.

Chapter 7: Conclusion

The seventh and final chapter revisits the overall aim and specific objectives of this research, where each objective is highlighted and addressed. The findings of this study are summarised and aligned with each specific objective. The conclusions of this research are also outlined and associated with each objective. The three main contributions of this study are highlighted, and finally, the limitations and proposed future research of this work are presented.

References

This section of the thesis contains an alphabetical listing of the sources referenced in The Harvard system.

Appendix

This final section contains four subsections of supporting information for the research context, data collection and data analysis. The analytical procedure and detailed results are also provided as references to the summarised data reported in Chapter 5: Empirical Findings.

Blank Page

Chapter 2: Literature Review

2.1 Introduction

This literature review will address the first and second research objectives, which aim to:

1. *Clarify and discuss the importance of embeddedness with regards to micro-institutional change.*
2. *Critically evaluate the notion of embeddedness from a social network perspective to understand the institutionalisation of new practices within an organisational context.*

By addressing these objectives, theoretical developments will be made by elucidating the synergies and inconsistencies between institutional and social network literature to examine embeddedness within the context of micro-institutional change and the institutionalisation of new practices. In section 2.2, micro-institutional change is presented to establish this work's theoretical positioning, and views of embeddedness are dissected to highlight the inconsistencies within the institutional literature. This critique illustrates that institutions' microprocesses and actors' embeddedness are conflated, resulting in a limited understanding of the role of embeddedness in micro-institutional change. In section 2.3, embeddedness is decomposed from a social network perspective. This alternative perspective focuses on structural embeddedness and examines its relevance to institutionalising new practices in organisations. In this study, structural embeddedness focuses on understanding the configuration of relationships that support or constrain new practices' institutionalisation among organisational actors.

Previous research found that two forms of embeddedness, closure and bridging, have varying consequences for sharing information among actors (Burt, 2001; Reagans & McEvily, 2008). Closure is associated with cohesive groups of closely connected actors, and bridging is associated with spanning the gap between disconnected actors; however, it is unclear what role these structures play to institutionalise new practices. One key mechanism associated with these structures is the triad (Krackhardt & Kilduff, 2002), representing complex social and relational processes in a group of three actors, where these dynamics remain as the group size increases. In this case, a closed triad represents closure among actors, and alternatively, an open triad is associated with brokering between actors. Together, these structures and relationships provide insights and implications to understand the institutionalisation of new practices, an essential process underlying micro-institutional change. At the end of this chapter, in section 2.4, the literature review is summarized, and a revised understanding of embeddedness in institutions is offered by highlighting issues in existing literature, which justifies the need for empirical research and further exploration.

2.2 **Microfoundations of Institutions**

2.2.1 Microprocesses of Change & The Institutionalization of New Practices

Institutional theory is one of the most dominant approaches to understanding organisations. It has a long history in examining the forces that shape and legitimize the rules, norms, shared understandings and arrangements within organisations and fields (Garud et al., 2007; Greenwood et al., 2008; Scott, 2014). An institution is an enduring social structure that embodies the cultural–cognitive, normative and regulative activities and practices that provide stability and give meaning to behaviour within a social context (Scott et al., 2000; Scott, 2003). Accordingly, institutional theories have provided key insights to understand organisational action and explaining macro-level structure and processes, such as legitimacy and diffusion. However, its macro-level emphasis neglected the micro-level aspects that facilitate action and change within institutional settings (Powell & DiMaggio, 1991). Hence, the microfoundations agenda sought to explore the links between institutions and individuals, to understand "patterns of behaviour in a collectivity and individual-level cognitions and behaviours that produce and change those collective patterns (Tolbert & Zucker, 2019, p. 4)." Therefore, in addition to representing enduring social structures that embody normative activities and practices; institutions denote general patterns of behaviour within a collectivity, and one of the aims of this agenda is to understand the processes and social interactions that produce changes in shared cognitions and patterns of behaviour, that result in new and transformed institutions (Barley & Tolbert, 1997; Tolbert & Zucker, 2019; Zucker & Schilke, 2019).

Consequently, a tremendous body of literature highlighted "the origins, mechanisms, and unfolding of change" within institutions (Smets et al., 2012, p. 878), where institutional change is the difference in form, quality, or state of an institution over time (Hargrave & Van De Ven, 2006). Several models detail institutional change processes based on temporal developments (Hargrave & Van De Ven, 2006; Beckert, 2010a; Scott, 2010). However, even with the plethora of models, scholars agree that institutionalisation is a crucial process that underpins institutional change (Maguire & Hardy, 2009). This process refers to the emergence, acceptance and adoption of new organisational activities or practices and can be triggered by external pressures or internal agents, where practices and activities are not entirely accepted or embedded among the actors in an organisational or institutional setting (Barley & Tolbert, 1997; Greenwood et al., 2002). Of particular interest is the institutionalisation of new practices where attempts to drive change within professional organisations are seen as a complex phenomenon. This complexity emerges from an institution's nature, where enduring rules, norms and practices are not easily set aside because they become deeply ingrained within organisations, which make some organisations

resistant to improvement initiatives and other change-oriented and developmental endeavours (Greenwood & Suddaby, 2006; Kennedy & Fiss, 2009; Smets et al., 2012).

A large body of work investigated institutional change processes, and scholars have come to agree that new practices become established through two mechanisms: legitimation and diffusion (Reay et al., 2006; Lounsbury & Crumley, 2007; Chandler & Hwang, 2015). Legitimation is the level of social acceptance or appropriateness placed on an organisational action, actor or activity (Bitektine & Haack, 2015; Suddaby et al., 2017) (Lounsbury & Crumley, 2007; Schneiberg & Lounsbury, 2008) and diffusion, within an institutional context, refers to the adoption and spread of new practices among organisational actors (Boxenbaum & Jonsson, 2008, 2017). Studies of diffusion focus on how ideas are embraced or resisted and whether they become institutionalised over time (Greenwood et al., 2002; Kennedy & Fiss, 2009; Chandler & Hwang, 2015; Chandler & Haunschild, 2018). Based on these definitions, institutional change occurs when new practices become widely shared and accepted among actors in organisations, causing both organisational and institutional structures to grow more alike (Sahlin & Wedlin, 2008; Schneiberg & Lounsbury, 2008; Beckert, 2010b; Boxenbaum & Jonsson, 2017).

However, legitimacy and diffusion are macro-level concepts that capture new practices' development over a long period. Therefore, much of this work has been criticized for ascribing a disproportionate emphasis at the macro level of analysis where the initiation and unfolding of change are due to external forces and ignores the purposive actors who are responsible for changes in the institutions in which they are embedded (Schneiberg & Lounsbury, 2008; Powell & Rerup, 2018; Harmon et al., 2019). This macro-level emphasis prevented developing theories that would support deeper insights into the role that individuals and collective action "play in generating, sustaining, and changing institutions" (Barney & Felin, 2013, p. 144). This dominance sparked interest in the micro-level influences responsible for shaping and institutionalising organisational norms and practices (Powell & DiMaggio, 1991; Cardinale, 2018).

According to Tolbert & Zucker (2019), one specific concern in microfoundations agenda is to understand the nature of communication processes and behaviour that are likely to affect the acceptance or rejection of existing practices, and thus understanding how it affects the spread of new activities and practices within an institutional setting. At the micro-level, the institutionalisation of new practices involves the legitimation and diffusion of new practices through the communication, transmission or translation of practice, and broadly the interactions and negotiations of various institutional actors (Zilber, 2006; Lounsbury & Crumley, 2007; Sahlin & Wedlin, 2008; Bridwell-Mitchell, 2016). In practical terms, actors make modifications to their practice (Gray et al., 2015) or search for and implement "new ways of carrying out specific activities" (Smets et al., 2012, p. 894) in their efforts to complete jobs or accomplish a common

goal. Therefore, change in practice arises when actors make localized attempts to cope with ambiguity and institutional complexity (Orlikowski, 1996; Tsoukas & Chia, 2002; Dorado, 2005; Wijen & Ansari, 2007; Battilana et al., 2009). In the initial stages, when a new practice is shared and enacted, actors acknowledge that they are "doing things in new ways" (Reay et al., 2006) and evaluate the suitability of a new practice in addressing a problem with which they are faced (Dorado, 2005; Bridwell-Mitchell, 2016). New ways of work may require institutional actors to move away from the existing norms and persuade others to adopt and engage in new practices that may diverge from the established norms in their institutional environment (Battilana & Casciaro, 2012). When the practice becomes widely accepted and reaches an institutional status, it no longer needs to be legitimized, and actors cease talking or thinking about them because they are now a normal facet of their daily work. This process is known as micro-institutional change, where change depends on the extent to which innovation, communication and socialization, "as well as cohesion and diversity in community interactions allow actors to generate widely shared understandings about the technical and social requirements of new work practices" (Bridwell-Mitchell, 2016, p. 162).

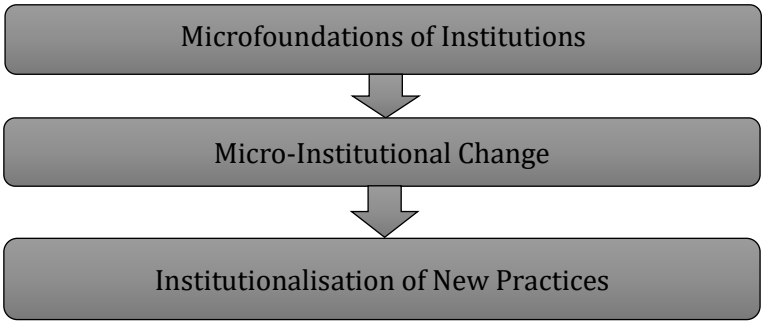


Figure 1: Theoretical Basis

Taken together, this forms the basis of this research's theoretical position (See Figure 1), which suggests that the institutionalisation of new practices requires varying degrees of interaction among actors to influence the circulation, acceptance, and adoption of new practices, where interactions among actors play a role in determining the acceptance and adoption of emerging practices (Reay et al., 2006; Smets et al., 2012, p. 899; Raffaelli & Glynn, 2014). Due to the combined influence of interactions and norms, the institutionalisation of new practices is also related to social and professional dynamics, since shared understandings about practice are developed through the interactions of individuals who mimic and modify tasks and routines in their everyday work and collaborations (Kogut & Zander, 1996; Lindkvist, 2005; Felin et al., 2012; Bridwell-Mitchell, 2016). Studies within this domain illustrate that the extent to which new practices are shared and accepted relies on a "multiplicity of actors to interactively produce institutional change" (Lounsbury & Crumley, 2007). Within the institutional theory domain, one stream of literature focuses on practices as a key mechanism of change, rather than the actors

who enact those practices (Smets et al., 2018). Other literature streams emphasize institutional logics (Thornton & Ocasio, 2008; Micelotta et al., 2017) and power dynamics (Rao et al., 2004; Lawrence & Buchanan, 2018) as the focal lens better to understand institutional change processes. However, existing research has focused less on understanding the social processes among the groups of actors responsible for institutionalising new practices.

2.3 Embeddedness & the Institutionalisation of New Practices

Due to this interplay of the institution's macro-level forces such as structure and the micro-level influences such as agency, a paradox emerged that raised a deep-rooted case for institutional change. It stated that,

> *"If actors are embedded in an* institutional *field and are subject to regulative, normative and cognitive processes that structure their cognitions, define their interests and produce their identities, how are they able to envision new practices and then subsequently get others to adopt them?"* (Garud et al., 2007, pg. 961).

This paradox of embedded agency questioned how actors change institutions, as traditional institutional perspectives have acknowledged that is it unlikely for them to do so, since institutional mechanisms tend to replicate, rather than change, existing arrangements (Powell & DiMaggio, 1991; Garud et al., 2007). A key argument, in this case, is that the notion of change occurring within a highly institutionalised setting contradicts an institution's meaning and existence (Dacin et al., 2002; Greenwood & Suddaby, 2006). However, despite our theoretical understanding of this process, we know it occurs. One assumption in this perspective is that an embedded actor would not be motivated to envision or be aware of alternatives because of the taken-for-granted qualities that make up institutions (Seo & Creed, 2002; Battilana et al., 2009). However, this wrongly portrays actors as over-socialized and subject to institutional norms without question. DiMaggio and Powell (1983) criticized early theorists for associating institutional embeddedness with a lack of reflection and absence of agency when organisational actors are purposive agents who can question and re-evaluate institutional rules and practices.

From an institutional perspective, embeddedness is the degree to which actors and their actions are linked to or shaped by their social and institutional context (Reay et al., 2006; Hinings & Tolbert, 2008; Schneiberg & Lounsbury, 2008; Godwyn & Gittell, 2012). Embeddedness separates itself from other organisational theories (Granovetter, 1985), as it views individual action and reciprocal interactions as influenced by the social context in which they are rooted, and the actors within the respective domain are further influenced by these actions. Traditionally, institutional studies have argued that embeddedness is a problem and paradox that constrains the likelihood of change (Battilana, 2006; Garud et al., 2007; Hardy & Maguire, 2008). Further, the only attempts

to consider embeddedness from a micro perspective originate from the institutional entrepreneurship literature. This work sought to unpack concepts such as agency, embeddedness and social positions to uncover the conditions that enabled and constrained action among actors to transform institutions, despite their inherent contradictions and embeddedness (Battilana, 2006; Garud et al., 2007; Battilana et al., 2009; Tolbert et al., 2011; David et al., 2017). These arguments view central and highly embedded actors as restricted by their institutional environment and having no desire to initiate or engage in new practices, activities and change initiatives. The opposing view is that peripheral actors who are not deeply embedded within their institutional environment are not as constrained and, therefore, have a greater motivation to initiate and engage in change initiatives (Greenwood & Suddaby, 2006; Hardy & Maguire, 2008). They argued that actors mobilize "cognitive, social, and material resources" (Dorado, 2005, p. 389) to legitimize new practices within an institutional environment (Battilana et al., 2009; Ocasio et al., 2018). This work diversified the institutional literature by providing a more inward-looking, actor-centric and micro-oriented account of change and stasis within organisations (Greenwood et al., 2008; Powell & Colyvas, 2008). Some studies single out individual actors who are less embedded and are not bound to established practices (Battilana et al., 2009; Tracey et al., 2010; Lockett et al., 2012, 2014), but this does little in explaining the process of institutionalising new practices among a collective of actors. In many cases, narratives are focused on the organisation's upper levels and ignore the actors responsible for enacting and engaging with new practices, thus making our understanding of micro-institutional change biased and limited.

Eventually, this actor-centric narrative became problematic, as it depicted privileged "species" of actors (Meyer, 2006, p. 732; Hardy & Maguire, 2008) who heroically acquired the power to change institutions, based on their ability to strategize, persuade and garner support for new rules and practices. Building on this narrative, these heroic actors would be responsible for changing every actor's judgements, actions, and behaviours in the organisation, institution, and field. Based on the very definitions, characterizations and theories that underpin institutions, it is unlikely that individual actors, or even a few, would be responsible for the disestablishment of taken-for-granted norms and practices or the institutionalisation of new norms and practices (Oliver, 1992; Sahlin & Wedlin, 2008; Hiatt et al., 2009; Chandler & Hwang, 2015). Ultimately, this literature came under fire for illustrating overly simplified descriptions of institutionalisation, driven by a few organized, purposeful actors who would skillfully draw on other fields' institutional practices and apply them to their own (Wijen & Ansari, 2007; Smets & Reihlen, 2013). This depiction became an impractical and unrealistic representation of micro-institutional change. Thus, we have a limited understanding of the processes underpinning micro-institutional change. More specifically, we have little understanding of how actors use their embeddedness in

their attempts to influence changes within their organisational environment when new practices are introduced.

2.3.1 Actors' Embeddedness: Problem or Solution?

In response to these theoretical shortcomings, further attention was placed on understanding embeddedness rather than viewing it as a problem; it was viewed as a solution that serves as the foundation to support change opportunities (Reay et al., 2006, p. 977). Scott et al. (2000) provide some insight into the role of actors in shaping institutions. Like many others, they conceptualize institutions as patterns of social activity that shape collective and individual experiences because they define ways of actors behaving, relating and interacting with others (Bellah et al., 2011). When viewed in this way, actors are seen as carriers and agents of institutional norms and practices (Scott et al., 2000). As carriers, both individual and collective, institutional actors embody, reproduce and preserve norms and practices within the field; whereas as agents, actors have varying capacity to shape and "exercise power to affect and alter the existing systems and rules" (Scott et al., 2000, p. 172). Whether as carriers or agents, these actors have varying roles, responsibilities and identities that further influence their behaviours and practice. Thus, Scott et al. (2000) argue that institutional change occurs at the microlevel and the "nature and extent of relations among actors in an organisation or field, influences change and transformation" (pg. 24). This perspective further highlights that the agency and interests of actors are shaped by their location within the organisation and field and influenced by social structure, meaning that it is not evenly or uniformly distributed among social actors but varies considerably due to influences of an actor's location within the broader social structure and the context of the surrounding environment.

If institutions are patterns of social activity that shape and sustain individual and collective roles, behaviours and experiences (Scott, 2003; Schneiberg & Lounsbury, 2008; Battilana et al., 2017), embeddedness provides a key link between actors' relationships and micro-institutional change, rather than a problem or paradox to be solved. By changing the perspective, the role of actors, embeddedness and interactions could also be seen as a facilitator and mechanism of micro-level change rather than a barrier that inhibits it (Powell & Colyvas, 2008; Zucker & Schilke, 2019). One key idea is that actors' everyday actions and interactions shape and reproduce institutions (Powell & Colyvas, 2008; Powell & Rerup, 2018). Further, it is argued that the institutionalisation of practices is driven by actors whose everyday work on the frontline is responsible for institutional change (Barley, 2008; Smets et al., 2018; Powell, 2019). Since institutions, in general, emerge from various types of symbolic, material, social and relational systems that operate at different levels, including localised interpersonal relationships (Godwyn & Gittell, 2012; Scott, 2014), it is reasonable to assume that the actions and interactions of embedded agents have a

role in maintaining and reshaping existing institutional arrangements. This agenda focuses on understanding the ways individual and collective behaviour can support or challenge institutions (Powell & Colyvas, 2008; Roulet et al., 2019) due to increased recognition of how institutions are shaped by people on the ground (Hallett & Hawbaker, 2019; Powell, 2019).

Similarly, if we assume that actor embeddedness and interactions are related to the likelihood of micro-institutional change (Garud et al., 2007); a counter-argument can be presented which explains that it is *due* to the interplay of actor embeddedness and institutional structure that actors can change the institutions in which they are a part of (Reay et al., 2006; Bridwell-Mitchell, 2016; Cardinale, 2018). Dacin et al. (1999) explain that embeddedness can allow individuals to shape their context in ways that allow actions to occur by serving as "means of stratification by opening windows of opportunity for some while erecting barriers" for others (pg. 335). This perspective widens the scope and contrasts the long-standing argument that individuals' actions are constrained by their embeddedness and existing institutional arrangements (Battilana, 2006; Garud et al., 2007). As embeddedness is associated with the institutional entrepreneurship literature and other heroic narratives where powerful actors envision, create, negotiate and pursue these desirable or potential future states (Hardy & Maguire, 2008; Battilana, 2010; Lockett et al., 2012, 2014), another question arises.

While it is true that some actors envision, conceptualize and motivate potential changes, singularly, they are unable to enact the type of change that is required to transform institutions. Similarly, while some actors are in positions that offer legitimacy to change initiatives (Battilana, 2006, 2010), this alone is insufficient regarding the communication, translation, diffusion and enactment of practices that result in organisational and field-level changes (Boxenbaum & Jonsson, 2008; Schneiberg & Lounsbury, 2008; Czarniawska, 2009; Kennedy & Fiss, 2009). At one extreme, there are over-socialized accounts of actors who lack agency, are constrained by their institutional environments, and do not envision and enact change (Felin et al., 2012). At the other extreme, there are heroic accounts of actors who single-handedly envision and enact institutional change, despite their embeddedness and the surplus of forces responsible for institutions' persistence and stability. Overall, these types of arguments conflate power, motivations, ability, and change interest which is to the detriment of understanding micro-institutional change processes. These contrasting perspectives also suggest that traditional views of actor embeddedness are exaggerated and conflated and that by distinguishing forms of embeddedness, we can argue that it does not constrain agency or action, but it serves as fabric to support change (Garud et al., 2007; Cardinale, 2018; Harmon et al., 2019).

These over-socialized and heroic narratives ignore the complex social processes at play within organisations and the diverse interests and perspectives within institutions. Recent views assert

that micro-institutional perspectives are "ridden with tensions" between actors and their role within the context of institutions (Patriotta, 2020). These perspectives highlight metaphorical, cognitive and communicative problems in the literature and call for revised definitions of actors and actorhood in the micro-foundations of institutions (Bitektine et al., 2020; Meyer & Vaara, 2020; Voronov & Weber, 2020). In essence, these perspectives emphasize that institutions do not exist without actors, communicating, interacting, co-constructing and maintaining behaviours and processes. Together, this underscores a key point of this research regarding the way actors are depicted, how they interact, are shaped by and in turn shape institutions; if their ongoing interactions enact and sustain institutions (Meyer & Vaara, 2020).

As this research is focused on micro-institutional change, the actor is not overly constrained or heroic, but one who is actively communicating, interacting, introducing, and implementing new practices within their environment. Therefore, a revised definition of the actor must consider an actor's involvement in the change process and their acknowledgement and awareness of alternative practices. The practice-driven institutionalism literature speaks to the degree of awareness of institutional alternatives and actor's receptiveness to other ways work being key factors in the institutionalisation process (Smets et al., 2012, 2018). However, this literature's theoretical focus is on practice, not actors, which limits its adoption as a theoretical frame for this research.

The inhabited institutionalism literature tends to this gap as proponents of this perspective argue that social interactions are vital to understanding institutions and how they operate, by providing a meso-sociological approach that is consistent with core principles of institutional theory (Hallett & Hawbaker, 2019). Scholars argue that "social actors are intuitively aware of the ability of actorhood models to transmit norms, values and other types of institutions to new hosts" (Bitektine et al., 2020, p. 893). However, this literature rarely addresses micro-institutional change processes specifically and has a similar caveat as most of this literature lacks a reflective discourse. As such, this research requires a revised model of the actor which captures actors who have an awareness of and engage with institutional alternatives while considering the implications of social interactions among said institutional actors. Further, acknowledging a sense of awareness and engagement with institutional alternatives is important as actors would likely have varying degrees of agency regarding their actions, their interactions with others and their engagement with new practices. For example, actors with high awareness of institutional alternatives would potentially have more interactions to drive micro-institutional change processes, whereas their less aware counterparts are unlikely to be actively communicating, interacting and maintaining behaviours to drive micro-institutional change.

As a result, the explanations of how actors' embeddedness is related to and becomes a driver for micro-institutional change remains limited and underspecified. Likewise, our understanding of the micro-level forces of change is incomplete since "heroic actors and cultural dopes are a poor representation of the gamut of human behaviour" (Powell & Colyvas, 2008, p. 277). Therefore, new work is needed that strikes a balance between these two extremes and accounts for a more inclusive dialogue regarding collectives of actors, embeddedness and the institutionalisation of practices within organisations. When we decompose embeddedness and draw on social network concepts, we see that it becomes a fundamental source and necessary precondition for micro-institutional change; since embeddedness has many forms that influence the interactions, positions and agreement of groups of actors within institutions (Nahapiet & Ghoshal, 1998; Dacin et al., 1999; Moran, 2005).

2.4 Social Network View of Embeddedness

Social network theory has a long tradition in examining embeddedness and how social structures, groupings and positions among actors influence both opportunities and constraints for action (Burt, 2001). A core assumption for a relational perspective, such as social network theory, is that patterns of relationships matter because actors take on identities and give meaning to social action through their relatedness to others (White & Mohr, 2008; Kilduff & Brass, 2010). Social network theory does not give prominence to actors' inherent characteristics or attributes, but rather the emphasis is placed on the relationships among a group of actors. Based on this understanding, social relationships and interactions have been comprehensively examined in the past, and it is widely accepted that the informal networks of actors are built from the day-to-day interactions and communication within an organisational setting (Kilduff & Tsai, 2003; Kilduff & Brass, 2010; Tasselli et al., 2015). These social structures both shape and explain organisational outcomes and processes, such as knowledge sharing (Hansen, 1999; Phelps et al., 2012; Brennecke & Rank, 2016), learning (Zappa & Robins, 2016), productivity (Reagans & Zuckerman, 2001), innovation (Lee, 2010; Vedres & Stark, 2010), creativity (Vaan et al., 2015), and performance (Rodan, 2010; Tortoriello et al., 2012; Anjos & Reagans, 2013). Thus, organisational social network research emphasizes that social structures emerge from patterns of social interactions and relationships, where different structures and ties have distinct functions that play a significant role in the achievement of organisational (Ibarra et al., 2005; Kilduff & Brass, 2010; Tasselli et al., 2015) and, more recently, institutional outcomes (Battilana & Casciaro, 2012; Vasudeva et al., 2012; Raffaelli & Glynn, 2014).

Informal social networks are emergent patterns of interpersonal interactions that actors develop to pursue their instrumental and socio-emotional needs (McEvily et al., 2014). They are considered to be sources of influence in organisations that affect the initiation and

implementation of new policies and organisational change in general (Ibarra & Andrews, 1993; Kilduff & Brass, 2010; Battilana & Casciaro, 2012). This notion further is supported by Beckert's (2010a) explanation that "social networks play a crucial role in the change process because they can influence interpretations of collective events more powerfully than individual actors" (p. 619). This process occurs through mechanisms of social cohesion, conformity and control, since individuals and collective actors in an institutional setting create, embody and reproduce the practices of the field (Orlikowski, 1996; Tolbert & Barley, 1997).

For example, from an institutional perspective, when actors enact new practices, socialization and normative pressures reward or sanction the engagement in those practices (Molm, 1997; Romzek et al., 2012; Bitektine & Haack, 2015; Bridwell-Mitchell, 2016). Therefore, actors are penalised when engaging with phased-out practices and rewarded for engaging with institutionalised practices. Over time, as the enactment of new practices is rewarded, this results in social conformity and homogenization, and it also fosters further cohesion as more actors adopt the practice, leading to its institutionalisation. However, from a social network perspective, when new practices emerge, actors interact, communicate and engage with each other regarding the enactment and implementation of the practice. Like the institutional perspective, the practices need to be enacted and engaged among the majority of actors to increase adoption and gain further acceptance among the actors in the wider organisational context (Seo & Creed, 2002; Battilana & Casciaro, 2012). If new practices become endorsed among relevant actors and are deemed appropriate responses to uncertainty or complexity within a specific community, it further attracts attention and becomes more easily accepted (Dorado, 2005; Hargrave & Van De Ven, 2006). As individuals interact with peers within and outside the organisation, new practices become more widely observed and enacted. Further, as new practice accumulates and becomes endorsed within other organisations, it supports the notion that the acceptance and diffusion of practices occur through the interactions of the professionals engaged in similar work practices (Wijen & Ansari, 2007; Deephouse & Suchman, 2008; Leicht & Fennell, 2008; Sahlin & Wedlin, 2008; Deephouse et al., 2018). Thus, informal social relationships have been associated "with systems of interaction for making decisions, mobilizing resources, and coordinating behaviours and tasks" (McEvily et al., 2014, p. 307) because they are driven by interpersonal attraction, individual agency and behavioural norms (Brennecke & Rank, 2016). Therefore, within the social network literature, it is well established that social network structures provide both opportunities and constraints for action and interaction among actors (Borgatti & Cross, 2003; Contandriopoulos et al., 2010; Tortoriello et al., 2014).

Based on this view, it can be argued that social network theory has always focused on the study of social institutions, where networks become a linkage mechanism that bridges micro-level

systems of social interaction to the meso and macro levels of organisational and institutional fields (White & Mohr, 2008; Tasselli et al., 2015). This connection presents an apparent assumption that social relationships are the building blocks of institutions and networks, as they are concerned with the influence of embeddedness and social structures among actors (Owen-smith & Powell, 2008; Powell & Oberg, 2018). When discussed in this way, institutions' social networks provide insight into the micro-level processes that influence institutional change (Owen-smith & Powell, 2008; Gibson & Vom Lehn, 2018; Hallett & Hawbaker, 2019). With this understanding, Powell and Oberg (2018) propose that social network theory and analysis can shed further light on the "aggregation of legitimacy, the diffusion of practices, and the embeddedness of individuals and organisations" (page. 6). However, few attempts were made to bring these domains closer (Owen-smith & Powell, 2008; Powell & Oberg, 2018). Consequently, this has resulted in the link between networks and institutions being over-theorized and under-examined (Zucker, 1987; Owen-smith & Powell, 2008; Beckert, 2010a).

Like intuitionalists, social network theorists recognize the importance of social structures and the embeddedness of actors. Similarly, both theoretical domains have a keen interest in the significance of embeddedness for actors and organisations, where embeddedness is framed as an opportunity and constraint for action. At the same time, social network theory has produced detailed accounts on how embeddedness and network structures influence organisational outcomes (Kenis & Oerlemans, 2009; Godwyn & Gittell, 2012; Vasudeva et al., 2012; Tasselli et al., 2015), the traditional focus on macro-level theories of institutions, restricted institutionalists from examining the microfoundations of institutions (Cardinale, 2018; Powell & Rerup, 2018; Harmon et al., 2019). Likewise, due to its theoretical basis and the focus on the regulative, cultural and political dynamics, institutional theory overlooked the influence of social processes and the patterns of social relationships that underpin both institutional stability and change. Therefore, a fundamental insight of social network theory that is often neglected in institutional studies is that relationships are not only essential to sharing and embedding knowledge and practice within an institutional field, but they are also a mechanism that aids in rendering social action sensible (Owen-smith & Powell, 2008). Thus, a social network view complements the institutional perspective of understanding organisations, as it adopts an explicitly relational and structuralist orientation to explore how relationships and connections among actors are related to institutional change processes (Argote et al., 2003; Burt et al., 2013).

When a social network lens is cast on micro-institutional change, it reveals that the traditional institutional view of embeddedness constraining action is limited and conflated. In general, there are many forms of embeddedness, which complicate whether it would be an opportunity and constraint for change; however, these perspectives are not discussed or presented in much of the

institutional discourse. These forms of embeddedness include, but are not limited to, structural, relational, cognitive and cultural forms of embeddedness (Uzzi, 1996; Nahapiet & Ghoshal, 1998; Dacin et al., 1999; Moran, 2005; Giuliani, 2007). Therefore, this singular concept accepts that actors and professionals are entrenched in various contexts that shape their ability to interact, relate to, perceive and shape their institutional environment (Dorado, 2005; Garud et al., 2007).

As such, *structural embeddedness* will be examined within this study as it gives attention to the types of relationships and structures that influence social action and organisational outcomes (Gulati & Gargiulo, 1999; Tasselli et al., 2015). Structural embeddedness focuses on examining the social patterns and structures that emerge within the network to understand the specific social processes present in a network (Dacin et al., 1999; Moran, 2005; Kilduff & Brass, 2010). By examining the ***structural*** characteristics of embeddedness, this research sheds light on how social relationships are associated with institutionalising new practices among actors.

2.4.1 Social Relationships in Organisations

Before examining structural embeddedness, the nature and role of the social relationship must be understood. Social relationships have become increasingly important in organisations as they are more representative of how work transpires compared to the relationships recognized from the formal organisational structure (Bouty, 2000; McEvily et al., 2014; White et al., 2016). Within an institutional context, different types of relationships emerge that support the work and responsibilities of actors. In this case, actors may share "multiple bases for interaction" such as formal and informal roles, actions and exchanges (Marsden et al., 1984; Wasserman & Faust, 1994). These relationships create bonds of affiliation and attachment as they require actors to learn how their work and others are related (Ibert & Müller, 2015; Müller & Ibert, 2015). By working together, actors produce a community by developing unstated norms and informal rules about working together (Bouty, 2000; Gabbay & le May, 2004; Ward et al., 2012; Rathi et al., 2014; van Marrewijk et al., 2016). As Scott et al. (2000) have pointed out, the nature and extent of relations among actors are crucial to understanding the transformation, change, and institutionalisation of practices because organisations and fields are constructed over time by actors' collective interactions. Social relationships are typically characterised into two main categories: instrumental or expressive relationships. An instrumental tie is a goal-oriented or advice-based relationship where actors share and exchange knowledge and formal and informal information; whereas, expressive ties are informal and commitment-based relationships where actors relate to each other based on trust, closeness and friendship (Ibarra, 1992; Levin & Cross, 2014; Fang et al., 2015).

In general, when professionals interact in their everyday work, they share knowledge and learn from each other, giving and receiving advice to develop solutions and make sense of new

practices. Similarly, their awareness of colleague's expertise frames and gives meaning to the way practices are used. In giving and receiving information and advice, actors develop relationships that build shared understandings about new practices and replicate micro-level patterns of engagement associated with the acceptance and engagement of those practices. Similarly, when actors are faced with problems within their daily work, they search for and consider alternatives to address uncertainties and emerging demands in the present (Emirbayer & Mische, 1998; Smets et al., 2018). In this case, actors turn to colleagues for advice and support (Dorado, 2005; Smets et al., 2012), engage in peer learning (Bridwell-Mitchell, 2016; Chandler & Haunschild, 2018) and knowledge brokering (Tucker et al., 2007; Vasudeva et al., 2012) to search for solutions and justify the change in response to the individual or collective difficulties they may face.

One study was found that an organisation's adoption of new practices was influenced by relational pluralism, which are the different types of ties to actors within and outside of the institutional field (Raffaelli & Glynn, 2014). This study explored the microprocesses of practice diffusion in relational networks, found that normative pressures within professional networks increased the likelihood of an organisation adopting tailored practices and highlighted that network ties are critical for practice diffusion. However, this work focused on organisations' embeddedness in multiple fields, rather than actors' embeddedness, to support the spread of practices. However, when we examine the actor level, we notice that actors are linked by social relationships and shared training, professional affiliations, and memberships. This relatedness cultivates interdependent roles, identities and behaviours that guide their responsibilities and the practical understandings of their daily work (Wenger, 1998; Brown & Duguid, 2001; Raffaelli & Glynn, 2014). Taken together, professional roles, groups and associations emphasize the normative aspects of practice, which further influences the acceptance and legitimization of new practices among actors (DiMaggio & Powell, 1983; Zucker, 1987; Smets et al., 2012, 2018). Next, an actor's understanding, expertise and social attachments are, in part, a function of the interaction patterns within their professional space (McWilliam et al., 2009; Janhonen & Johanson, 2011). This view indicates that actors in their everyday work develop both normative networks and social relationships that guide and enforce the norms and stable conduct of practice (Scott et al., 2000).

Therefore, social relationships can lead to greater flexibility in building network ties that motivate the diffusion and adoption of innovations, the ability to adopt tailored innovations and participation in alliances and other institutional relationships (Kraatz & Block, 2008; Beckman et al., 2014; Raffaelli & Glynn, 2014; Sytch & Tatarynowicz, 2014; Wang et al., 2014). Similarly, trust and advice among actors influences organisations and institutions, as actors develop networks that frame and give meaning to the way knowledge and practices are used, and this provides

various explanations for the way new knowledge and practices are accepted among actors (Brown & Duguid, 2001; Ferlie et al., 2012). Together this supports the notion that social relationships are an essential aspect of institutionalising new practices. However, relationships do not exist in a vacuum and are better understood when examined within the context of other relationships.

2.4.2 Structural Embeddedness & the Institutionalisation of Practices

Structural embeddedness is a conceptualization of social structure based on actor ties and direct relationships (Dacin et al., 1999; Moran, 2005). It refers to the extent of connectivity, the likelihood of interactions among actors within a social space, and the extent to which individuals are anchored in closely knit social communities (Granovetter, 1985; Goldberg et al., 2016). Nahapiet and Ghoshal (1998) extend this definition to incorporate the configuration of interpersonal linkages between people or groups, including the presence or absence of network ties between actors and other structural features such as cohesion and density. While the relationship or tie between two actors is linear, the connections between them and other actors amplify into a complex network of relationships and interactions. Therefore, structural embeddedness exposes the presence of structural configurations from a global or macro view of the network and goes beyond immediate interpersonal linkages (Martins et al., 2017) since relationships cannot be understood without examining them within the context of the configuration of other relationships (Van De Rijt, 2011). These connections and interpersonal linkages represent ties and interactions among actors that span professional boundaries. In general, we know that networks provide several opportunities for cooperation, exchange, and value creation between actors, but the positions and connections within the network mediate the opportunity to do so (Gulati & Gargiulo, 1999; Cheng et al., 2014). Therefore, structural embeddedness depicts actors' overall relatedness, patterns and positions within a network, size, density, and composition, providing indicators of interaction and institutional processes.

Previous research found that two structural forms, closure and bridging, have varying consequences for sharing information among actors (Burt, 2001; Reagans & McEvily, 2008). Closure is associated with cohesive groups of closely connected actors, and bridging is associated with spanning the gap between disconnected actors; however, it is unclear what role these structures play to institutionalise new practices. One key mechanism associated with these structures is the triad (Krackhardt & Kilduff, 2002), representing complex social and relational processes in a group of three actors, where these dynamics remain as the group size increases. In this case, a closed triad represents closure among actors, and alternatively, an open triad is associated with brokering between actors. In addition to macro-structures, structural embeddedness can be further examined by magnifying the network's relational mechanisms to

closely examine the type of connections, interactions, and groups within the network. Relational mechanisms have four main categories: reciprocity, repetition, clustering and closure, and degree (Rivera et al., 2010). These mechanisms are tied to Simmel's classic relational debate on the triad (Krackhardt & Kilduff, 2002; Tortoriello & Krackhardt, 2010; Simmel, 2011). The idea of this work is that complex relational processes can be examined as a group of three. As the group increases, triadic and clique relationships are understood based on the degree of reciprocity, interaction and connectivity through clustering and closure among actors (Rivera et al., 2010).

In that case, the micro-level dynamics of institutional change and structural embeddedness can then be theoretically debated and empirically examined to broaden the scope and understanding of new practices' institutionalisation in two ways. First, when examining closure and bridging at the structural level, a macro view of social relationships can investigate collective action through a network's overall embeddedness and the global presence or absence of cohesive group structures within the network. Second, by drawing on Simmel's notion of the triad, various forms of triadic structures, such as closed and open triads, can be investigated to understand the extent of reciprocity and the nature of embeddedness within networks and groups. These angles lead to more detailed views into the structural embeddedness of actors and more nuanced views of the relational mechanisms associated with social structures and the implications regarding the institutionalisation of new practices.

2.4.2.1 *Closure & the Institutionalisation of Practices*

Building on this understanding, one of the most influential social network perspectives is that actors and organisations benefit from being socially embedded within cohesive network structures (Coleman, 1988; Nahapiet & Ghoshal, 1998; Reagans & McEvily, 2003; Moran, 2005). In this structural configuration, closure emerges from closed triadic structures (See Figure 2) where actors are directly connected to other members of a subgroup (Robins et al., 2009; Scott, 2017). These structures are established by closely-knit ties and reciprocity within networks where actors are more likely to endorse a behaviour or action, in this case, new practices if they share a joint partner (Simmel, 1955). Closure stimulates a sense of belonging (Coleman, 1988), builds trust (Reagans & McEvily, 2003; Tortoriello et al., 2012; Zhong et al., 2017), facilitates the exchange of complex practices and tacit knowledge (Hansen, 1999; Uzzi & Spiro, 2005) and enables the creation of a common culture, language and shared identity (Kogut & Zander, 1996; Nahapiet & Ghoshal, 1998; Brown & Duguid, 2001). Accordingly, the link between closure and the institutionalisation of new practices is that closure engenders strong social pressures that foster familiarity and shared values that determine the way actors create, use and share new practices (Kogut & Zander, 1996; Nahapiet & Ghoshal, 1998; Cook & Brown, 1999; Brown & Duguid, 2001; Burt, 2001; Tortoriello et al., 2012). As a result, these cohesive groups are typically characterized

by low diversity, enhancing group coordination and increasing their overall performance and productivity (Reagans, Zuckerman, and McEvily, 2003).

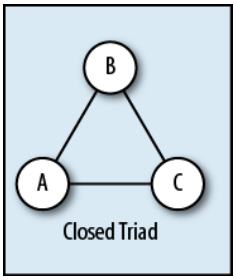


Figure 2: Closed Triad

Closure among actors also promotes normative justification and influences the professionalization of practice, which further encourages practitioners and organisations to adopt and implement new practices (DiMaggio & Powell, 1983; Smets et al., 2012; Raffaelli & Glynn, 2014). Battilana et al. (2012) drew on closure to understand the initiation and adoption of organisational change. This study examined the link between structural embeddedness and varying degrees of institutional change. They found that low levels of closure in a healthcare professional's network facilitated the initiation and adoption of changes that diverged from their institutional status quo but hindered the adoption of less divergent changes. Within the context of practice change, Birdwell-Mitchell's (2016) comparative case study revealed some insights that resonate with structural embeddedness and micro-institutional processes. The research found that patterns of interactions in large, cohesive, homogeneous groups supported the process of micro-institutional change compared to several small cliques, as professionals could converge on widely shared understandings of appropriate practice (Birdwell-Mitchell 2016, p. 183). She observed that the large cohesive groups fostered strong social pressures that encouraged conformity regarding new practices and reinforced feedback about how to address practice dilemmas. The smaller fragmented groups, which were considerably diverse, produced weak social pressures that did not support the spread of new practices within the various groups. These differences highlight that practice change depended on the extent of socialization and patterns of interaction, either cohesive or diverse that allowed actors to develop more consistent and shared understandings about new practices' technical requirements (Birdwell-Mitchell 2016. p.174). This work revealed that, in some contexts, professional networks are organized to allow the institutionalisation of new ideas and practices, whereas, in others, the patterns of interactions result in "social disorganisation". Therefore, new ideas and practices "do not take root or spread" (Birdwell-Mitchell 2016, p. 162).

Since the institutionalisation of new practices is considered as "an exercise in social influence, defined as the alteration of an attitude or behaviour by one actor in response to another actor's

actions" (Battilana & Casciaro, 2012, p. 381), cohesion and reciprocity mediate concerns when among actors when they are faced with conditions of ambiguity and uncertainty (Möllering, 2014). First, reciprocity and shared relationships between actors are associated with the stability of interactions over time (Rivera et al., 2010; Block, 2015). Likewise, unreciprocated ties are seen as unstable, with the possibility of becoming reciprocated or remaining disconnected in the long term. A large body of literature exemplifies that institutional actors are connected by shared norms, knowledge and understandings that determine the appropriate actions and practices within that institutional domain (Brown & Duguid, 1991; Davis & Greve, 1997; Schneiberg & Lounsbury, 2008; Chandler & Hwang, 2015). Research also points to the importance of reciprocity and closure as it builds interpersonal trust, which garners support for undertakings that are new to the institutional domain (Aldrich & Fiol, 1994). When reciprocity and closure are high, actors are less likely to question behaviours, increasing the likelihood of sharing and engaging in new practices (Lumineau & Schilke, 2018; Zucker & Schilke, 2019).

Since social and professional networks influence collective interpretations more deeply than individual actors (Beckert, 2010a), reciprocated relationships and cohesive networks play a critical role in the institutionalisation process and supplement knowledge and advice among actors when new practices are introduced. This notion is vital as everyday activities and patterns of engagement build trust and reciprocity through the socialization and participation of professionals, whose ongoing social relationships further define and legitimize the shared norms and understandings between them (Kramer, 1999; Möllering, 2014). If we assume that professional roles and the normative aspects of practice support the legitimization and institutionalisation of new practices within an organisation (DiMaggio & Powell, 1983; Zucker, 1987; Seo & Creed, 2002; Raffaelli & Glynn, 2014); then cohesion and reciprocity among professionals, and becomes a relational mechanism that supports acceptance, stability and homogeneity of practices within organisational fields (Beckert, 2010a).

Generally, the effects of network closure suggest that these relationships enhance cooperation and coordination among groups of actors by promoting norms of trust and reciprocity, but high levels of cohesion also limit their exposure to new information and ability to deviate from established norms and conventions (Coleman, 1988; Uzzi, 1996). As such, excessive social cohesion can become problematic, as some adverse effects emerge from the very influences from which closure derives its benefits. First, it can negatively influence low diversity, which results in redundancies and groupthink (Lindkvist, 2005; Crilly et al., 2010). This negative influence of social cohesion can work against a change initiative if actors collectively agree to resist the change. Additionally, since closure fosters homogeneity within the group or community, actors are less likely to consider new or alternative practices that may lead to more appropriate or

enduring solutions (Granovetter, 1983; Hansen, 1999; Fleming et al., 2002). Despite the drawbacks, cohesive networks are associated with better coordination, socialization and engagement regarding new practices.

Overall, closure comprises relational mechanisms such as cohesion and reciprocity are responsible for legitimating practices within the institutional domain (Reay et al., 2006; Lounsbury & Crumley, 2007; Raffaelli & Glynn, 2014; Bridwell-Mitchell, 2016; Smets et al., 2018). In summary, closure among actors establishes the social structure and context actors use to "draw on to make sense of the situation and behave within it" (Gray et al., 2015, p. 119). Therefore, when new practices are introduced, actors may be more or less open to the practice since their social relationships would provide the appropriate frame of reference to guide their acceptance. In this case, structural and relational features such as closure and reciprocity become an important mechanism to share and legitimize new practices among organisational actors (DiMaggio & Powell, 1983; Scott, 2001).

2.4.2.2 Bridging, Brokering & Institutionalisation of New Practices

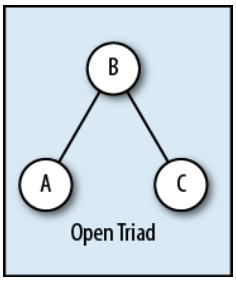


Figure 3: Open Triad

Since structural embeddedness is concerned with actors' structure within a social space, closure signifies cohesive relationships among actors and their consequences for organisational outcomes and institutional change processes. When drawing on closure and connectivity, we are left with dualistic arguments about cohesive and non-cohesive structures influencing institutional outcomes since patterns of interaction among actors also influence and redefine organisational processes. Social networks and structures are considered to be built from local patterns and configurations of relationships that arise from social processes among actors (Lusher, Koskinen, et al., 2013). Based on the previous findings, we know closure within a network influences the institutionalisation of new practices; however, we recognize that other structural forms are also present. Closure inspired an alternative view, Burt's structural holes theory, which focuses on benefits outside the group structure rather than within (Burt, 1992, 2004). Burt describes a structural hole as the "separation … or a relationship of non-redundancy" between two actors that enable them to "provide network benefits that are … additive rather than overlapping" (Burt, 1992, p. 18). While disconnection between actors and groups provides an

essential requirement for the existence of a structural hole, some explanations underpin the opportunity, ability or motivation to broker information or advice between disconnected actors and groups (Mehra et al., 2001; Oh & Kilduff, 2008; Kleinbaum et al., 2012, 2015; Fang et al., 2015). This bridging behaviour is represented by an open triad (See Figure 3), where two disconnected actors are connected through their relationship with a third actor. When bridging a hole between disconnected actors, the focal actor, Actor B in Figure 3, is bestowed with distinct positional advantages between groups, as they broker or span the boundary between actors or groups (Burt, 1992; Long et al., 2013; Quintane & Carnabuci, 2016). Unlike closure, much emphasis is placed on the individual broker, and value comes from the position and ability to efficiently span and the structural hole and exploit the opportunities it creates. From this perspective, benefits accrue for both the actor and the network, as structures rich in holes capture diversity and novelty by accessing the proficiencies of actors who are disconnected from each other and who have different perspectives, skills and expertise (Fleming et al., 2002; Uzzi & Spiro, 2005; McFadyen et al., 2009; Zaheer & Soda, 2009).

The outcomes are understood to be determined by the broker's ability to identify opportunities, bridge the gap and create value for themselves and disconnected groups. However, these opportunities to control the access resources and control benefits between disconnected groups is risky, as this position is associated with the ambiguity surrounding coordination and tensions due to conflicting norms, practices and perspectives between the groups (Obstfeld, 2005; Ward et al., 2012; Quintane & Carnabuci, 2016; Mallidou et al., 2017).

Overall, these arguments are aligned with the institutional entrepreneurship literature, where positions among actors determine the extent and likelihood of change within an environment. In considering the bridging or brokering in networks as a mechanism to support the institutionalisation of practices among actors, we see another level of interaction and engagement among actors to share and institutionalise new practices within an organisational context. For example, in addition to the findings on closure, Battilana and Casciaro's (2012) work also found that structural holes in actors' networks increased the likelihood that they would initiate organisational changes that diverged from the institutional status quo. For example, an initiative to develop nurse-led discharge that would transfer clinical tasks and decision-making authority from physicians to nurses was seen as a change that would diverge from the status quo. However, it was observed that brokering among different professional groups increased the likelihood that nurse-led discharge would be implemented and adopted. This change was facilitated by nurses connections to managers, nurses and doctors who would need to share the responsibility and risk for clinical decisions. However, an initiative to hire an administrative assistant to implement a computerized appointment booking system did not diverge from the institutional status quo and

did not affect the balance of power between health care professionals within the general practice (Page 388). In later work, Bridwell-Mitchell (2016) found that even though brokers within highly fragmented groups interacted across teaching communities, the opportunities for peer learning and practice adoption were not fully realized. First, administrators formally selected brokers or tended to be in positions "which undermined their ability to convey lessons from other communities" (Page 179). Second, they were seen to be less influential, and they infrequently interacted with other members who were dissimilar to them. As a result, brokers' information and advice regarding new practices were less frequent and considered to be less reliable. One reason this may have been the case is that the leading brokers belonged to multiple communities and were "exposed to different instructional approaches, and this can create a sense of dissonance for them" (Page 177).

The distinction among brokers has varying implications regarding the institutionalisation of new practices, as it highlights a key challenge in understanding brokering relationships as either intergroup or intragroup interactions. Gould & Fernandez (1989) conceptualize five brokerage roles: *coordinator, gatekeeper, representative, consultant, and liaison*, which takes this distinction into account as they explicitly consider the internal and external flows of interactions and information flows within a network. Externally-oriented brokering roles, such as the representative, consultant and liaison roles, are necessary to bring new knowledge and practices within a community. In contrast, internally-oriented brokering roles such as the coordinator and gatekeeper roles are required to transfer, transform and apply new information and knowledge within the established professional communities. These orientations inform our understanding of whether and to what extent information circulates within and across communities. These arguments collectively reveal that brokering between different groups may affect the institutionalisation of new practices, but it varies depending on the actor, the role, the context, or the type of change initiated. Therefore, by examining the nuances of bridging structures and brokering roles within structural embeddedness, this research considers the structures and relations of actors in established professional communities.

2.5 Literature Review Summary: Embeddedness & Micro-Institutional Change

An overwhelming body of research examines varying aspects of institutional change processes (Hardy & Maguire, 2017; Lawrence & Buchanan, 2018); however, many areas remain neglected. First, an overemphasis on the macro level of analysis has resulted in a lack of understanding of institutional change processes at the micro-level, specifically institutionalising practices. Therefore, by taking this turn to shed light on the microfoundations of institutions, further attention will be placed on the micro-level processes at play, and this would inform how they aggregate and contribute to broader organisational and institutional processes (Barley, 2008; Powell & Colyvas, 2008; Powell & Rerup, 2018). Second, in considering the microfoundations of institutions, greater attention has been placed on understanding the role of agents and collective actors within organisations and their association with micro-institutional change processes. This perspective highlights the actors whose everyday actions and interactions are responsible for carrying out and supporting practice changes (Smets et al., 2018; Zucker & Schilke, 2019). At first, this led to a body of work that examined how roles (Reay et al., 2006), identities (Battilana et al., 2017; Glynn, 2017) and social positions (Battilana, 2006, 2010) influence institutional change processes; however, less attention is placed on understanding how the embeddedness of actors influences micro-institutional change.

Traditional arguments assume a singular form of embeddedness that constrains organisational actors and limits the likelihood of micro-institutional change; however, this is not the case. This assumption has been so widely accepted within the institutional literature that it became taken for granted and unproblematic. However, when we question this, we see many levels and dimensions of embeddedness within an institutional and organisational context. When we disentangle embeddedness into different types, it becomes clearer to conceptualize embeddedness as both a driver and constraint for action among actors. In drawing on social network concepts, we see that embeddedness becomes a source and precondition of micro-institutional change since embeddedness has relational, structural, cognitive, and cultural forms that influence the interactions, connections, and agreement of groups of actors within organisations and institutions (Nahapiet & Ghoshal, 1998; Dacin et al., 1999; Moran, 2005). This perspective highlights a new narrative regarding social relationships and the microprocesses associated with institutional change. It is unsurprising as the arguments against institutional entrepreneurship and other heroic narratives emphasize that collective and process-centric narratives would more truthfully represent the social dynamics that underpin the initiation and support of change within organisational and institutional fields (Hargrave & Van De Ven, 2006; Lounsbury & Crumley, 2007; Wijen & Ansari, 2007). This argument is further supported since even within the context of institutional entrepreneurship; institutional entrepreneurs must

engage with and interact with other members of the field to bring about change (Dorado, 2005; Garud et al., 2007; Hardy & Maguire, 2008; Battilana et al., 2009). Therefore, the embeddedness and interactions of actors become an essential component of micro-institutional change. However, we still know very little about the role of embeddedness in shaping institutional processes, specifically the institutionalisation of new practices.

Few studies have attempted to link embeddedness, social network theory, and institutional processes, even with this micro turn. Institutionalists and social networks theorists draw on embeddedness concepts to understand organisational outcomes, but there has been little development in this camp, despite the clear synergies between them. Scott et al. (2000) add to this by arguing that "the extent and the ways in which actors are connected are as important in their effects on social behaviour as the characteristics of the actors themselves. Social network theorists would assert that the relational properties are more important because they provide the supportive or constraining contexts within which activities are carried out" (pg. 354). These points highlight that structural and relational processes play a role in changes in practice. Therefore, from an institutional perspective, we know that practices endure in organisations when patterns of engagement support legitimation and actors have widely shared understandings that are taken for granted (Gray et al., 2015; Deephouse et al., 2018; Zucker & Schilke, 2019), but we also know that micro-institutional change can be driven by changes in practice (Smets et al., 2018). Nevertheless, studies primarily examine this at the macro level of analysis, which has sparked further interest in the microprocesses of institutional change.

From the micro-level, we know that actors need to interact in some way to drive institutional change and support the institutionalisation of new practices (Barley, 2008; Gibson & Vom Lehn, 2018; Hallett & Hawbaker, 2019). We also recognize that it can be quite complex, especially in highly professionalized organisational settings where different groups tend to not interact with each other due to institutional rules, roles, power and status differences (Lawrence & Buchanan, 2018; Schilke, 2018). However, some studies have highlighted the importance of social relationships among professionals during the institutionalisation process (Reay et al., 2006; Battilana & Casciaro, 2012; Raffaelli & Glynn, 2014; Bridwell-Mitchell, 2016). In this space, when actors interact with peers and engage in new practices by making adjustments and improvisations to their daily work, it contributes to institutionalising new practices (Dorado, 2005; Reay et al., 2006; Smets et al., 2018). Accordingly, an alternative theoretical framing is presented to understand the role of embeddedness and relationships (See Figure 4).

By changing the central-periphery narrative and examining the specific social processes that exemplify interactions and behaviours among actors, we move away from a one-dimensional view of how networks and relationships are associated with institutionalising new practices. In

this case, rather than associating changes in practice to actors at the centre or periphery of an organisation or field, a more nuanced look at structural embeddedness could tell us more about the specific patterns of interactions, whether closure or brokering, that support the institutionalisation of new practices within organisations. At present, we understand how closure is related to the institutionalisation of new practices; however, the role of bridging or combinations of the two is not as clear. With the literature reviewed, structural embeddedness provides a macro-level view of the network considering configurations such as bridging and closure. In contrast, relational mechanisms provide a micro-level view that emphasizes the influence and context of reciprocity, cohesion and brokering roles and structures. It is also important to realise that structural embeddedness and relational mechanisms investigate the same phenomena in different aspects and levels. First, relational mechanisms and assumptions are derived from the network's structural features, focusing on relationships based on information- or advice- relationships and indirect connections to other actors within the network. Second, these relationships are further investigated by considering the influences of cohesion and reciprocity within groups and communities. Therefore, structural embeddedness and the associated relational mechanisms provide the link to relate micro-level processes to the macro-level traditional theoretical debates that aim to explain the process through which new practices are shared, accepted and legitimised within institutional and organisational domains (Boxenbaum & Jonsson, 2008; Beckert, 2010b; Smets et al., 2012; Roulet et al., 2019).

From a social network research perspective, the bridging and closure literature has generated considerable research. There is some division regarding which of these two structures is most beneficial for organisations, especially regarding their consequences for organisational outcomes. Past debates have excessively polarized them, making it easy to overlook the complementarities between the two, as organisational networks are configured and organized around several different structural forms (Kilduff & Brass, 2010). This polarization and conflicting empirical findings have hindered the advancement of a cumulative body of research, as they are considered paradoxical in the sense that they are structurally opposing but functionally interdependent (Padula, 2008). Some scholars claim that researchers present evidence in their favour (Fleming et al., 2002), but it is also evident that conflicting arguments and findings arise from varying theoretical, empirical and contextual sources (Reagans & McEvily, 2008; Aral & Van Alstyne, 2011; Levin et al., 2016). Although these structures examine different network configurations, they agree that closure and densely connected networks are constraining (Kilduff & Brass, 2010). In the case of closure, this constraint is beneficial as reciprocity facilitates the sharing of new practices and the monitoring and enforcement of norms that generate professional identities and support cohesive relationships.

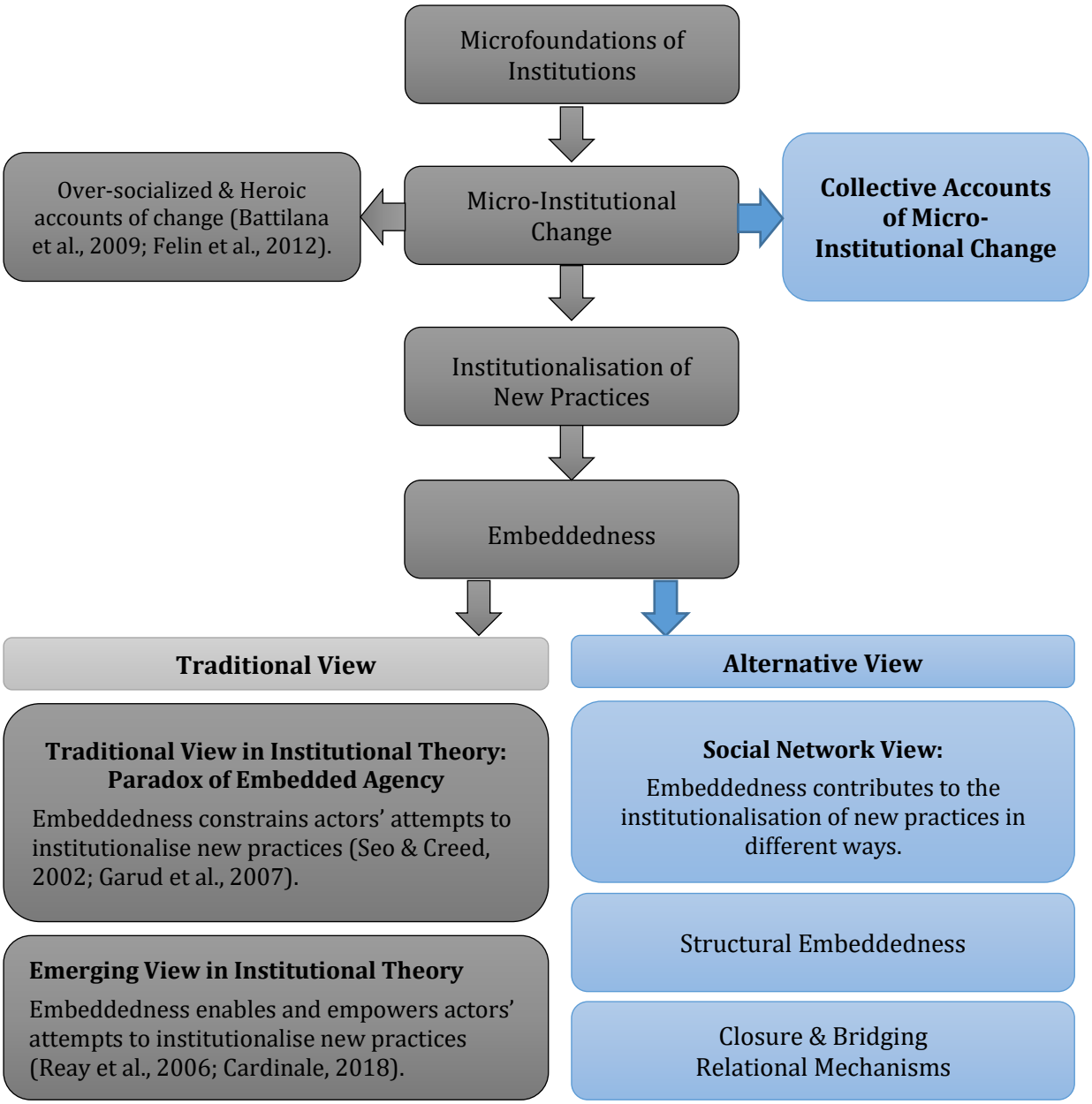


Figure 4: Summary of Theoretical Positioning of Embeddedness & the Institutionalisation of New Practices

This combination is critical for sharing and engaging with new practices. However, from the structural hole perspective, this constraint is detrimental, as it limits access to novel and diverse information sources (Kilduff & Brass, 2010). However, closure promotes bridging in networks through advice-seeking and provision from among actors. These activities bring diverse actors together and further promote creative problem-solving, innovation and new ideas (Fleming et al., 2002; Uzzi & Spiro, 2005; Vaan et al., 2015). Overall, closure is necessary for structural holes to exist, and they are functionally interdependent in that they provide diverse but complementary benefits that contribute to the sharing of information and advice regarding new practices. These arguments collectively show that structural embeddedness is characterized by structural

features such as closure and bridging among actors, and both are required to institutionalise new practices in organisations.

These arguments are also consistent with the view that individual actions and behaviours amplify (Gray et al., 2015), accumulate (Smets et al., 2018) or trickle up (Haack et al., 2019; Hwang & Colyvas, 2019) to the organisational and field levels, supporting the notion that macro-level phenomena are both the consequence and result of individuals and organisations affecting institutions (Coleman, 1986; Udehn, 2002). It also reflects the existing organisation-level narratives of institutional stability and change, where isomorphic pressures force organisations to adopt practices to increase their survival and legitimacy (Zucker, 1987; Hargrave & Van De Ven, 2006; Deephouse & Suchman, 2008; Schneiberg & Lounsbury, 2008; Czarniawska, 2009; Kennedy & Fiss, 2009). Overall, the combination of these processes results in a shift, where change amplifies from the micro to macro levels through the process of enacting, sharing, supporting and participating in the practice itself (Smets et al., 2012). When actors encounter new practices, they tend to provide information and seek advice from colleagues to understand the purpose, relevance and suitability of new practices within their immediate work environment. These interactions influence the institutionalisation of new practices through professional norms and relationships. Therefore, we understand that the structural and relational dynamics support actors to institutionalise new practices within their environment from a social network perspective. Similarly, we know that institutions, organisations and fields are made of actors whose everyday actions and relationships shape the micro-level processes (Powell & Rerup, 2017); however, this is still not fully understood.

To date, only two studies have directly investigated the relationship between social network structures and the features associated with institutional change processes and initiatives (Battilana & Casciaro, 2012; Raffaelli & Glynn, 2014). Battilana et al. (2012) used social network analysis to understand the initiation and adoption of new practices in organisations. Raffaelli & Glynn (2014) explored the microprocesses of practice diffusion in relational networks but focused on understanding how organisational characteristics influenced adopting different practices. These are the only known quantitative studies that draw on social network concepts to understand micro-institutional processes, and only the former is focused on the micro-level of analysis. Bridwell-Mitchell's (2016) qualitative study examined the pattern of interactions among actors to understand micro-institutional change. Consequently, what is missing from Battilana et al. (2012) and Bridwell-Mitchell's (2016) studies is a systematic understanding of the structural embeddedness and patterns of interaction within social networks and how they are associated with the institutionalisation of new practices within organisations.

Therefore, this research provides an alternative account of embeddedness and micro-institutional change by illustrating the structural and relational processes that support the

institutionalisation of new practices through the social relationships of organisational actors (Gibson & Vom Lehn, 2018; Hallett & Hawbaker, 2019). This perspective depicts a less dramatic process of institutional change, in comparison to the grander representations such as institutional entrepreneurship, by describing changes in practice as a modest process, as the institutionalisation of new practices, occurs through relationships among relevant actors within the context of their everyday work (Smets et al., 2012; Gray et al., 2015; Bridwell-Mitchell, 2016). This reconceptualization emerged from arguments explaining actors' collective efforts and shifts in taken-for-granted norms and practices responsible for institutional change (Möllering, 2007; Wijen & Ansari, 2007; Barley, 2008; Hardy & Maguire, 2017). Broadly, this work seeks to understand institutions' microfoundations through a social network lens by interrogating the link between structural embeddedness and the institutionalisation of practices. Taken together, this brings us to a broad research question, which seeks to understand *how actors' embeddedness influences the institutionalisation of new practices* by shedding light on *the structural and institutional features of embeddedness among groups of actors who seek to introduce and integrate new practices within their organisation.*

The next chapter, Chapter 3: Research Context, describes the empirical setting and the five organisations used to investigate closure, bridging, professional roles and structural embeddedness more generally. This chapter provides details on the organisations' aims, objectives, performance, and progress to justify its selection and suitability to answer the research question. This information is also aligned with the theoretical framework to support its utilisation.

Blank Page

Chapter 3: Research Context

3.1 Introduction

This research study has four inter-related objectives that seek to understand the role of embeddedness and the institutionalisation of new practices within an organisational context. The third objective seeks to *explore* structural embeddedness to institutionalise new practices among institutional actors; therefore, the research context must be established to empirically investigate this query. Before this is addressed, a distinction must be made between institutions, organisations, and fields. As previously stated, an institution is an enduring social structure that embodies the cultural–cognitive, normative and regulative activities and practices that provide stability and give meaning to behaviour within a social context (Scott et al., 2000; Scott, 2003). In contrast, organisations are specific sites where practices and institutional rules are shaped, reproduced and enacted (Scott, 2003; Powell, 2019), and an institutional field encompasses organisations, exchange partners, governing bodies, and groups that share similar rules, activities, and practices (DiMaggio & Powell, 1983; Hardy & Maguire, 2017). Thus, the link between institutions, organisations, and fields is that an institutional field comprises communities of organisations that operate and share a common meaning system; and the institution shapes the overarching professional system and the socio-cultural context of the organisation (Greenwood et al., 2014).

To illustrate, the Public Health division of the United Kingdom embodies an institutional healthcare field, where different organisations are associated with providing health care services (See Figure 5). Some institutions provide healthcare services directly to the public, where organisations such as NHS Trusts and local clinics enact the practices associated with these activities. Additionally, some institutions oversee and regulate the quality of care provided to the public, where organisations such as the NHS Improvement (NHSi) and the Care Quality Commission (CQC) enact practices associated with the governance and quality of healthcare services. There are several institutions and organisations within Public Health England; however, each engages in practices and norms based on their institutional context and mandate. As the third objective seeks to explore the role of structural embeddedness to institutionalise new practices among actors, a critical aspect of this research relates to the collection and analysis of empirical data to examine the structural and relational features among actors who are institutionalising new practices. The empirical sites selected are five NHS hospital trusts that are partnered with the Virginia Mason Institute (VMI) to introduce and integrate the Lean methodology (See Section 3.2.1 for more details) within these organisations, where new practices are expected to enhance the quality and provision of patient care, generate operational efficiencies and to create a culture of continuous improvement. This empirical setting is an

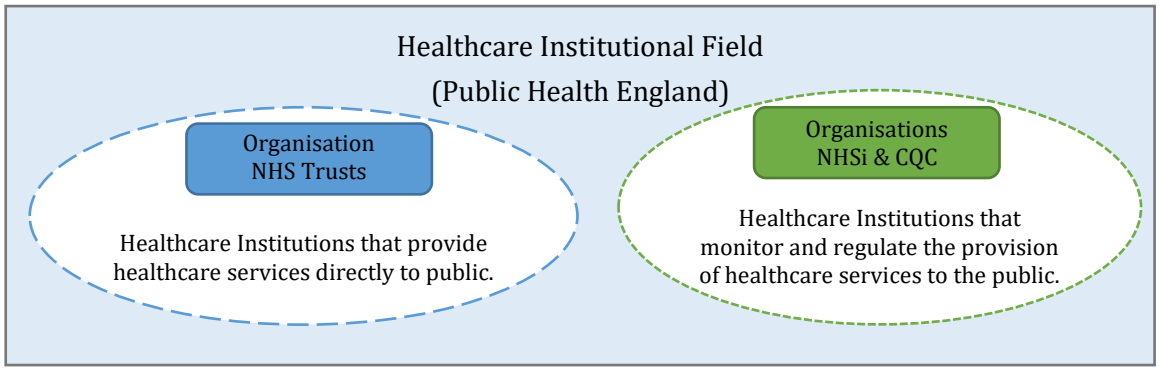


Figure 5: Healthcare Institutions & Field

appropriate context for examining embeddedness and institutional practices for three key reasons. First, healthcare is dominated by clinical professionalism and is deemed a highly institutionalised setting, which fits this study's theoretical basis. Second, this method and new practices deviate from the conventional approaches to daily work within these organisations, thereby indicating an institutional change initiative. Third, this initiative's nature is actively geared towards making functional, operational and cultural changes that we acknowledge are socially influenced. Therefore, data gathered from relevant professionals in these organisations qualify as appropriate for this research.

3.2 The NHS–VMI Partnership & the Virginia Mason Production System (VMPS)

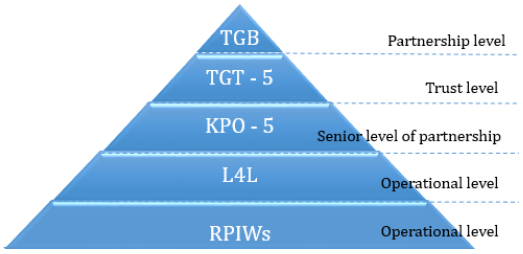


Figure 6: Partnership Structure

This study is aligned with a broader research initiative that seeks to evaluate the impact of the Virginia Mason Production System (VMPS) in five NHS hospital trusts. In 2015, a partnership between the NHS Improvement (NHSi), the Virginia Mason Institute (VMI) and the five hospital trusts was established to develop a culture of continuous improvement, to enhance the organisational culture and quality and efficiency of healthcare services within each trust (Health Foundation, 2018). The five-year partnership aimed to integrate the Virginia Mason Production System (VMPS) within each organisation to reduce waste, create efficiencies, and improve general performance. The Virginia Mason Institute (VMI) specializes in a healthcare management system that promotes lean principles, developed from Toyota's Production System (VMI, 2019). The VMPS is a lean management method that aims to change practices through small, incremental changes within the work environment that are consistently applied and sustained over long periods. These changes support continuous improvements that typically enhance the quality and

safety of care for patients, reduce practitioners' workload, and reduce the cost of providing healthcare for organisations (VMI, 2019). This initiative intended to provide healthcare professionals with new knowledge, tools and approaches to healthcare provision, which essentially challenged the existing norms, practices and approach to daily work within their respective organisations.

The empirical context comprises seven different organisations and is formally organized into five distinct levels or hierarchical groups (Figure 6). The Transformation Guiding Board (TGB) is an inter-organisational group comprised of five chief executives and senior members from the Virginia Mason Institute (VMI) and NHS Improvement (NHSI). The VMI provide training and guidance regarding the implementation of Lean within a healthcare context, whereas NHSI moderates the relationship between VMI and the five organisations. Strategic partnership decisions are made at the TGB level to determine improvement plans and track improvement progress across the five organisations. The Trust Guiding Team (TGT) is an organisational group comprised of the chief executives of each trust, the Kaizen Promotion Office Lead (KPO Lead) and other senior trust members and directors. The TGT strategically align improvement plans and formal training that are translated to the Kaizen Promotion Office (KPO), which are the implementation teams that oversee the improvement work's execution. The KPO has many duties, one of which involves training organisational leaders in the Lean methodology. These Lean for Leaders (L4Ls) are expected to apply and share the new methods, knowledge and practices, with the expectation of creating a culture of learning and change that leads to efficiencies and savings within their work environments. The rapid process improvement workshops (RPIWs) refer to the specific improvement initiatives identified from the value stream mapping process, where specific interventions are suggested and initiated within a five-day period and then tracked over time, for example, ninety (90) days. These workshops focus on restructuring processes, implementing changes, and monitoring progress to determine whether the interventions contributed to enhancing the patient experience and simplifying healthcare professionals' daily work. The L4Ls and RPIWs collectively mobilize teams to eliminate delays, redundancies, errors and waste within the healthcare delivery process by applying the Virginia Mason Production System (VMPS).

According to Virginia Mason (2019), adopting the VMPS requires “a paradigm shift from expecting errors and defects, to believing that the perfect patient experience is possible” (VMI, 2019). These changes require engagement at all levels within the organisation by rethinking current practices, deviating from established norms and employing new practices. The NHS–VMI partnership acts as an institutional change initiative, as it has three key features. First, it takes place over a long period (Hargrave & Van De Ven, 2006); second, it involves the introduction of

new practices and routines that deviate from established norms (Smets et al., 2018). Third, it requires a critical number of actors to make a multilateral departure from established patterns and norms towards a wider contextual change (Seo & Creed, 2002). Over time, new practices' institutionalisation is expected to change the organisation's frames, norms, practices, quality, or state. If there is a considerable difference compared to the organisation's initial state, institutional change has occurred (Hargrave & Van De Ven, 2006; Lounsbury & Crumley, 2007).

The NHS–VMI partnership transpired over five years within each of the five organisations. Similarly, complex initiatives ensued involving different professional groups to realize the partnership's local and system-wide goals. These initiatives engender institutionalisation since new practices are not yet fully embedded within the entire organisation. As a result, the healthcare professionals within each organisation interact and share knowledge about the Lean methodology to increase its acceptance and institutionalisation within their respective work environments. Therefore, this setting is a suitable empirical context to examine professionals' structural embeddedness to institutionalise new practices in organisations. This study focuses on the five NHS Trusts and the TGT, KPO, L4L and RPIW levels of the partnership within each organisation to narrow this context's scope due to this partnership's complex nature.

3.2.1 Improvement Progress

The five NHS trusts that are adopting and implementing these new practices to make long-term changes and sustainable improvements are anonymised to protect organisations' and individuals' identities and reputations. Henceforth, they are referred to as NHS-A, NHS-D, NHS-C, NHS-K and NHS-E. These organisations vary in terms of their technical and leadership training progress and their overall performance. First, there are varying degrees of progress in implementing the Lean improvement method within each organisation. In this context, the value stream is used to visual and delimit specific steps within a process that makes up a patient's journey and the rapid process improvement workshops (RPIWs) refer to the improvement initiatives identified from the value stream. In these workshops, specific interventions are suggested and implemented within a five-day period and then tracked over time. These measures in Table 1 indicate attempts to implement and conduct improvement work, not the quality, standard or outcome of these initiatives.

Table 1: Progress with Implementing the Lean Improvement Method

Progress with Lean Improvement Method (December 2015 – July 2019)					
	NHS-A	**NHS-D**	**NHS-C**	**NHS-K**	**NHS-E**
No. of Value streams	6	5	5	4	8
No. of RPIWs	23	21	16	12	38
No. of L4L Training	218	205	155	103	114
No. of Staff	4450	17000	8700	6500	5000
% of Staff as L4L	5%	1%	2%	2%	2%

3.3 Alignment of Empirical Setting & Theoretical Framework

After establishing the research's empirical setting, much consideration must be given to the empirical sites and the research's theoretical context to demonstrate their alignment. Based on the previous discussion, this section will identify some synergies that support the endorsement of this empirical setting as an appropriate context of study for this research. The healthcare field is a diverse, multi-professional context where patterns of interactions among professionals have become a prominent issue for delivering care, managing operations, improving safety and other related outcomes (Tasselli, 2014). In general, healthcare settings are seen as highly institutionalised settings where social actors create, enact and reproduce different roles, responsibilities and practices associated with medical professionalism (Battilana & Casciaro, 2012). Therefore, varying role divisions among professional groups increase or decrease the likelihood of interactions among actors (Scott et al., 2000). This distinction plays a key role in understanding embeddedness since social and professional networks influence collective interpretations more deeply than individual actors (Beckert, 2010a). This setting is important as healthcare professionals, in their initial training and daily practice, develop normative and social networks that guide their professions' norms and stable conduct (Scott et al., 2000). Additionally, institutions are generally defined as exceedingly resilient social structures composed of "cultural-cognitive, normative, and regulative elements that, together with associated activities and resources, provide stability and meaning to social life" (Scott, 2014, p. 56).

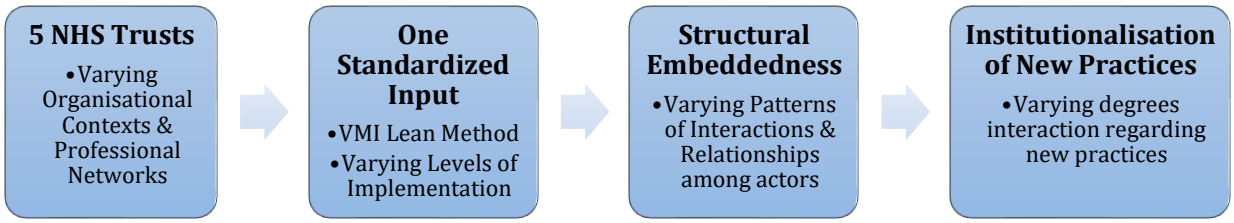


Figure 7: Link between Research Setting and Theoretical Framework

It was well established that institutions' formation and existence depend on social interaction, where institutions are seen as relational systems and carriers that rely on patterned interactions connected to social positions and role systems (Scott, 2003, 2014). Equally, organisations and institutional fields emerge from recurring and enduring patterns of social interactions when active participants define and embed the "mutual understandings and common practices that characterize the institutional environment" (Pacheco et al., 2010, p. 987). As such, sustained interactions among professionals developed networks are imbued with shared understandings and produce norms that define social action within institutional arrangements (Berger & Luckmann, 1966; DiMaggio & Powell, 1983).

Based on this understanding, social and professional networks were considered core components of DiMaggio and Powell's (1983) notion of an organisational field. Networks are relational

structures constructed by patterns of interactions, which produce complex webs of relationships, affiliations and positions among the actors within an organisational and institutional field (Simmel, 1955; Kilduff & Tsai, 2003; Godwyn & Gittell, 2012; Powell & Oberg, 2018). DiMaggio and Powell (1983) also reasoned that the professional networks contributed to the development of organisational fields through "increased interaction among participants; the development of well-defined status orders and patterns of collaboration; heightened information sharing; and mutual awareness and responsiveness" (Owen-smith & Powell, 2008, p. 597). Powell and Oberg (2018) further emphasized that each of these four processes is intrinsically relational, since "*increased interaction among participants is facilitated by societal rules that smooth the establishing and deepening of social relationships; status orders emerge from vertical relationships, whereas coalitions are formed by horizontal relationships; information is shared within already established relationships, and awareness and responsiveness are bi-directional ties of mutual recognition and observation*" (Page 3). Similarly, White and Mohr (2008) also assert that by framing institutions as relational structures, social networks become a tool to model institutions.

Accordingly, some fundamental connections are made. First, if institutions are relational, they reflect patterns of interaction over time within a professional context (Scott, 2003; Garcelon, 2010), then professional networks reflect active forms of engagement, where knowledge, practice and shared understanding circulate and become embedded among actors. Second, if professional networks are made up of practitioners who embody practices and the widely shared understandings of institutions, then relational ties function as institutional carriers that offer exposure to and transport practices over time, space, and organisational settings (Scott, 2003; Raffaelli & Glynn, 2014). Similarly, if practitioners are carriers of institutions (Smets et al., 2012, 2018), then professional networks and the relationships between them would promote the acceptance, legitimacy and normative justification of practices (DiMaggio & Powell, 1983; Smets et al., 2012; Raffaelli & Glynn, 2014; Gray et al., 2015).

3.4 Research Context Summary

According to Scott et al. (2000), an institutional change initiative is signalled when organisational actors engage in new practices that are not widely accepted or embedded within their institutional field. In this case, the research context is aligned with British healthcare professionals in distinct professional groups being trained in a Japanese-inspired, US-based healthcare management system. The L4L training emphasizes professionals leading continuous lean improvements in their departments and direct work environments. In contrast, the rapid process improvement workshops (RPIWs) focus on restructuring processes, implementing changes, and monitoring progress to determine whether the interventions contributed to enhancing the patient experience and simplifying healthcare professionals' daily work. These

interventions involve collectively mobilising healthcare professionals to eliminate delays, redundancies, errors, and waste within the delivery process. As such, these activities indicate deviations from the practice-based norms of their organisations.

Generally, diverse organisational actors function as carriers and enactors of institutional practices. Diverse actors encompass differing ways of knowing and doing within the same organisational culture and institutional environment (Lindkvist, 2005; Evans & Scarbrough, 2014). Further, the healthcare environment consists of actors with multiple, institutionally derived identities embedded within multiple normative domains and are subject to different governing cultural and institutional spheres (Kraatz & Block, 2008). These organisational actors produce professional networks developed through the interactions and relationships of individuals who mimic and modify practices in their everyday interactions. Therefore, relationships among actors play a vital role in determining the utility and acceptance of emerging practices (Reay et al., 2006; Smets et al., 2012, p. 899; Raffaelli & Glynn, 2014). Thus, this multi-professional institutional setting adds another layer of complexity which complicates relational mechanisms and institutionalising new practices among actors. Ultimately, the NHS, a highly institutionalised medical context, provides an appropriate setting to draw on healthcare professionals' social networks to explore structural embeddedness and its association with the institutionalisation of new practices.

The following chapter, Chapter 4: Research Methodology, outlines the research philosophy, design, data collection, analysis and other relevant methodological considerations. These sections are detailed to answer the research question and address the third research objective, which explores the role of structural embeddedness within each of the five organisations.

Blank Page

Chapter 4: Research Methodology

4.1 Introduction

This research study has four inter-related objectives that seek to understand the role of embeddedness and the institutionalisation of new practices within an organisational context:

1. *Clarify* and discuss the importance of embeddedness with regards to micro-institutional change.
2. *Critically evaluate* the notion of embeddedness from a social network perspective to understand the institutionalisation of new practices within an organisational context.
3. *Explore* the role of structural and institutional embeddedness with respect to the institutionalisation of new practices among institutional actors.
4. *Advance* institutional perspectives by illustrating the role of embeddedness with respect to the institutionalisation of new practices in organisations.

The first and second objectives are addressed in Chapter 2, the literature review, which explicates the linkages between embeddedness and the institutionalisation of new practices and recognises some theoretical inconsistencies. The divide between institutional and social network theory has provided an opportunity to explore the synergies between these two domains and gain insight into the role of embeddedness in institutionalised settings. This alternative perspective contributes to the study of embeddedness and institutional change processes and develops a deeper understanding of embeddedness and institutions in general. Therefore, one of this work's contributions will be analysing empirical data that examines the associations between structural embeddedness of professionals' networks, based on data collected from five healthcare organisations.

The empirical sites are discussed in Chapter 3, where five NHS hospital trusts partnered with the Virginia Mason Institute (VMI) to introduce and integrate new practices within their organisations. Thus, in line with the theoretical concepts highlighted in the literature review and the alignment of these concepts to the empirical setting, data collection focused on acquiring social network data to determine healthcare professionals' structural embeddedness. By comparing theory and empirical findings, this research will shed light on the role of embeddedness within an institutional setting and specifically aim to uncover the intricacies of social embeddedness and the institutionalisation of new practices. This chapter on the research methodology provides details regarding the research strategy and design, the sample and site selection, collecting data, and the approach to analysis.

In previous studies, social network analysis (SNA) has been used to examine institutions and structures, but it was mainly used descriptively. However, recent developments in SNA, such as Exponential Random Graph Models (EGRM), have allowed researchers to take a deeper examination of networks' social structures and processes. Therefore, this method provides a more nuanced view of embeddedness, compared to centre-periphery arguments that have dominated perspectives of micro-institutional change and, consequently, the institutionalisation of new practices. Following this discussion, this chapter will address the methodological and ethical considerations of this work, including the limitations and biases that emerge from the research design and data collection decisions.

4.1.1 Philosophical View

Research methodology discussions are often accompanied by philosophical considerations to support empirical and analytical inquiry. From this perspective, the investigation process is based on ontology, epistemology and the methodology associated with researchers' assumptions about the social world (Easterby-Smith et al., 2018). Research ontology refers to the assumed nature of reality (Daniel & Harland, 2018). Epistemology refers to the most appropriate means of inquiring into the nature of that reality, and methodology refers to the collection of research-specific procedures and techniques used to inquire in a specific situation (Risjord, 2014; McIntyre & Rosenberg, 2017). These broad concepts determine and guide the research design, strategy, and overall approach to the research.

There are two main research ontologies, objectivism and constructionism, and similarly two main epistemologies, positivism and interpretivism (Rosenberg, 2016), where each has specific accompanying methodologies. Objectivism and positivism are philosophically aligned and view reality as existing externally and that its properties should be objectively measured to test theories and make predictions (Cartwright & Montuschi, 2014). This research approach applies quantitative methods to test hypotheses about the relationships between observed phenomena. Constructionism and interpretivism are also philosophically aligned and view reality as being constructed and experienced by people rather than external objects or factors (Bryman, 2012; Easterby-Smith et al., 2018). This research approach explores reality by developing qualitative accounts and descriptive theories to understand the social world (Hallebone & Priest, 2008).

Institutional research is traditionally aligned with a constructivist ontology that views the institutional reality as socially constructed based on actors' experiences. It is associated with an interpretivist epistemology where intersubjective experiences generate meanings, norms, regulations, and cultures embodied and enacted among institutional actors. Much of the traditional institutional literature regarding the institutionalisation of new practices develop qualitative accounts from ethnographic studies that verify the subjective realities and meanings

of practices among institutional actors. This work mostly produces detailed individualistic accounts to understand how roles, identities, and status among actors are associated with creating, accepting and adopting new practices (Reay et al., 2006; Lounsbury & Crumley, 2007; Smets et al., 2012).

However, taking a social network view of institutions and embeddedness promotes an alternative philosophical view as it holds social relationships among multiple social actors as the primary lens to understand institutional change processes. From a social network perspective, research on embeddedness views social actors and organisational outcomes as reciprocally influenced by their ties and relationships. Social network studies have been traditionally associated with positivist dispositions due to their focus on the mathematical tools and methods to analyse complex social relations. Opposingly, social network studies have a long sociological history that seeks to understand and explain the implications and consequences of networks among actors (Buch-Hansen, 2014). The former is aligned with a positivist approach to science, which uses research as a means to attain generalizable truths to predict future events, whereas the latter adopts a critical realist approach as it attempts to understand the social world through explanation by uncovering and examining causal mechanisms between actor's relationships and social outcomes (Bhaskar, 2008; Buch-Hansen, 2014).

4.1.2 Critical Realism & Social Network Research

Critical realism is a philosophical perspective in social research that falls between positivism and constructionism (Fleetwood, 2014). It combines features from both positions to create "a compromise between the extreme versions of positivism and constructionism, but with greater emphasis on objectively measuring the social world" (Easterby-Smith et al., 2018, p. 80). In drawing on elements from both positions, it is flexible in terms of methodology, acknowledging both quantitative and qualitative approaches to empirical investigation (Hallebone & Priest, 2008; Kincaid, 2012). This perspective acknowledges that there is a reality independent of our thinking that science can study and assumes that reality can only be imperfectly known, as the object under investigation can never be examined with total precision (Archer, 2013; Fleetwood, 2014). This view accepts that social life is both produced by and influenced by the actions of individuals and also provides a more balanced approach to examining social problems, as it assumes that specific features of the social world such as power, class or wealth exist within our social reality and have varying effects whether they are observed or not (Easterby-Smith et al., 2018).

A critical realist perspective supports empirical investigation where concepts in theories are linked to observable phenomena so that expectations and hypotheses are testable using quantitative methods (Miller, 2002). This approach encourages different approaches to gather

and analyse data to gain a more comprehensive understanding of the phenomena under investigation. Based on this understanding, a critical realist view recognizes that all observations and measurements are prone to different types of errors and biases and is, therefore, emphasizes the importance of multiple measures and indicators to gain a better understanding of reality (Hallebone & Priest, 2008; McIntyre & Rosenberg, 2017). This approach also increases certainty in findings and strengthens explanatory theories that are developed from this research approach.

Traditionally, social network concepts and theories map and analyse structures that shape the social world. This methodological approach is based on the assumption that relationships among interacting units hold some importance in explaining the social world (Wasserman & Faust, 1994). As such, "*critical realism ascribes considerable importance to social structures and relations in the explanation of events and other phenomena in the social world*" (Buch-Hansen, 2014, p. 307). Critical realism, embeddedness, and social network concepts coincide as this philosophical perspective acknowledges that "*pre-existing social structures constrain and facilitate agency and are subsequently reproduced or transformed through social interactions (Archer, 1995: 196; Bhaskar, 1979: 35)" and "the network approach investigates the constraining and enabling dimensions of patterned relationships among social actors within a system" (Emirbayer & Goodwin, 1994: 1418; see also Haines, 1988: 176 and Wetherell, 1998: 126)* (Buch-Hansen, 2014, p. 315). Consequently, social relationships become the primary unit of analysis to explain social structures and interactions among actors, and greater emphasis is placed on the social-theoretical nature and importance of networks and their consequences regarding the embeddedness of actors.

Research Philosophy: Critical Realism

- *Combines features from both positivism & interpretivism.*
- *Accepts both quantitative and qualitative methodologies.*
- *Aligned with social network and embeddedness perspectives.*
- *Accepts that social connections and relationships can be the primary means of interpreting the social and organisational worlds.*
- *Accepts that quantitative methods can be used to understand relationships and draw conclusions about the social world.*

Figure 8: Research Philosophy - Critical Realism Summary

Social network research rests on the theoretical claim that actor and organisational outcomes are influenced by the structure of relationships and interdependence among actors. By taking a social network perspective, this research assumes that actors are connected in many ways, and outcomes are associated with their relatedness. Consequently, this work's methodological

premise is based on examining the link between actors' relationships and network structures and introducing new practices within an institutional context. This premise suggests a relational view where the relationships among actors influence the institutionalisation of practices. Likewise, it also suggests that by focusing on networks, we view social connections and relationships as the primary means of interpreting the social world. Overall, a critical realist approach complements the social network perspective as we can apply quantitative methods to understand social relationships and draw conclusions about the social processes in organisations.

4.2 Social Network Research Strategy & Design

4.2.1 Research Design

This research employs a social network research design based on the theoretical and methodological orientation of this work. There are two main types of social network research designs: whole network designs and ego-centric network designs (Hanneman & Riddle, 2005; Borgatti et al., 2013). In a whole network design, the relationships among all the actors within a given group are captured and examined. However, in an egocentric network design, only the relationships among specific actors are captured and examined. Ego-network designs are better suited for large-scale studies since capturing several egocentric networks allows researchers to construct the network's key features reliably. Similarly, a whole network design requires full knowledge and data collection from all actors within a well-defined group; however, this was not feasible due to the organisation sizes in this research context.

This research adopts an egocentric network design as it was most appropriate to sample network data from large organisational networks by asking participants to self-report their networks and describe their relationships with their most important contacts. An egocentric network design is a *non-experimental quantitative research design*; however, this study is also *cross-sectional* and *comparative*. It is quantitative as it applies a standardized network analytic methodology to systematically examine the nature and structure of social relationships from local and global perspectives (Wasserman & Faust, 1994). It is cross-sectional as it collects a large sample of quantifiable data from a predetermined population of interest at a single period (Bryman, 2012). This design is standard as it determines the prevalence of an issue, attitude, or behaviour, provides a snapshot of a subject at a specific point in time (Kumar, 2011) and allows multiple concepts to be simultaneously measured to examine the underlying relationships and relevant patterns of association between them (Novikov & Novikov, 2013; Easterby-Smith et al., 2018).

Finally, this work is bolstered by a comparative design as it applies identical methods, instruments and analysis to examine multiple sites. This approach is used to develop more robust explanations, as it highlights parallels and differences between sites to gain a deeper understanding of the social reality in different organisational contexts (Jupp, 2006; Bryman,

2012). While making comparisons across different contexts is beneficial for theorizing, it is also advantageous to garner more accurate and generalizable findings (Marczyk et al., 2005; Kumar, 2011; Bryman & Bell, 2015). These sites were purposively sampled due to their theoretical and practical relevance for the institutionalisation of new practices within an organisational context. In summary, this research has a non-experimental quantitative research design. It adopts a cross-sectional survey research design to gather data and employs a comparative approach to identify similarities and differences across sites. After determining the social network research design, two steps must be satisfied before data is collected and analysed. The first step entails boundary specification, which refers to determining which specific actors are included in the networks of interest (Laumann et al., 1983; Wasserman & Faust, 1994). The second step is to clearly define the sampling strategy after the network boundary is specified.

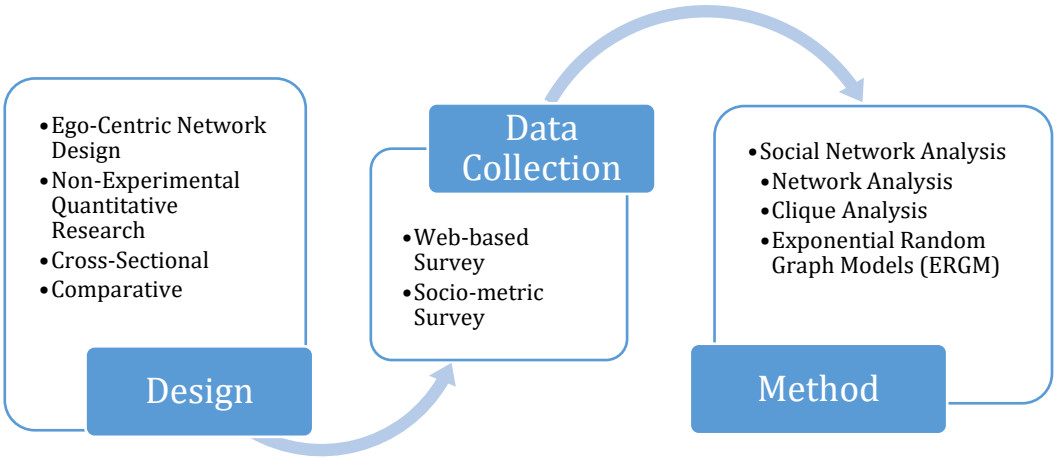


Figure 9: Research Design Summary

4.2.2 Boundary Specification

Network boundary specification is critical to capture the relevant network, and it has two implications. The first determines the potential actors relevant to the study, and the second defines the content or nature of the relationship between these actors. In this context, the relevant actor sets include the persons directly involved with the institutionalisation of new practices within each organisation. The network boundary was specified to include members from the four organisational levels of the partnership TGT, KPO, L4Ls and RPIWs. The TGB level was excluded as this is the inter-organizational level of the partnership. After defining the network boundary, either a realist or nominalist specification approach must be selected. The nominalist approach uses phenomena of interest, such as specific groups or industries, to define actor boundaries, whereas the realist approach relies on actors' perceived networks to define actor boundaries. This research adopts a realist approach to capture actor networks at the TGT, KPO and L4Ls levels since it is the more widely used method when gathering data from large networks at the

interpersonal level (Carpenter et al., 2012). In this approach, actors are directly asked by an interview or survey with whom they interact regarding a specific activity (Ibarra, 1992). For example, when measuring advice networks, a researcher would ask the respondent, "Who do you go to for advice about work matters?" These types of questions are used to determine network boundaries.

4.2.3 Sociometric Sampling Strategy

Next, socio-metric sampling strategies need to be selected after network boundaries have been identified and specified. In social network research, the sampling method is associated with how actors groups are known. For example, simple random sampling and opportunity sampling are based on information availability, especially when predetermined actors sets and categories are mostly unknown or undefined (Arora et al., 2012; Carpenter et al., 2012). Socio-centric sampling methods are used when well-defined actor sets already exist; in this case, whole network designs can be conducted by providing actors with a complete roster of members to specify their relationship with other actors (Provan et al., 2007; Kelley et al., 2011). In comparison, when studies require well-defined network boundaries but do not have well-defined actors sets, egocentric sampling methods are adopted.

This research adopts an egocentric sampling strategy to gather data from the actors within each organisation. This strategy is a purposive, non-probabilistic form of sampling since the sample's inclusion and exclusion criteria are well defined, and persons who met the inclusion criteria are included in the sample (Bethlehem, 2009; Fink, 2017). In this case, although well-defined group boundaries exist at the TGT, KPO and L4L levels, egocentric sampling methods were used to capture the relationships of persons engaged in improvement work in an organisational context rather than relationships within the context of the partnership. This sample includes clinical and non-clinical healthcare professionals at all levels of the partnership in each organisation, including senior executives, clinical managers, consultants, matrons, nurses, pharmacists, radiologists, dieticians, physiotherapists and non-clinical management professionals. This approach allows the most appropriate participants directly involved in the training and application of the Lean Methodology to be selected to gather the most suitable sources of information. Most suitable actor networks can be constructed to achieve the research objectives (Kumar, 2011). In summary, this research applies a realist approaches to boundary specification and adopts an egocentric and purposive sampling strategy to capture the relevant networks.

4.3 Social Network Data Collection

Structural Embeddedness is conventionally examined via social network data, allowing researchers to capture connections and dependencies among related actors or entities (Scott, 2012). Network research requires sociometric data conduct analysis, where sociometry is a method for measuring and assessing the relationship between units (Gozzo & Tomaselli, 2017). In line with the critical realist perspective that permits data collection from multiple sources, this study used two self-reporting instruments to collect social network data to measure structural embeddedness and collect actor attribute data to measure actor-relation effects within each organisation. The first approach was to gather social network data from the KPO & TGT via a paper-based socio-metric survey, and the second approach was administered via a web-based survey that captured L4L ego-networks and attributes data. Network self-report instruments are a ubiquitous and reliable method of network data collection as they can consistently and systematically capture instrumental and expressive ties and describe the patterns of relationships (Wasserman & Faust, 1994; Carpenter et al., 2012; Scott, 2012). By asking persons whom they talk to and collaborate with regarding improvement work, data is gathered based on contacts. Next, a network of relationships is constructed through graph theory based on their responses. Further, to maintain consistency and bolster the comparative framework, the same survey was administered to each organisation's respondents.

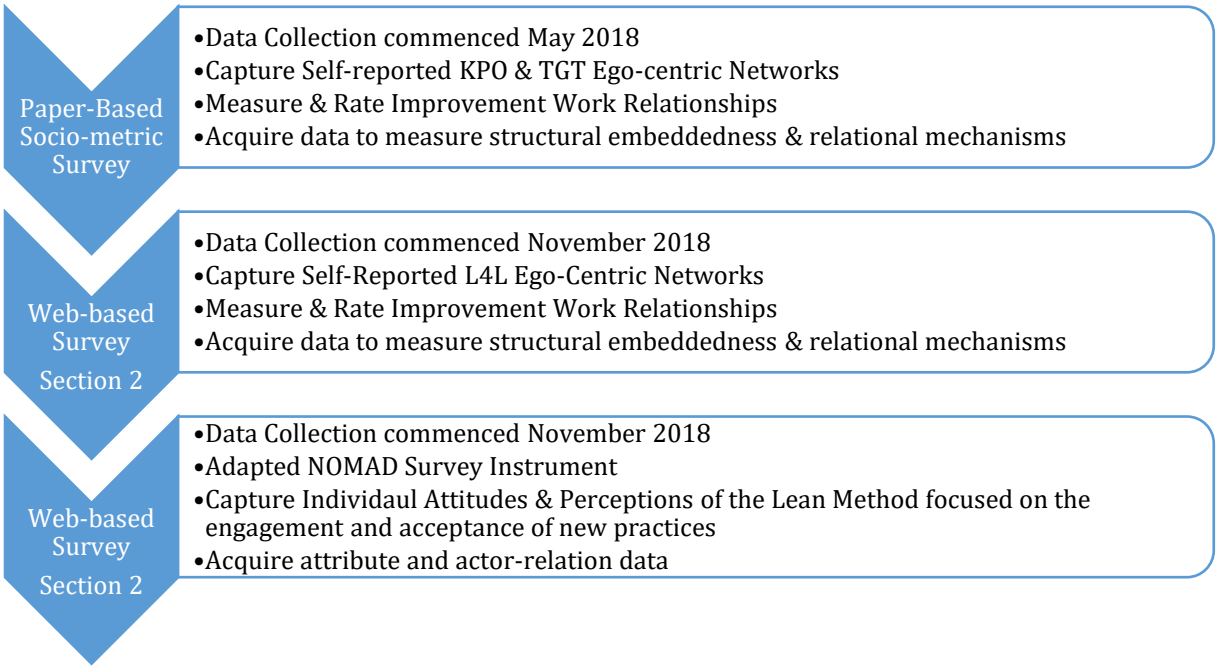


Figure 10: Data Collection Methods Summary

4.3.1 Paper-based Socio-metric Survey

In May 2018, a paper-based sociometric survey was designed and administered to members of each organisation's TGT and KPOs at the end of each interview (See Appendix B1). The five-

question self-reporting survey instrument allowed respondents to list and rate the relationships of a maximum of 10 persons with whom they share knowledge about improvement work. The survey instrument was designed using the method discussed by White et al. (2014, 2016), where a 5-point Likert scale is used to measure the subjective evaluations of relationships among actors. This instrument's use in previous studied contributes to the items' validity and robustness and has been used as the standard approach for sociometric survey data collection (Ibarra, 1992; Ibarra & Andrews, 1993; Morrison, 2002; Moran, 2005). This survey asked persons to list the name, role and organisation of at least five persons who are in some way involved in their improvement work regularly. To capture the quality of instrumental and expressive relationships, respondents were asked persons to rate these relationships on a "Strongly Disagree – Strongly Agree" five-point scale (See Table 2). Although the TGT and KPO are not practising clinicians, they play a critical role in training, planning, and strategically integrating the organisation's lean methodology. They were key actors within the network and needed to be included when considering actors' embeddedness and new practices' institutionalisation.

Table 2: Paper-Based Sociometric Survey Questions

Survey Question	Measures
Q1: I am aware of this person's areas of expertise and so understand which aspects of improvement work they can help me with	Instrumental Tie Knowledge-Based Relationship
Q2: This person provides me with information or advice with regards to improvement work	Advice Provision Informal Instrumental Tie
Q3: I feel personally comfortable asking this person for information or advice	Advice Seeking Informal Instrumental Tie
Q4: This person is influential with regards to improvement work issues	Perceived Social Influence Expressive Tie
Q5: I trust this person enough to talk freely to them about improvement work matters	Expressive Tie Trust-Based Relationship

4.3.2 Web-based Lean for Leaders (L4L) Survey

In November 2018, the web-based survey was administered via Qualtrics to the Lean for Leaders (L4Ls) level of the network with the dual purpose of capturing their attitudes and perceptions regarding the Lean Methodology and their knowledge-sharing networks, as they were the actors trained to use the Lean Methodology in their daily work. In terms of the population, the L4L represents healthcare professionals from various levels and backgrounds within each organisation, including non-clinical and non-managerial roles. This web-based survey was divided into two parts, where section 1 collected individual psychometric and attribute data of the Lean for Leaders (L4L), and section 2 collected socio-metric data via a web-based self-reporting survey instrument with the same questions as the paper-based survey instrument.

Web-based surveys are considered to be among the most useful methods to study improvement initiatives among healthcare professionals due to the measurement and operationalization of variables and the content or number of persons involved (Portela et al., 2015; Kaltenbrunner et al., 2017; Goodridge et al., 2018). This survey method of data collection is more commonly used to collect data from a large quantity from a large number of respondents (Bryman & Bell, 2015). In this case, a website link is sent to each potential participant, the respondent would complete the survey, and the responses were automatically stored and updated in a database for analysis. Compared to interviews, direct observation or medical record reviews, it allows researchers to systematically and quantitatively capture participants' various opinions in a structured and well-organised manner.

A standard survey research design was used as the specific method to collect data from each organisation, and this is a type of cross-sectional design where data is collected by questionnaires (Bryman, 2012; Rea & Parker, 2014). This approach is traditionally aligned to a positivist epistemology that assumes that consistent and verifiable patterns in human and organisational behaviour exist that can be objectively but, incompletely, measured to explain observed phenomena (Fink, 2017; Easterby-Smith et al., 2018). It is a systematic approach to data collection where questions are developed from and aligned with theoretical concepts, which are operationalized into quantitative variables. This approach supports the exploration, description, correlation or statistical inference of different types of constructs and variables (Groves et al., 2009). Organisational surveys are commonly used as tools for assessment and change, as they facilitate the collection of opinions and attitudes about the organisation, which is used to develop recommendations to stimulate change and improvements (Kraut, 1996).

Accordingly, the L4L survey instrument was designed to survey the L4Ls across the five organisations (See Appendix B4). In total, the survey has thirty-five (35) questions and sixty-nine (69) items, with a combination of closed-ended, multiple selections and written responses. The survey was divided into two main sections, where Section 1 included questions 1 to 31. The second section was designed in a socio-metric survey format. It captured social network data to measure structural embeddedness and construct the supporting variables for analysis. Section 1 of the survey required respondents to complete each question before moving on to another subsection, whereas section 2 was not mandatory, and respondents could complete the social network section at their discretion. The questions in section 1 had an individual focus and were used to capture the study's actor attribute data, such as respondents' past lean experience, the application and impact of their training, and colleagues' interest and engagement with training (See Appendix C1).

4.3.2.1 *Section 2 Sociometric Survey*

In section 2, respondents were similarly asked to name or list the initials of up to five persons they work with and talk to about improvement work to understand how improvement knowledge and practices are spread within each organisation. Like the paper-based survey, respondents were asked to identify the roles and organisation of each person identified. This web-based survey used the same five questions from the paper-based survey and included three additional questions (See Table 3). To capture these relationships' quality, we asked persons to rate these relationships on a "Disagree – Agree" three-point scale. The decision to change the scale from a five-point to a three-point scale was made during the survey pilot, as respondents felt the presence of the five-point scale for each question was overwhelming, cluttered and increased the likelihood of respondents leaving the survey incomplete. In this data collection mode, the L4L respondents were actively engaged in applying the Lean Methodology in their daily work and environment, whereas persons at the TGT and KPO level have a more strategic and administrative role in guiding improvement work. In contrast to the paper-based survey, these respondents apply new knowledge and practices and share with colleagues, rather than being responsible for training or the strategic aspects of the Lean methodology within each organisation.

Table 3: Web-based Survey Socio-metric Survey Additional Questions

Web-Based Social Network Survey Questions	Measures
Q1: We have worked together prior to L4L – Yes or No	New Relationships
Q2: We mainly communicate – In-person, By Email, Via Messenger etc.	Mode of Communication
Q3: This person and I have similar ideas, goals and objectives regarding the implementation of Lean principles.	Expressive Shared Understanding

4.3.2.2 *Organisational Social Network Data*

The survey was piloted in NHS-C in November 2018 by twenty (20) L4Ls and was adjusted based on their feedback. The pilot respondents indicated that they understood most of the questions, and few changes were made to the wording of questions and the sociometric section, part B of the survey (See Appendix B4). After the feedback was considered and incorporated, the survey was administered via a WBS-licensed version of Qualtrics, an industry leader in survey software solutions. The final survey was sent to 765 persons across the five organisations, collaborating with the KPO teams at each organisation (See Table 5). Consent to participate in the study was made explicit, as respondents could not begin the survey without approving their involvement in the study. The survey was active from November 22nd until December 14th, 2018 and reminder emails were sent two (2) weeks following the initial invitations (See Appendix B2-3). During this time, 333 persons clicked the survey link giving a click-through rate of 44%, 319 persons started

the survey, giving a response rate of 42%, and 271 persons completed the entire survey giving a completion rate of 85% (See Table 4). Overall, 300 responses were retained for analysis.

Table 4: Survey Click-Through Rate, Response Rate & Completion Rate

Survey Click-Through Rate, Response Rate & Completion Rate			
No of Persons who Clicked Survey Link	333	Click-Through Rate (CTR)	44%
No of Persons who Started Survey	319	Response Rate	42%
No Surveys Completed	271	Completion Rate	85%

Table 5: Social Network Data Collection

Network Data Collected	**NHS-A**	**NHS-D**	**NHS-C**	**NHS-K**	**NHS-E**	**Total**
Web-based Survey (L4L Respondents)	80	54	47	28	51	260
Paper-based Survey – (TGT, TGB, KPO)	14	16	20	21	16	87
Total	**94**	**70**	**67**	**49**	**67**	**347**
No. Of Collaborators Identified (No. Actors in each Network)	**247**	**181**	**167**	**133**	**187**	**915**
Average Number of Collaborators	2.6	2.6	2.5	2.7	2.8	
Actor-Relation Measures						
No. Survey Invitations Sent	198	195	155	103	114	**765**
Survey Responses	96	64	58	39	62	**319**
Survey Data Retained	91	60	56	32	61	300
Survey Response Rate	48%	33%	37%	38%	54%	42%

The web-based socio-metric survey gathered 260 responses: 28 responses were collected from NHS-K, 47 from NHS-C, 51 from NHS-E, 54 from NHS-D and 80 were collected from NHS-A. In the paper-based survey, a total of 87 ego-centric networks were captured across the trusts. For each organisation, 21 ego-centric networks were collected from NHS-K, 20 were collected from NHS-C, 16 were collected from NHS-E & NHS-D, and 14 were collected from NHS-A. Three hundred forty-seven (347) ego-centric networks were collected across the organisations, and 915 collaborators were identified. Table 5 also provides a breakdown of the total number of actors within each organisational network and the average number of collaborators identified within the organisation. NHS-D and NHS-A both have an average of 2.6, NHS-E has an average of 2.8 collaborators, NHS-K has an average of 2.7 collaborators, and NHS-C has an average of 2.5 collaborators. Actor-attribute data was only acquired from the respondents and not the collaborators who would have been nominated. As such, only one-third of the network data has associated attribute data. This missing data issue is addressed in section 4.7 Methodological Considerations & Limitations and is common in network research since the persons nominated as collaborators are only identified after data collection.

4.4 Improvement Progress & Performance Measures

To assess the relative improvement progress and performance of each network and organisation, secondary data was acquired from each of the five organisations.

4.4.1 Improvement Progress

To assess the relative improvement progress of each organisation, lists and reports of all attempted and completed change initiatives were gathered and reviewed. In the initial stages, there were attempts to organise this data to develop objective standards of progress, however, most reports were measured and recorded inconsistently, therefore, this approach was abandoned. As each organisation had the same improvement resources, counts of the number of completed value streams and RPIWs were used to measure and assess the relative progress of each organisation.

Since the beginning of the partnership in 2015 and until July 2019, NHS-A had six (6) value streams and twenty-three (23) RPIWs that focused on early identification of sepsis, early detection of inpatient diarrhoea and improving processes of outpatient bookings and administration, cancer diagnosis and discharge planning. NHS-D had five (5) value streams and twenty-one (21) RPIWs that focused on orthopaedic and surgical assessment, patient preparation, patient flow and administration. NHS-C had five (5) value streams and sixteen (16) RPIWS, and they conducted improvement work in areas of patient safety, surgical assessment, theatres and discharge planning. NHS-K had four (4) value streams and had initiated improvement work in twelve (12) RPIWS focusing on geriatric assessment, patient safety, cancer diagnosis and discharge planning. Finally, NHS-E had the most value streams and RPIWs, likely aligning with their inadequate CQC rating, with eight (8) value streams and thirty-eight (38) RPIWs. They conducted improvement work in many areas, including sepsis, recruitment, ophthalmology and surgical pathways.

The next benchmark of progress is associated with the Lean for Leader Training in each organisation. The general training included six (6) modules and accompanying assignments, where L4Ls were expected to use the Lean method to make micro-level improvements within their work environment. The training focuses on fostering a culture of continuous improvement to enhance patient safety and care by minimizing waste in operational processes. One of the key benefits of the training is that it allows professionals at any level in the organisations to more easily initiate improvements and engage others to implement improvements within their work environment. Regarding Lean for Leader Training, NHS-A made the most progress in training 5% of their staff to be L4Ls, whereas NHS-K, NHS-E and NHS-C each trained 2% of their staff to be L4Ls. Finally, due to their large organisation population of over 17,000, NHS-D trained approximately 1% of its staff. Further organisational characteristics are described in Appendix A.

It was revealed that NHS-A and NHS-D had average progress regarding the number of value streams and RPIWs and above-average progress regarding the number of L4Ls trained. NHS-E have above-average progress in terms of value streams and RPIWs progress, but below-average progress in terms of the number of L4Ls trained, and NHS-C and NHS-K had below-average progress overall.

Table 6: Improvement Work Progress Standardised

Progress with Lean Improvement Method Standardised							
	NHS-A	**NHS-D**	**NHS-C**	**NHS-K**	**NHS-E**	**Mean**	**SD**
No. of Value streams	6	5	5	4	8		
No. of RPIWs	23	21	16	12	38		
Average No. of RPIWs in Value Stream	3.83	4.20	3.20	3.00	4.75	3.80	0.64
Average No. of RPIWs Standardised	0.06	0.63	-0.93	-1.24	1.48		
Relative Progress	**Average**	**Average**	**Below Average**	**Below Average**	**Above Average**		
No. of L4L Training	218	205	155	103	114	159	46.42
No. of L4L Training Standardised	1.27	0.99	-0.09	-1.21	-0.97		
Relative Progress	**Above Average**	**Above Average**	**Below Average**	**Below Average**	**Below Average**		

Once again since each organisation had the same improvement resources, progress was standardised to determine each organisation's progress compared to the average progress (See Table 6). As RPIWs are part of value streams, the average number of RPIWs in each value stream was calculated, and then the mean and standard deviation for the five organisations was calculated. NHS-A (0.06) and NHS-D (0.63) had standardised values that were very close to the mean, indicating that they had average progress. NHS-E's (1.48) standardised value was greater than one standard deviation above the mean, indicating above-average progress. NHS-C (-0.93) is close to one standard deviation below the mean, and NHS-K (-1.24) is greater than one standard deviation below the mean, indicating that both have below-average RPIW progress. The same procedure was applied to the number of L4Ls trained. The results revealed that NHS-A (1.27) and NHS-D (0.99) had above-average progress, whereas, NHS-C (-0.09), NHS-K (-1.21) and NHS-E (-0.97) had below-average progress. In this case, NHS-C's progress was closest to the mean; however, NHS-K and NHS-E are greater than or almost one standard deviation below the mean. Overall, NHS-A and NHS-D have similar progress at or above-average, whereas NHS-C and NHS-K have below-average progress for RPIWs and L4L training. NHS-E's progress varies as they have above-average progress for RPIWs and value streams and below-average performance for L4L training.

4.4.2 Organisational Performance

Table 7: Organisational Performance Summary

Organisational Performance: CQC Ratings					
Safe	Good	Requires improvement	Good	Requires improvement	Inadequate
Effective	Good	Good	Good	Good	Requires improvement
Caring	Outstanding	Good	Good	Good	Good
Responsive	Outstanding	Good	Requires improvement	Requires improvement	Requires improvement
Well-led	Outstanding	Good	Good	Good	Inadequate
Use of resources	Outstanding	Outstanding	Requires improvement	Requires improvement	Requires improvement
Ranked Good or Outstanding	6/6	5/6	4/6	3/6	1/6
Overall Rating	☆ **Outstanding**	**Good**	**Good**	● **Requires improvement**	● **Inadequate**

Next, to acquire a more objective view, national performance assessments were gathered and summarised from an external source and this data highlighted further performance differences among the organisations (See Table 7). The external assessment of performance was evaluated by the Care Quality Commission (CQC), an independent public body established to regulate and inspect health and adult social care services in the United Kingdom (CQC, 2020). They grade healthcare organisations at four levels across six dimensions: safety, effectiveness, care, responsiveness, leadership and use of the resources. These six dimensions produce one of four overall ratings that indicate the over-performance of the organisations. An organisation with an **Outstanding** rating performs exceptionally well, whereas an organisation with a **Good** rating performs well and meets CQC expectations. In contrast, organisations with a **Requires improvement** rating is not performing as well as it should, and the service improvements must be made, whereas an organisation with an **Inadequate** rating is performing poorly, and actions are taken against the service provider. In the CQC ratings, NHS-A has the highest grade of Outstanding, followed by NHS-D and NHS-C, which have a **Good** rating, and NHS-K and NHS-E, which have ratings of Requires Improvement and Inadequate, respectively.

Altogether, NHS-A has the highest organisational performance rating and has made the most progress in the L4L training methodology. NHS-D and NHS-C are similar in terms of performance rating and progress with the improvement method, both having a Good CQC rating and initiating work on five value streams. Next, NHS-K and NHS-E are similar in terms of L4L training; however, they differ regarding their attempts at improvement work, where NHS-E has double the number of value streams and three times as many RPIWs; however, they vary in terms of performance since NHS-E has an Inadequate rating. Overall, the five organisations vary in terms of their technical and leadership training progress and their general organisational performance.

4.5 Data Analysis: Social Network Analysis for Organisational Networks

Social network analysis (SNA) is the study of social relations among various actors, where distinctive methodologies are used to identify, capture, visualize and analyse the actors and relationships (Scott, 2017). As social network analysis is focused on understanding the structure and patterning of social relationships, mathematical and statistical models are applied to examine network structures. Social network analysis produces an alternate view of social actors and relationships since actors' relationships within the network are more important than individual attributes. Several unique patterns emerge within a network of social relationships, where each pattern has a different function and produces opportunities and constraints for actors and outcomes within the networks (Brass et al., 2004; Kilduff & Brass, 2010). Therefore, this approach is used to systematically assess the structure of a social network in terms of the connections between individual actors and the overall network structure. However, it is limited as its explanations do not leave room for individual agency and because it is primarily focused on using network structures to explain causes and outcomes (Tasselli et al., 2015). In essence, SNA is the process of mathematically and statistically examining social structures, actors, and relationships.

Since the early ’60s, SNA emerged in social research and has been used to study social interactions, groups, communication, social psychology, economics and organisational studies (Dunn, 1977; Granovetter, 1985; Kilduff, 1990; Ibarra, 1992; Kilduff & Tsai, 2003; Fang et al., 2015). In general, social network research has established that the shape, structures, and connectivity influence a network's utility for actors (Kilduff & Brass, 2010). For organisations, networks have been used to examine and explain variances in individual and overall performance (Uzzi, 1996; Burt, 2004; Rodan, 2010), knowledge sharing (Hansen, 1999; Reagans & McEvily, 2003), job satisfaction (Bizzi, 2013), leadership (Li, 2013), innovation (Valente, 1996; Vedres & Stark, 2010), creativity (Vaan et al., 2015) and several other traditional organizational outcomes (Brass et al., 2004). In terms of organisational research, it is a computational method used to theorize social and organisational phenomena (Carley, 2001, 2002), as networks provide an alternative depiction and understanding regarding the interplay of social actors, structure, and complex relationships that characterize them.

Since SNA allows researchers to simultaneously investigate phenomena by drawing on organisational sociology and social network concepts, social network structures and analysis are relevant for healthcare organisations since healthcare professionals have relationships and are connected in ways that produce varying organisational outcomes. Similarly, professional groups and relationships have also been associated with work satisfaction, leadership, change behaviour, knowledge transfer, the diffusion of innovation, and performance (West et al., 1999; Battilana & Casciaro, 2012; Tasselli, 2014, 2015). Therefore, in this research and from a theoretical

perspective, SNA can provide significant insight into the social relationships' characteristics and the network's overall structure to understand the social processes underpinning the micro-institutional change. Practically, SNA can examine the patterns and structures of relationships that connect actors and groups by revealing interesting and actionable points that may promote collaboration and knowledge sharing across the organisation. SNA examines the patterns of social relationships and the structure of the organizational networks within the NHS-VMI partnership to understand structural embeddedness concerning implementing an improvement methodology within each of the five NHS trusts.

As with traditional statistical analysis studies, univariate analysis is conducted to describe each organisational network's overall structure. In this stage, the density, centrality, size and other network measures are examined and compared across organisations. Second, to examine closure and bridging, a triad census is conducted to examine closed and open triads, cohesion, clustering and transitivity in each organisational network. Next, to simultaneously examine closure, brokering, centrality and other relational mechanisms, exponential random graph models (ERGMs) are used to identify and make statistical inferences of network structures to understand the social processes underlying the observed network structure (Lusher, Johan, et al., 2013).

In the first stage, UCINET, a comprehensive software package for the analysis of social network data, is used to conduct the univariate analysis (Borgatti et al., 2002); and PNET a software used to conduct the statistical and inferential analysis of social network data using Exponential Random Graph Models (ERGM) (Wang, Robins, et al., 2009). Both programs were developed by academics for academic research and were used in several peer-reviewed articles in some of the highest-rated management and organisational science journals.

4.5.1 Social Network Data Transformation

After the social network data is collected, the data must be transformed before social network analysis can be conducted. Respondents were asked to whom they share advice and information regarding an improvement to capture their ego-network as this is used to measure relationships and connections between actors to whom they are tied regarding improvement work (Kilduff & Tsai, 2003). After data collection, respondents and collaborators names were anonymized and structured in Excel into adjacency matrices for each question and each organisation. The adjacency matrix is a square array that allows researchers to record relational data of nodes, as the cases are recorded in both the rows and columns of the array, and the connection between two cases or actors is recorded as the observation inside the array (Scott, 2017). Each cell with a value indicates whether a tie exists between two actors, and each cell with a zero indicates no relationship between two actors.

An example is illustrated in Figure 11, which provides a snapshot of the NHS-K organisational network. Data for NHS-K was arranged in a 133 × 133 binary adjacency matrix, data for NHS-D was arranged in a 181 × 181 binary adjacency matrix, data for NHS-A was arranged in a 247 × 247 binary adjacency matrix, data for NHS-E was arranged in a 187 × 187 binary adjacency matrix and finally data for NHS-C was arranged in a 167 × 167 binary adjacency matrix. These adjacency matrices were imported into UCINET, a social network analysis software package used by academics to create the networks and conduct univariate and descriptive analysis on the data. In each matrix, the tie between two professionals (ij), a focal actor (i) would refer to a colleague (j) as a collaborator for improvement work; however, the colleague (j) may not refer to the focal actor (i) as a collaborator for improvement work.

	A	B	C	D	E	F	G	H	I	J	K	
1		NHS-K01	NHS-K02	NHS-K02A	NHS-K03	NHS-K03A	NHS-K03A	NHS-K04	NHS-K04A	NHS-K04A	NHS-K05a	NI
2	NHS-K01	0	3	0	3	0	0	0	0	0	0	0
3	NHS-K02	3	0	3	3	0	0	3	0	0	0	0
4	NHS-K02A02	0	0	0	0	0	0	0	0	0	0	0
5	NHS-K03	0	0	0	0	3	3	0	0	0	0	0
6	NHS-K03A03	0	0	0	0	0	0	0	0	0	0	0
7	NHS-K03A04	0	0	0	0	0	0	0	0	0	0	0
8	NHS-K04	0	0	0	0	0	0	0	3	3	0	0
9	NHS-K04A02	0	0	0	0	0	0	0	0	0	0	0
10	NHS-K04A03	0	0	0	0	0	0	0	0	0	0	0
11	NHS-K05a	0	0	0	0	0	0	3	0	3	0	0
12	NHS-K05A01	0	0	0	0	0	0	0	0	0	0	0
13	NHS-K05A02	0	0	0	0	0	0	0	0	0	0	0

Figure 11: Data Structure Example

Accordingly, knowledge-sharing networks are not symmetric as persons may not refer to each other as collaborators or have reciprocated interactions (Tortoriello & Krackhardt, 2010). In line with White et al. (2014), the paper-based surveys and the scale for each relationship was measured on a Strongly Disagree – Strongly Agree five-point scale. The L4Ls network data was collected online, and after feedback from the pilot study, the scale was changed from the five-point scale to a three-point Agree-Disagree scale. Therefore, to reconcile these two formats and combine the networks as they were collected from different data sources, the paper-based surveys' data were re-coded. This representation is illustrated in Table 8, where all values of 4-5(Somewhat Agree and Strongly Agree) are re-coded to 3 (Agree). Next, all values of 3 (Neither Agree or Disagree) are re-coded to 2 (Neither Agree or Disagree), and all values of 1-2 (Somewhat Disagree and Strongly Disagree) are re-coded to 1 (Disagree).

Table 8: Social Network Data Recode

Paper-Based Survey Code	Online Survey Code	Final Network Code
TGT, KPO	**L4L**	**TGT, KPO, L4L**
1 Strongly Disagree	1 Disagree	1 Disagree
2 Somewhat Disagree		
3 Neither Agree or Disagree	2 Neither Agree or Disagree	2 Neither Agree or Disagree
4 Somewhat Agree	3 Agree	3 Agree
5 Strongly Agree		

Table 9: Binary Recode Format

Format	If the tie is valued at:	Tie	No Tie
1	Agree Only	3 = 1	2 – 1 = 0
2	Agree or Neither Agree or Disagree	3 or 2 = 1	1 = 0
3	Agree, Neither Agree or Disagree or Disagree	3, 2 or 1 = 1	0 = 0

After the scales were converted to normalize the data and ensure consistency in analysis, all valued data required a second conversion (See Table 9), to facilitate more in-depth structural analysis (See Section 4.4.3). Therefore, data were transformed to a binary format where three different formats were created for each question and each network. The first format recorded all data valued at 3 as 1 and the remaining values as 0. Similarly, the second format re-coded all data valued 3 and 2 to 1, and the remaining values as 0; and the final format re-coded all three values as 1 and the remaining values as 0.

Like the social network data, actor attribute data needs to be transformed into a binary structure to examine the association between actor attributes and the relational tie previously discussed. Table 10 summarises data for Gender, Clinical Roles, Leadership Roles and Tenure, which were self-reported, whereas the partnership roles were coded and determined based on the official documents and records. Variables such as Gender, Professional Role and Partnership Role were collected in a binary state. Gender was coded as 1 for Women and 0 for Men. The Clinical role measure distinguished persons who directly engaged with patients; this was coded 1 for Clinical and 0 for Non-Clinical. This measure was further reduced into four categories: Nurses, Doctors, Allied Healthcare Professionals, pharmacists and physiotherapists and Non-clinical Management Staff, including persons who work in human resources and finance departments. These four categories were coded as 1 for Yes and 0 for No. Next, to determine whether persons held a leadership role in addition to their professional role, for example, persons who are clinical directors, the Leadership Role measure was derived, and Yes was coded as 1, and No or Missing was coded as 0. The Partnership Roles were categorised into four groups, TGT, KPO, RPIW and L4L, and each was coded as 1 for Yes and 0 for No or Missing.

Table 10: Actor-Relational Effects Recode

Measure	Variable Name	Coded as:	
Professional Role			
Clinical Role	ClinicalRoleID_Bin	Clinical = 1	Non-Clinical = 0
Nurses	RoleNurse	Yes = 1	No = 0
Drs	RoleDrs	Yes = 1	No = 0
Allied Healthcare Pro.	RoleOHCP	Yes = 1	No = 0
Non-Clinical Management	RoleNCMGMT	Yes = 1	No = 0
Leadership Role	Q10_LeadRole_Bin	Yes = 1	No/Missing = 0
Partnership Role			
TGT	TGT1Yes0No_Bin	Yes = 1	No/Missing = 0
KPO	KPO1Yes0No_Bin	Yes = 1	No/Missing = 0
RPIW	RPIW1Yes0No_Bin	Yes = 1	No/Missing = 0
L4L	L4L1Yes0No_Bin	Yes = 1	No/Missing = 0

4.5.2 Univariate Measures

The data was analysed when the cleaning, organising and transformation phases were complete. The first step involves describing and summarizing each of the five networks using standard network measures such as network size and density will provide the primary comparators for each organisation. In this case, measures of connectivity, centralisation, and centrality are presented to conduct univariate analysis at the network's local and global levels (Wasserman & Faust, 1994).

4.5.2.1 Connectivity Measures

Measures of connectivity provide preliminary insights into a network's size and scope and are generally focused on the network structure's global level. Compared to centrality and cohesion measures, these measures help distinguish each network's significant structural differences to set a benchmark for their comparison, rather than provide insights regarding structural embeddedness. ***Network size*** measures the number of actors, and this provides a benchmark for the extent of connectivity among actors compared to the ***number of ties*** within the network. This comparison is referred to as ***network density***, which is the overall degree of existing connections present among a population of actors (Reagans & Zuckerman, 2001). Network density gives insight into the extent of connectivity within a network since densely connected networks are associated with closure and cohesion; this helps share information and advice in an organisational and change-focused context.

As previously discussed, reciprocity indicates the stability of relationships within the network. The global and role-based ***arc reciprocity*** is reported to measure the extent of reciprocity across the network and determine actors who are directly referring to and collaborating. Global network arc reciprocity indicates the proportion of ties reciprocated within the network or how many persons have nominated each other as collaborators regarding improvement work. Practically this indicates the extent to which actors are mutually interacting with each other regarding improvement initiatives. Similarly, role-based reciprocity categorises the extent of reciprocity based on the professional roles of actors. In this research, four categories are examined, Nurses, Doctors & Consultants, Allied Healthcare professionals such as therapists and pharmacists, and Non-clinical and management professionals. This categorisation of reciprocity indicates the extent to which actors are mutually interacting with each other based on their professional roles regarding improvement initiatives.

4.5.2.2 Centralisation Measures

Next, centralisation measures are global level measures that support the comparison of different networks by indicating the extent to which a global network has a centralized structure. Where density measures the overall degree of existing connections within a network, centralisation measures the extent to which the network is centred around a specific focal point. As this is a directed network, in-degree and out-degree centralisation are measured. Higher values of ***in-degree centralisation*** indicate that a single actor or few actors are very central regarding their knowledge of improvement work and are prominent in the network. Higher values of ***out-degree centralisation*** indicate that a single actor or few actors are very central regarding their information-seeking behaviours in the network, thereby making most of the remaining actors less central and connected. Overall, a centralized network would have larger values, indicating that most ties are concentrated around one or a few actors. In contrast, a decentralized network would have little variation between the number of ties and actors within the network, thereby indicating a lack of influential actors. These measures support network comparison and provide the first insight regarding the nature of structural embeddedness to examine the distribution of incoming and outgoing ties between actors in the entire network and across multiple networks.

4.5.2.3 Closure, Bridging & Subgroup Measures

Closure in networks is examined through measures of cohesion and the subgroups of actors within a social network. Cohesion refers to the degree to which actors are directly connected within small subgroups. Due to this type of connectivity, actors are tightly knit, generating consensus and agreement within the subgroup. Cohesion is measured based on the ***number*** of triads present within the network. Types of cohesive relationships are measured through ***transitivity,*** which measures the possible range of relationships within triads. It is argued that the most basic forms of social relationships can be observed and examined through triads (Wasserman & Faust, 1994; Krackhardt & Kilduff, 2002; Simmel, 2011) as they indicate exchange, balance, hierarchy, power and other social processes based on a simple structural configuration. A ***triad census*** is conducted on the entire network of actors to identify and examine transitivity using the types of relationships present among groups of three (See Figure 12). Although theoretically there are 16 types of triads, this research will focus on 11 of these, four (4) of these are open triads (012C, 111D, 111U and 201), which represent different types of brokering relationships, and seven (7) of these are closed triads (030T, 030C, 120D, 120U, 120C, 210 and 300) which represent triadic closure, cohesion and more complex forms of interaction among groups of three.

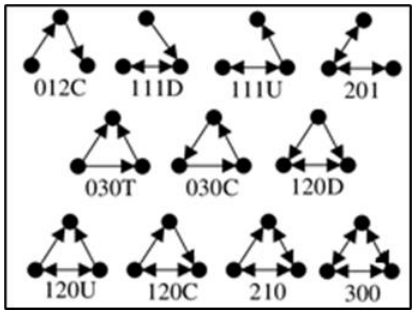


Figure 12: Examples of Triadic Structures

Although useful, centrality-based measures neglect information about any pre-defined groups in the network, as this measure does not distinguish between the tie of actors in the same or different groups. Relational mechanisms are important to distinguish intergroup brokering, and intragroup interactions have varying implications for sharing information and advice regarding improvement work. Therefore, analyzing brokerage patterns and the direction of relationships between groups in networks generates additional insight into the processes underlying embeddedness and new practices' institutionalisation. Gould et al. (2018) conceptualize five brokerage roles that take this distinction into account as it explicitly considers subgroup dynamics and tie direction. The five network ***brokering roles*** are as follows: *coordinator, gatekeeper, representative, consultant, and liaison* (See Figure 13). These roles specify the internal and external flows of information and advice within a network and highlight varying implications regarding the extent to which information is shared within and across different groups. The groups are determined by four professional roles and affiliations, nurses, doctors, allied healthcare professionals and non-clinical management professionals. This category was chosen to highlight the traditional professional boundaries within a healthcare organisation, as the network actors are sharing improvement work knowledge at varying levels of the organisation and the partnership. In this research, this analysis will be used to examine the extent to which professional groups are involved in improvement work and brokering information and advice about new practices, rather than focusing on the specific brokering roles. The professional group classifications also highlight institutional boundaries to understand the brokering activities of the groups further.

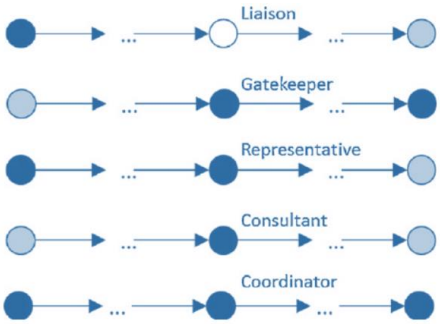


Figure 13: Graphical Representation of Gould & Fernandez Five Network Roles

4.5.3 Exponential Random Graph Models (ERGMs)

Structural embeddedness research has illustrated several implications and contextual influences that emerge from relationships between actors and the network's configuration. Structural embeddedness typically has a non-personal orientation and is associated with the network level of analysis and the patterns and configurations of actors within the network (Uzzi, 1997; Goldberg et al., 2016), whereas relational mechanisms are associated with the context and direction of relationships among actors (Nahapiet & Ghoshal, 1998; Uzzi & Lancaster, 2003). Said differently, structural embeddedness assesses the structures within a network, whereas relational mechanisms assess the qualitative differences between different network patterns and configurations, based on both tie and actor attributes.

Due to its structural emphasis and the nature of social networks, there are many different approaches to measuring, capturing, and operationalizing its structural features. One of the most common structural embeddedness measures is Burt's (1992) network constraint, which measures brokering among actors and examines the extent to which an actor's contacts are connected and the degree of structural holes within that actor's network. This measure was used by Battilana and Casciaro (2012) to examine the effects of initiating and adopting change within an organisational context. It was also adopted by Goldberg et al. (2016) to disentangle how structural and cultural embeddedness are associated with individual attainment within organisations. Similarly, it was used by Reagans and McEvily (2008) to examine the effects of knowledge sharing concerning competitive advantage. Structural embeddedness was also examined using density and clique measures by Moody and White (2003) to understand social cohesion. In contrast, Moran (2005) measured structural embeddedness as the number of direct and indirect ties among actors. A common factor is that these measures assess network features such as connectivity, hierarchy and closeness among the network actors.

However, using measures such as size used by Moran (2005) or density used by Moody and White (2003) do not capture the effects of actor dependence or redundancies within the network. This understanding is vital to examine embeddedness since the connectivity nurtures interdependencies and additional consequences of network structure. For example, when drawing on network constraint, researchers primarily examine the degree of brokerage within the network; however, brokering behaviours between intermediaries is only one type of social process among many within a network. Similarly, researchers primarily examine the degree of clustering or ties shared among several common actors when drawing on density or cliques measures. These measures are used to examine social cohesion, another social process associated with the degree of closeness among groups of actors within a network. The studies previously mentioned only draw on a maximum of two measures to examine the network's structural

features and their association with outcomes. As such, past studies examine one or two structural features or social processes when several different types of structures and processes exist within a network and among a group of social actors.

As discussed in Chapter 2 section 2.3.3, Structural embeddedness is based on theories of closure and bridging among actors, where researchers rely on structural configurations as proxy measures to model and examine social networks (Siciliano et al., 2020); as such, it has a patterns-based orientation that examines the macro-level features of the network. Therefore, based on the weaknesses in existing research, this study supports the use of traditional modes of analysis such as examining triads and centrality but proposes Exponential Random Graph Models (ERGM) to examine the structural embeddedness of actors. ERGMs are a superior approach to study network formation and model the endogenous social processes present within a network, along with actor-specific attributes and relational effects (Lusher, Johan, et al., 2013). ERGMs are used to analyse structural interdependencies within social networks (Robins, Pattison, et al., 2007; Lusher, Johan, et al., 2013) since they do not adhere to independence assumptions are required in other standard statistical approaches such as regression models.

The use of ERGMs allows researchers to explicitly model the observed organisation's networks against theoretically informed and supported network configurations to estimate their effects. In this case, various patterns of closure and bridging are represented through structural motifs. These localized network configurations represent various social processes present in the network and provide individual and collective insights into its structure and makeup. Thus, the application of ERGMs to measure structural embeddedness permits this study to delve deeper and examine multiple structural configurations and social processes within a network and removes the limitations of examining one or two structural configurations. In the following subsections, an in-depth discussion of ERGMs, the model specification, the selection of structural parameters and the model estimation is provided.

Therefore, to address the third objective and the broader context of the research concerning embeddedness and to examine the underlying structure of the network in terms of the specific social processes that are present or absent within the network, exponential random graph models (ERGMs) or p* models are employed to analyse binary socio-metric data (Hanneman & Riddle, 2005; Robins, Pattison, et al., 2007). Where univariate analysis and other traditional approaches to social network analysis are centred on descriptive measurement and characterization of network structures, ERGMs are statistical models applied to observed network data and used to understand the network processes influencing network structure formation. They account for the presence and absence of network ties and consider a range of possible alternative networks formations to the observed network (Wasserman & Faust, 1994; Contractor et al., 2006; Lusher,

Koskinen, et al., 2013). In recent years, this modelling approach has been adopted by social network researchers to understand the social processes and network mechanisms associated with communication (Shumate & Palazzolo, 2010), knowledge and expertise (Brennecke & Rank, 2017), trade (Brailly et al., 2016; Hollway & Koskinen, 2016), leadership (White et al., 2014, 2016) and other areas of interest for social networks (Lusher, Johan, et al., 2013).

An ERGM estimates the observed data in the same way that a regression model estimates non-network and non-relational data (Carrington et al., 2005; Lusher, Johan, et al., 2013); however, traditional statistical approaches are not appropriate to estimate social network models as they violate independence assumptions due to the complex relational dependencies that exist within a network. Frank & Strauss (1986) proposed a Markov dependence assumption which assumes that two tie-variables are dependent if they share a node. The method is based on the premise that there are dependencies between network ties (Frank & Strauss, 1986) due to the probability of a tie being absent or present for a given number of actors within the network (Lusher, Johan, et al., 2013). As such, an ERGM determines and estimates the probability distribution across the entire set of possible network graphs and the probability for a tie to form between two or more actors based on patterns, subgroups and smaller sections of the network. The patterns and subgroups that make up the entire network are referred to as configurations, and they are used to derive statistical parameters and estimates within the network (Robins, 2011). These configurations represent a range of social processes, and combinations of configurations are simultaneously tested to determine the significance of the social processes that underpin the network (Robins, Snijders, et al., 2007; Wang et al., 2016; Crossley et al., 2017). Estimations and simulations of the observed networks are conducted using well-established statistical approaches such as Maximum-likelihood estimation, undertaken through Markov chain simulation-based approaches. In this approach, parameter estimates are determined based on differences between observed data and simulated distributions until parameter estimates achieve convergence (Snijders et al., 2006; Robins, 2011).

ERGMs represent a combination of social structures or configurations within the observed network and are used to test the probability that ties existed relative to no tie as a function of the network's structural properties and to test assumptions about mechanisms underlying the presence of relations between actors. These assumptions are tested using model parameters represented by a range of structural patterns of motifs that make up the overall network. Model parameters are theoretically guided, signifying that models, parameters and structural motifs are only selected based on their theoretical relevance as they represent proxies of varying social processes underpinning both network structure and social interaction.

The basic models are typically applied to single, cross-sectional networks, but there are expansions for bipartite, multi-network, longitudinal and actor attributes data (Robins, 2011; Lazega et al., 2016). This development in SNA has allowed researchers to dig further into the nuances of social structure by asking what types of structures and what specific patterns of network configurations are present and how might these structures and patterns be related to actor attributes, such as professional roles and demographics (Wang et al., 2016). As such, this method allows networks, in general, to be examined through a more rigorous approach and under the scrutiny of statistical parametric tests (Robins, Pattison, et al., 2007; Robins et al., 2009; White et al., 2014). By taking this approach, varying structural effects can be captured, measured, and statistically associated with actors' embeddedness.

4.5.3.1 Model Specification

For ERGM's to be estimated, they must first be specified, and this includes the theoretical selection of configurations or parameters that are used to make inferences about the types of social processes that make up the network and draw conclusions about the presence and significance of the network structure. In Chapter 2, section 2.4.2, this research emphasizes that two key structures, closure and bridging, are associated with the institutionalisation of new practices. As previously mentioned, ERGMs allow researchers to simultaneously examine different network parameters and structural configurations that are theoretically relevant as they aim to capture these structural forms within each of the organisational networks. To empirically examine bridging and closure, this research explicitly draws on different types of triadic structural patterns to similarly determine their presence and significance in each network.

For this study, which examines directed networks, the sixteen (16) parameters are estimated, with the computational model's specific parameters in brackets (See Table 9). First, to model the basic connectivity tendencies in a network, the Arc and Reciprocity parameters are specified. The tendency for actors to establish network ties and make connections is captured is estimated through the ***Arc (Arc)***. This parameter captures the network's extent of connectivity and corresponds with information and advice sharing and interaction. ***Reciprocity (Reciprocity)*** estimates the actors' tendency to engage in reciprocated relations with their connected actors. This parameter captures a dyadic effect as it only exists between two actors. In addition to the ERGM forms of arc and reciprocity parameters presented in Section 4.5.2 Univariate measures, four groups of parameters were selected to structurally examine the social relationships within each organisational network: ***centrality, brokering, closure and actor-relation effects.***

4.5.3.1.1 Centrality Effects

In line with traditional ERGM studies, ***centrality effects*** are considered to determine the distribution of activity, popularity and general prominence of actors within networks (Lusher, Johan, et al., 2013). Theoretically, this is important as some actors tend to have more or less social relationships compared to others based on their involvement in the change initiative and awareness of new practices; and therefore, ascertaining the extent, nature and direction of centrality within a network, aids in appropriately making inferences about the basic social processes that make up a network's social structure. Four star-based parameters are selected to model centralisation and degree distribution effects within the network, Two Out Star (2-out-star), Three Out Star (3-out-star), Popularity Spread (AinS) and Activity Spread (AoutS). Star-based parameters model centralisation within the network, where high or large positive estimates of these parameters indicate network centralisation. For example, a significantly large positive parameter would indicate that in-degrees are centralized on a few key actors. Similarly, a small or even negative parameter would indicate a decentralized approach to knowledge sharing and collaboration across actors within the network (Robins et al., 2009). As a social process, star-based parameters model activity and popularity effects and give some insight into the centralisation of power, influence and popularity with the network (Robins et al., 2009; Robins, 2011). The ***Two Out Star (2-out-star)*** and ***Three Out Star (3-out-star)*** model out-going ties to two and three actors respectively and captures the tendency of an actor to collaborate with and seek advice or information regarding improvement two or three persons. ***The popularity Spread (AinS)*** parameter estimates prestige and influence within the network, and a negative or small estimate indicates that most actors have similar popularity levels. ***Activity Spread (AoutS)*** parameter estimates outgoing contact and interaction with other actors and indicates the extent to which an actor may seek out information or advice from connected actors. In this case, a negative activity spread parameter indicates that most actors have similar levels of activity and the network is not centralized around a few key actors.

4.5.3.1.2 Brokering Effects

Within the context of a change initiative, actors are likely to broker information about the change initiative and new practices to other actors within the network. As discussed in section 2.4.2.2, brokering is structurally associated with open triads, a pattern observed when one actor is the centre of a non-closed triadic social relationship. This structure is explicitly modelled as ***Simple Connectivity (Path2)*** which measures the extent to which actors who send ties also receive them and equates to an actor's likelihood to broker information or advice with another actor. This estimate is often negative and controls for the correlation between the in- and the out-degree in networks. Further, in theory, and practice, there are multiple forms of brokering and ERGMs aim to capture these dynamics by having higher-order effects and multiple ties are sent or received

by a central actor. These higher-order brokering effects are examined through three additional star-based parameters **One-In-Alternating Out Star (1inAout-star), Alternating-in-One-Out Star (Ain1out-star)** and **Alternating-in-Alternating Out Star (AinAout-star)**. These configurations are different from the previously mentioned star parameters as they have two levels of connectivity and an intermediary or brokering actor. The ***One-In-Alternating Out Star (1inAout-star)*** measures the extent to which a connected actor sends ties to multiple other actors, which equates to the likelihood of an actor disseminating information or advice across a range of contacts and indicates the sharing of information of advice within the network. The ***Alternating-in-One-Out Star (Ain1out-star)*** measures the extent to which an actor who receives ties from multiple actors to be connected to at least one other actor, whereas the ***Alternating-in-Alternating Out Star (AinAout-star)*** measures the extent to which an actor who receives ties from multiple actors to be connected to multiple other actors. These parameters also have hierarchical connotations and influences. For example, the One-In-Alternating Out Star (1inAout-star) configuration can indicate a traditional brokering relationship and formal and informal superior and subordinate relationships, where one connected actor can efficiently communicate and distribute information across their network of contacts. This social process is expected in a healthcare setting to evidence communication and interaction between organisational leaders and their collaborative contacts.

Conversely, the Alternating-in-One-Out Star (Ain1out-star) configuration can also indicate formal and informal superior and subordinate relationships but reflects bottom-up interactions where information is communicated from the organisation's lower levels to actors at higher levels of the organisation. On the other hand, the Alternating-in-Alternating Out Star (AinAout-star) configuration indicates a brokering relationship where an actor who receives information or advice also shares this information with multiple connected actors. These interactions are spread across a wide range of actors. Like the other parameters, a significantly large positive parameter would indicate that these parameters exist beyond what is expected by chance and indicate higher degrees of brokering activity regarding improvement work and collaboration present in the network (Robins et al., 2009).

4.5.3.1.3 Closure Effects

Closure is a social process that is likely to emerge in an institutional change process as actors are likely to have dense connections and cliques around specific initiatives, for example, RPIWs, training and value streams. This creates goal-oriented behaviours where activity-based clustering is likely to emerge. As discussed in section 2.4.2.1, closure is structurally associated with closed triads, a pattern observed when actors are connected and tend to cluster within networks. Similar to brokering effects, there are also different forms of closure and ERGMs aim to capture these effects to determine the presence and nature of closure within networks. To

facilitate this examination, three triangulation-based configurations are used to model and examine network closure: **Transitive Closure also referred to as Path Closure (AT-T), Popularity Closure (AT-TD)** and **General Transitivity (AT-TDU)**. These configurations model the degree of clustering, dense connectivity, transitivity or triangulation in the network at the triad level, or groups of three connected actors (Robins, 2011). The ***Transitive Path Closure (AT-T)*** configuration measures an actor's tendency to choose a collaborator who shares information and advice with their existing network of contacts. This configuration is associated with the social process of choosing friends of friends and is interpreted as a tendency for structural holes to close when there are multiple independent paths between two collaborators (Robins et al., 2009). Here, a large and positive estimate indicates a high degree of closure or multiple alternating triadic clusters in the network. ***Popularity Closure (AT-TD)*** configuration models the tendency for a high degree of closure to be present around actors similar in their indegree or popularity. This parameter indicates hierarchical connectivity or the extent to which deference or status-based homophily is present in the network (Robins et al., 2009; Lusher, Johan, et al., 2013). In this case, a large and positive estimate indicates that there is a high degree of status-based closure or triadic clusters in the network. The ***General Transitivity (AT-TDU)*** configuration is a parsimonious parameter that captures three transitive triadic effects: path, activity, and popularity closure (Robins et al., 2009). Rather than modelling each of these effects separately, this parameter indicates a tendency for hierarchical-based network closure without distinguishing the three effects (Lusher, Johan, et al., 2013). In this case, a large and positive estimate indicates a high degree of transitivity or triadic clusters in the network and provides evidence that closure in the network occurs because of the closure of the multiple alternating triangular structures. From a social process view, closure-based structures and configurations are associated with varying forms of social cohesion and collective action among actors and high degrees of (indirect) reciprocity and shared understandings within the network.

4.5.3.1.4 Actor-Relation Effects

In social network research, actors' attributes may be relevant for network formation and structure (Wasserman & Faust, 1994; Kilduff & Krackhardt, 2008; Kilduff & Brass, 2010). Attribute variables and measures are used to examine actor-relation effects, the association between demographics such as professional role, and a relational tie between two actors. Therefore, sixteen (16) actor-level attribute variables were used to account for the interplay between an actor's attributes and their relationships (See Table 11). Next, to capture organisational roles, seven constructs were identified as relevant to the empirical context, focussing on the clinical and non-clinical nature of these roles, and the scope of these roles, since professional groups tend to display varying patterns of interactions that support and inhibit changes initiatives. For example, West et al. (1999) found that nursing networks are centralized,

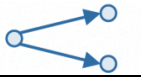
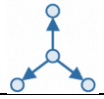
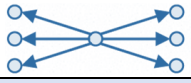
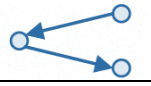
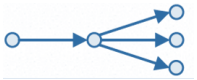
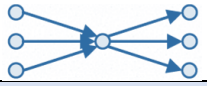
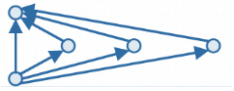
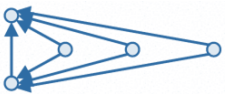
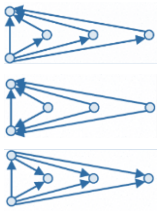
allowing them to gather and disseminate information more effectively. In contrast, clinical directors and doctors have more hierarchical networks that are more densely connected than nursing networks, which allows them to be "more potent instruments for changing, or resisting changes, in clinical behaviour" (pg. 633). Therefore, professional roles have a significant relationship with social structure and influence varying organisational outcomes and healthcare change initiatives (West et al., 1999, p. 633).

Respondents were categorised based on their clinical role, where all respondents involved in direct patient care were considered to be in clinical roles, including traditional roles such as nurses, doctors and allied healthcare professionals. In contrast, the non-clinical staff was defined as administrative and supportive roles that do not involve patients' direct treatment or care (Seto et al., 2011). These are non-clinical management roles such as finance and human resource professionals who work in a healthcare setting.

Next, leadership roles were categorized to capture the scope of each respondent's professional role. In this case, leadership roles among clinical and non-clinical professionals have several consequences for change initiatives since professionals in central network positions are seen as leaders by their colleagues (Tasselli, 2014). Their role makes them popular sources of information regarding new practices as they would either provide information or advice to colleagues, or other professionals would seek them out to find out more information regarding change initiatives. For example, some studies have found a strong link between leadership positions and the structure of professionals' interactions. For example, obstetricians, who were more central in advice networks, were more likely to be considered opinion leaders by coworkers, even among physicians and nurses (Kravitz et al., 2003). Overall, formal leadership roles display parallels with professionals' popularity in social networks and need to be considered when examining organisational networks' structures and relationships.

The respondents' roles were recorded from documents and recorded to categorize distinctive interactions among professionals based on their partnership roles. In line with the partnership structure discussion in section 3.2, four (4) groups were identified: The Transformation Guiding Team (TGT), the Kaizen Promotion Office (KPO), the Lean for Leaders (L4L) and the Rapid Process Improvement Workshop participants (RPIWs). Due to this initiative's nature, we would expect engagement within these groups to facilitate improvement work within their respective domains, and therefore, it is important to consider the influence of partnership interactions in the analysis. In general, the organisational and professional role is linked to understanding and embeddedness in the organisational culture and change resistance among professionals (Furst & Cable, 2008; Erwin & Garman, 2010; Levay, 2010).

Table 11: Configurations & Parameters for ERGMs

Parameter (PNet Name)	Structural Configuration	Description of Social Process
Purely Structural Effects		
Arc (arc)		This is a baseline propensity for tie formation.
Reciprocity (Reciprocity)		Models the tendency for ties to be reciprocated in the network.
Centrality Effects		
Two Out Star (2-out-star)		Models the tendency for actors to collaborate with and seek advice or information from two other actors regarding improvement work.
Three Out Star (3-out-star)		Models the tendency for actors to collaborate with and seek advice or information from three other actors regarding improvement work.
Popularity Spread (AinS)		Models popularity and the tendency for an actor to be a key collaborator or source of information and advice.
Activity Spread (AoutS)		Models activity and the tendency for an actor to seek collaborators or share information and advice regarding improvement work.
Brokering Effects		
Simple Connectivity (Path2)		Models simple brokering and measures the extent to which actors who receive information and advice regarding improvement work to share this information.
One-In-Alternating Out Star (1inAout-star)		Models complex and top-down brokering and measures the extent to which an actor who receives information and advice regarding improvement work to share this information with multiple connected actors.
Alternating-in-One-Out Star (Ain1out-star)		Models hierarchical brokering and measures the extent to which an actor receives information and advice regarding improvement work from multiple connected actors to share this information with one connected actor.
Alternating-in-Alternating -Out Star (AinAout-star)		Models the extent to which an actor receives information and advice regarding improvement work from multiple actors to share information with multiple actors.
Closure Effects		
Transitive Path Closure (AT-T)		Models the actor's tendency to choose an improvement work collaborator who also collaborates with their existing network. It is also interpreted as a tendency for structural holes to close when there are multiple independent paths between two collaborators.
Popularity Closure (AT-TD)		Models the tendency for a high degree of closure to be present around an actor similar in terms of their popularity. It indicates hierarchical connectivity or the extent to which status-based homophily is present in the network.
General Transitivity (AT-TDU)		Simultaneously models three transitive triadic effects: path, activity, and popularity closure and a tendency for hierarchical-based network closure without distinguishing the three effects.
Actor-Relation Effects		
Homophily ([Attr]-Interaction)		Models the tendency of actors to interact with colleagues with the same attribute (E.g. Professional Group, Leader etc.)
Sender Effects ([Attr]-Sender)		Models the tendency of an actor having more outgoing connections because of the actor attribute.
Receiver Effects ([Attr]-Receiver		Models the likelihood of an actor having more incoming connections because of a specific actor attribute.

Circles denote actors, and an arrowed line denotes the presence of a directed tie between pairs of actors.

The previously discussed model parameters specify purely structural effects; however, since there is an expectation that professional and leadership roles have some effect on social structure, some configurations are included that specify the joint effects of structure and actor attributes. Therefore, by considering actor-relation effects, the tendency for actor attributes to affect tie formation is modelled, and further explanations regarding the structural configurations are derived by examining actor attribute effects and controlling for the structural effects in the network. As such, three actor-relation parameters are included in the model: Homophily ([Attr]-Interaction), Sender Effects ([Attr]-Sender) and Receiver Effects ([Attr]-Receiver). The ***Homophily ([Attr]-Interaction)*** configuration models the tendency for ties to be more or less likely between actors similar in both professional and managerial hierarchy. In this case, homophily is indicated by a positive parameter value for these effects. Next, the ***Sender Effects ([Attr]-Sender)*** configuration is included to model the likelihood of an actor attribute promoting an actor to be more active, therefore having more outgoing connections because of a specific actor attribute. Similarly, the ***Receiver Effects ([Attr]-Receiver)*** configuration is included to model the likelihood of an actor attribute promoting an actor to be more popular, therefore having more incoming connections because of a specific actor attribute.

By including these effects, ERGMs treat actor attributes as binary attribute and explanatory variables. They are used to determine whether social processes such as activity and popularity result from purely structural effects or actor-attributes of a combination of the two. The distinction between purely structural effects and actor attributes explanations is important to understand structural embeddedness and make inferences about the network due to the interplay of social structure and effects external to those that emerge from the social structure but still influence it. By simultaneously considering purely structural and actor-relation effects, both network dependencies and actor attributes are examined rather than overestimating the role of either effect in the network (Lusher, Koskinen, et al., 2013, pp. 26–28).

4.5.3.1.5 Summary Model Specification

Therefore, to theoretically assess brokering and closure in the networks, the research explicitly considers and examines various equivalent structural configurations to make reasonable conclusions on the structure of relationships within each network. Based on this view, two types of models are constructed. The first, Model A, examines the structural configurations discussed in the purely structural effects section above and selected the model that best characterises the network's overall structure. The second, Model B, combines the influences of structural and actor-relation effects within each organisational network, where the selected models are those that best describe the presence and significance of structures and actor-attributes within the network. In summary, this model specification allows for varying types and degrees of centrality, brokerage, and closure to be modelled within each network, thus allowing for various interpretations of each

organisation's structural embeddedness to be derived. Similarly, the simultaneous examination of structural and actor-relation effects via ERGMs poses a significant advantage for generating and testing network theory by examining the social processes and structures present and significant within varying organisational networks.

4.5.3.2 Statistical Model Specification

In addition to parameter specification, models are also statistically specified. In this case, the model determines which parameters are most important when deriving the formation and structure of ties within the observed organisational networks. Each possible network tie between the actors is measured as a random variable to derive a valid statistical model. Therefore, each pair of actors i and j are defined as a random variable Y_{ij}, where Y_{ij}, = 1 if a relational tie exists between i and j, and Y_{ij} = 0 if a relational tie does not exist between i and j. As collaborative and improvement work relations give rise to directed ties, Y_{ij} might be different from Y_{ji} . As such, the observed value is specified as y_{ij} for all i and j, with y the matrix of observed ties. Based on this understanding, ERGMs are seen in a standardized form where the response variable is the log-odds of the probability that a relational tie exists (Wasserman & Pattison, 1996). Since model parameters do not consider actors' identities and the related structural configurations, ERGMs derive a model of tie variables and parameters based solely on the absence or presence of the specified configurations within the network. Following Wasserman and Pattison (1996), the basic model has the following form:

$$P(Y = y) = \kappa^{-1} \exp\left(\sum_A \lambda_A Z_A(y)\right) \quad (1)$$

Where:

I. *Y is the n × n array of network tie variables, with realizations y;*
II. *λ_A is the corresponding parameter estimate (where λ_A = 1 if a configuration is observed and λ_A = 0 otherwise);*
III. *$Z_A(y)$ is the network statistic for all structural configurations A in the model;*
IV. *The value κ is the normalizing constant, which ensures that Equation. (1) is a proper probability distribution.*

The summation in the model is applied to the purely structural network effects specified in the given model. Equation (1) describes a probability distribution of graphs on n nodes or actors, where the probability of observing any particular graph y is dependent both on the statistics $Z_A(y)$. The corresponding parameter λ A for all structural effects in the model and the exponential term on the right-hand side indicates an exponential random graph model (ERGM).

Equation 1 is extended to model the actor attributes as explanatory variables to account for the actor-relation effects. In this case, a vector X of binary attribute variables is constructed with X_i = 1, if Actor i has the attribute, and $X_i = 0$ otherwise. The vector y remains for the set of

observations on Y; however, actor attribute effects are considered explanatory variables that operate simultaneously with structural effects. Consequently, the model derives the probability of the graph y given the observations of actor attributes x as $P(Y = y|\, X = x)$. Similarly, a Markov attribute assumption is derived between the actor attributes and network variables so that the attribute of *i* influences the possible ties that involve *i* (i.e. X_{ij}) (Robins, Snijders, et al., 2007). The model with actor attributes as explanatory variables has the general form:

$$P(Y = y|\, X = x) = \kappa^{-1} \exp\left(\sum_A \lambda_A Z_A(y) + \lambda_A Z_A(y, x)\right) \tag{2}$$

Where:

I. *X is the $n \times m$ array of individual attribute variables, with realizations x;*
II. *λ_A and z_A are the structural configurations and network effects;*
III. *$Z_A(y, x)$ is a network statistic computed for each particular network realization y that also considers the vector x of actor attributes.*

In summary, the model in Equation (2) can be used to examine the specific actor-relation effects on network ties while controlling for structural network processes.

4.5.3.3 Model Estimation

After the models are specified and the configurations are determined, the model is estimated in the PNet software package, simulating and conducting the stochastic analysis of social networks (Wang, Robins, et al., 2009). It is an iterative process where configurations are included and excluded from the model until model convergence is achieved. It is usually challenging to determine the normalizing constant k in Equations 1 and 2; therefore, it prevents the likelihood function's direct estimation (Wasserman & Pattison, 1996). As a result, Monte Carlo Markov Chain Maximum Likelihood Estimation (MCMCMLE) methods are used as pseudolikelihood techniques to estimate the model parameters (Snijders et al., 2006; Robins, Pattison, et al., 2007). This process involves the simulation of thousands of estimates and graphs, where probabilities are assigned to those that are most likely to be seen in the observed network so that it is central and not extreme with respect to the effects being modelled (Lusher, Johan, et al., 2013). Overall, the model parameters are estimated based on a distribution of graphs that are closely related to the observed network. Therefore, fitting and estimating a model entails determining the parameter configurations and values that give the most support in closely reconstructing the observed network.

The PNet package uses MCMCMLE to approximate a range of possible networks and to estimate λ_A . Since this estimation technique produces approximated estimates, model assessment and fit are based on predetermined criteria and heuristics, such as the parameter estimates, standard

errors, convergence statistics and goodness-of-fit ratios that compare the observed values with the fitted values (Hunter & Handcock, 2006; Morris et al., 2008).

In this case, a statistically significant parameter estimate indicates that the parameter estimate is greater than two times the standard error in absolute value; where a positive estimate indicates the structural effect appears more than is expected by chance, and a negative estimate indicates the structural effect appears less than is expected by chance, given the other effects in the model (Lusher, Johan, et al., 2013). For each parameter estimate, the convergence statistic or t-ratio is derived. The convergence statistic acts as a p-value in a regression model and evaluates the model fit. It is important to note that all fitted models will produce parameter estimates. However, these results are unimportant unless all the model parameters have converged and achieve a convergence statistic of less than or close to 0.1 (Lusher, Johan, et al., 2013). After the simulated networks are estimated, goodness-of-fit assessment methods are used to determine which model best represents the observed data by examining the similarities between the simulated and observed networks where a fitted model is deemed acceptable based on three criteria. First, the parameter estimates and standard errors are within the bounds of a reasonable model. Second, the convergence statistic or t-ratio for all the parameters estimated and specified in the final model are less than 0.1, and third, the goodness-of-fit convergence statistics are less than 2.0 (Hunter et al., 2008; Lusher, Johan, et al., 2013).

4.6 Methodological Considerations, Limitations & Generalizability

As with all modes of inquiry, some considerations and limitations emerge in the process of research. This research uses survey methods to conduct a social network study; therefore, it is subject to concerns regarding the research design, data collection, data analysis, and ethics, as data on real people is researched, surveyed, and analysed. In this section, these issues are recognized, and their implications and resolutions are discussed.

4.6.1 Research Design & Data Collection Limitations

The research design and data collection limitations are discussed together as the design decisions had accompanying data collection implications. As previously stated, this research is a comparative social network study of five organisations, which was conducted at one time period with a non-experimental quantitative approach. When comparing an ego-centric network to a whole network study, a whole network research design has several advantages. This approach includes capturing all the relationships among the actors in a specific group, context, or organisation and allows a more holistic and comprehensive study of the network. However, research is limited by resources such as time, access, finances, human resources, and computing. All these factors limited this research, and accordingly, some decisions were made that need to be addressed.

4.6.1.1 Sampling Errors: Population & Sample Selection

According to Bryman (2012), there are several sources of error in survey research; however, those of consideration in this research are sampling errors and non-sampling errors. Sampling errors emerge in statistical analysis from the sample's unrepresentativeness, and non-sampling errors associated with data collection and data processing due to deficiencies and inappropriate data analysis. In social network research, sampling errors are associated with boundary specification, and in this case, the organisations and the respective actors were purposively sampled. In some research, a purposive sampling strategy is seen as a limitation since it invites biases and representativeness issues within the study. In this case, the NHS-VMI partnership is a unique context and setting and was deemed appropriate to investigate the social networks of actors collaborating to embed new practices within their organisation.

Similarly, actors were purposively sampled as the improvement work initiatives were in localised areas of the organisation; therefore, a whole network study for each organisation would be unnecessary and unrepresentative. Since each organisation has thousands of professionals, conducting a targeted study was the most appropriate approach. Similarly, representation and bias issues are mediated since social network studies are traditionally targeted towards the most

relevant groups. Clear boundaries are specified within the population of interest, rather than the wider population, to acquire the most useful and valid responses possible.

In the process of addressing the limitation of purposive sampling, a second shortcoming emerges. The research design lacks a prior state, base case, or the selection of an organisational group that was not engaged in improvement work. As the social networks studied were designated to specific actors such as Lean for Leaders, RPIW participants, and members of the KPO and TGT, little attention was given to other groups to gain insight into the networks of actors who are not in the process of learning, applying, and adopting new practices. This issue is somewhat mediated by selecting five organisations with varying cultures, performance levels, organisational sizes, and improvement goals. However, it still poses a question of whether the goal-oriented networks have similar structures, characteristics, and relational mechanisms to those that are not pursuing improvement initiatives. Existing research at the inter-organisational level indicates that goal-oriented networks have different structures and features than serendipitous networks that emerge opportunistically (Provan & Kenis, 2008). Despite this understanding, there is no existing research at the interpersonal level to confirm this distinction.

Another perceived limitation associated with this point is that this research has a cross-sectional research design, so there is no prior research or secondary study to validate network processes and mechanisms, as networks change over time, especially knowledge and information sharing networks (Snijders, 2017). Although longitudinal research studies are ideal for providing more in-depth investigations and findings, the time and human resources associated with two phases of data collection and analysis were outside this PhD's scope. However, as previously stated, this is mediated by applying a single research design, where identical instruments, measures, and analyses are conducted on five organisations in various locations and contexts. As such, future research designs should consider including a case that is not engaged in improvement initiatives to investigate and acknowledge the differences or similarities between the two groups. Similarly, if the time, resources, and access allow, future research should consider a longitudinal research design feasibility to capture the social networks before the improvement work initiative and a few months after it has begun.

4.6.1.2 Non-Sampling Errors: Data Collection

In terms of data collection, further limitations are identified and considered. As the primary data collection method is through self-reported surveys, non-sampling error emerges from survey instruments and biases. Non-sampling errors include data collection and response biases associated with self-reporting, social desirability, and common method bias. Self-reported data is survey response data provided by the research subject and relies on their report of their actions, behaviours, beliefs, or attitudes. There are many questions around the reliability and

validity of self-reported data in social science research due to social desirability and other response biases. Social desirability is the tendency of survey respondents to answer questions in a manner that enables them to be favourably perceived by others; it involves over-reporting "good behaviour" or under-reporting "bad" or undesirable behaviour (Stoop et al., 2010; Bryman & Bell, 2015). The second concern is common method bias, which emerges from single-source, self-report, cross-sectional designs where the same method is used to measure multiple constructs; this may result in spurious method-specific variance that can bias observed relationships between the measured constructs (Podsakoff et al., 2003; Ireri et al., 2017). In this case, two data collection methods are used, the paper and web-based sociometric survey; however, the same measurement instrument is applied. In social network research, common method bias is associated with the possible inflation of correlation among network measures (Podolny & Baron, 1997; White et al., 2014). Social desirability and common method bias need to be considered, as respondents are asked to rate their relationships on a "Strongly Disagree – Strongly Agree" five-point scale; however, they are addressed in two ways.

First, a quadratic assignment procedure (QAP) was used to detect and test for differences in question responses and ratings while controlling for the underlying matrix structure. In this case, the ties between actors remain constant, but the ties' ratings are re-evaluated to examine the structural influence of the network and the ratings attributed to an actor. The results are displayed in a correlation matrix format to indicate the degree of similarity between each question's ratings, as the network structure does not change. The QAP examines the valued data structure, which includes ratings from 1 to 5 (Strongly Disagree to Strongly Disagree) for each of the five questions in the social network survey. A second analysis was then conducted using a binary data structure that recodes all responses to a 0 and 1 representation, where only the ties rated as a 5 (Strongly Agree) are retained. The differences in the valued summary data ranging from 1-5 and the binary data of 5 only indicate a moderate level of variability in the similarity of questions 1 (Knowledge of Expertise), 2 (Provides Information or Advice), 3 (Seeks Information or Advice), and 5 (Trust); and a high level of variability or a low level of similarity in the ratings for question 4 (Influence). The high levels of variability indicate a low degree of response bias and social desirability in terms of the rating for each of the five questions (See Appendix C2 for further details).

The second method to address this is associated with the data transformation process. Since binary data is best suited for social network analysis programs, the data were dichotomized at various levels in the data transformation process, and another QAP was conducted on the aggregated data to examine response bias. The results confirmed the previous findings regarding comparing valued data and the binary data below the threshold suggested by Podsakoff et al.

(2003). Further, the survey instrument was adapted from a peer-reviewed study conducted by White et al. (2014, 2016), supporting the instrument's robustness and validity and network measures. Additionally, the network's structural elements are emphasised in this work, not the individual questions' subjective ratings, which would incur response and common method bias. Despite this, these areas must be considered, even though it does not present an issue to this work.

The final data collection limitation relates to the incompleteness of data. As there were two modes of data collection, the social network data was collected effectively, whereas however, the associated actor-relation data such as age, professional roles, and tenure, other attributes were not. The web-based survey had several attitudinal and behavioural questions regarding actor acceptance and engagement regarding the new practices and improvement work; however, this data was not collected from the paper-based respondents or the identified collaborators from the social network data collection. This incompleteness did not pose a serious issue to the research, but further analysis could have been conducted regarding actor sentiments if it were available. For example, a multiple-regression quadratic assignment procedure would have been conducted to simultaneous examine multiple variables such as acceptance or non-acceptance of practices, or engagement and non-engagement in practices, to produce a binary result similar to that of a logistic regression which models a binary dependent variable (Carpenter et al., 2012; Robins, 2013; Levin et al., 2016). However, as over 50-70% of that data was missing, even imputation methods were not viable. This omission changed the original research focus, which attempted to highlight the association of the acceptance of new practices with social network structures. Therefore, future research would consider setting up a second data collection process to survey collaborators whom the original respondents nominated.

4.6.2 Data Analysis Limitations

As with other research, there are also data analysis limitations. As previously mentioned, the data for the social network analysis conducted needed to be transformed into a binary format of zero (0) to represent the absence of a relationship and one (1) to represent a relationship's presence. This data transformation is an aggregation of data which means a loss in detail and quality of the originally collected data. In this case, to conduct structural analyses, the data associated with the quality of relationships is lost. The response data is normalised, and various cut-off points are determined and analysed so that the representative relationships are maintained (Pappi & Scott, 1993; Borgatti et al., 2013). After this process is completed, further QAPs are conducted to assess the consistency of the data. Second, each analytical method is applied to the extreme cases of the dichotomized values, and the results are inspected. This method was applied to the univariate and triad census as well as the ERGMs. The results revealed no significant differences in the

aggregation levels within each network question, but as expected, the results varied between questions. For example, after the data transformation, there were no significant differences between the results with a Format 1 with a cut-off of 3 only versus results with a Format 3 where there was no cut-off (See Table 9) for Question 1 on Expertise; however, the results for Question 2 and 5 varied as they indicated two different types of relationships.

The final data analysis limitation to be addressed is model specification and model estimation for ERGM analysis. First, there is no automated specification for ERGMs; they must be manually determined in an iterative process of including and excluding structural motifs until the Goodness-of-Fit criterion is met. Like traditional statistical analysis, models do not represent the observed data with 100% accuracy. Therefore, determining an adequately fit model requires hundreds of hours of analysis to assess models with millions of simulation iterations. The larger the dataset, the longer and more computing-intensive this process is. As such, this study's analysis became unmanageable as there were five organisational networks and five relational networks. In the initial stages, all twenty-five networks were analysed for Model A, which included purely structural effects. After examining Goodness-of-Fit results, the analysis focused on Q2, Q3, Q5 for theoretical relevance and time required to examine each organisational network. After further analysis, Q2 remained the analytical focus for three reasons.

First, since each of the organisational networks has the same actors and the same structure, a well-fitted model would fit all the questions with varying but similar parameter estimates and coefficient results. Said differently, there are no structural differences between questions at the same cut-off point, and there are only qualitative differences in the responses, therefore since the structure does not change twenty-five (25) different sets of analysis was not required for Models A and B, only five (5) sets of analysis were required. This decision reduced the specification and estimation from fifty different (50) models to ten (10), and even this reduction was still labour and computing-intensive.

The second reason that Q2 remained the focus of the analysis was that the parameter estimates for Q1, Q3 and Q5 were at times indistinguishable; this was examined at various cut-off points and confirmed to be the result of similarities in the questions that were asked. Therefore, as these results were so similar, it was redundant to continue analysing each of them and analysis continued on Q5. The third reason for this selection was theoretically guided. First, Q4, a question on social influence was not a theoretical focus of this work; this question assessed an actor's perceived influence, not the actor's structural prominence or influence. If this work had a relational embeddedness or social exchange frame, this question would have been retained for further analysis; however, this was not appropriate. Comparatively, Q2 had a more relevant theoretical frame, as it gauges the extent to which collaborators engaged with the respondent

regarding improvement work rather than the respondents' information-seeking behaviours. By focusing on Q2, this work can theorize based on incoming information and advice regarding improvement work since outgoing behaviours are measured through the naming of collaborators and the direction of ties within the overall network.

Due to these issues and considerations, the analysis was reduced to two questions, Q2 and Q5, to limit redundancies and time required to conduct analysis. The Q5 results are presented in Appendix D5, and the results for Q2 are presented in Chapter 5.

4.6.3 Ethical Considerations

This study's further considerations include six primary ethical concerns regarding the study participants: the collection, confidentiality and anonymity of data, informed consent, providing incentives, and harm to participants (Pruzan, 2016). Similarly, there are four primary ethical considerations related to the researcher: the inappropriate use of participant data or the research methodology, incorrect reporting and avoiding bias throughout the research process. First, in terms of participant ethics, the surveys were not administered and could not be completed without explicit consent. After the data was collected, all participant data was collated into a master list and anonymized at two levels. The participants and collaborators' names and emails addresses were replaced with a unique organisational ID at the first level. Then each unique ID was recoded to anonymise the organisation at the second level. Actors are not identifiable in the networks; however, an actor's professional and partnership roles remain part of the analysis. The master list was encrypted after it was finalized; this ensured the survey respondents and their collaborators' confidentiality. Additionally, no incentives were provided to take part in this research, and no known physical, emotional, or psychological harm was caused to participants in the administration of this survey or the collection of this data.

Next, ethical considerations as they pertain to the researcher are removed where possible. First, the participant data will only be used for research purposes under the General Data Protection Regulation (GDPR) protocols. Several discussions with experts were made, and the resulting revisions ensure that the appropriate research methodology, data collection and analytical methods were applied. As no research study is without its failings, several considerations were made to reduce or negate any such issues which did emerge. However, some issues may subconsciously emerge in the form of confounding or information bias, which are unintended errors or conclusions that arise in the research process due to the interpretation of results that are aligned with a researcher's expectations or predetermined views (Bryman, 2012; Bryman & Bell, 2015; Pruzan, 2016). Therefore, as it pertains to the reporting of results and findings, the researcher aimed to maintain an above-board and non-biased cognitive frame when analysing, interpreting, and engaging with research.

4.6.4 Generalizability & Transferability

After reviewing the limitations of this study, one critical step involves evaluating the generalizability and transferability of the research results, findings, and conclusions. A study's generalizability refers to how its findings may be extended to other situations (Graham & Tetroe, 2007). The three forms of generalization are classical statistical or probabilistic generalization which extrapolates the findings from a sample to the population; the second is an analytic generalization, where the study extrapolates the broad constructs of a theory; and the third is transferability, which is also called reader generalizability (Polit & Beck, 2010; Smith, 2018). This study focuses on the two latter forms of generalizability, analytic generalization, and transferability.

Analytic generalization expands the specifics of lower-level constructs to broad theoretical concepts and is associated with theory-driven quantitative research, such as this research. In this case, this research develops conceptualizations of social and structural microprocesses such as triadic structures, relationships and brokering roles and aligns them with the higher-level theoretical concepts in institutional theory regarding institutionalising new practices within an organisational setting. The study's transferability is determined by the study's readers, who find practical and useful points to either extend this study or incorporate it into existing research (Bryman, 2012). Although generalizability is specific quantitative and theoretical implications, transferability has a broader application, which allows the readers of the research to determine relevant associations between focal research and their own. In this case, the transferability of this work can be extended to other areas of social network and institutional inquiry, but also to theories that examine the social aspects of organisational change and to work investigating the microfoundations of institutions (Felin & Foss, 2019; Zucker & Schilke, 2019).

Generalizability and transferability cannot be discussed without considering the threats associated with invalidating this work's findings and conclusions. External validity describes the extent to which the conclusions in a study are upheld in other places, contexts and periods (Davis et al., 2007; Corley & Gioia, 2011). Therefore, threats to validity are associated with the context, time, actors, and sites related to the research.

This study's broad context is aligned with a training and knowledge-sharing partnership among healthcare professionals who are seeking to institute new practices within their respective organisations. Improvement initiatives, knowledge-sharing partnerships and collaborations are increasingly common in institutional environments at governmental and non-governmental levels (Hibbert et al., 2009; Nasir et al., 2013; Majchrzak et al., 2015; Cannella & McFadyen, 2016). In scientific and research domains, the recent agreement for NASA and ESA (European Space Agency) to collaborate on the Artemis Gateway for lunar

communications and increased space exploration (Anderson et al., 2020) provides another example of entities sharing resources to achieve a common goal. Therefore, the concept of institutions partnering to achieve common goals is not a new phenomenon and is likely to continue.

Similarly, these findings are more relevant to contexts where the initiative's purpose has a more strategic, collaborative, and collective aim than a competitive dynamic, where activities are focused on outperforming other actors. Therefore, the individuals and the inquiry sites bring us to the second point, which provides some bearing on the results. For example, in a healthcare setting, actors and their efforts are cooperative, and they experience similar situations even when working in different locations, due to the nature of their work, the professional requirements and responsibilities of their role (Kippist & Fitzgerald, 2009; Croft et al., 2015; Evans et al., 2016). The study's findings may not be directly relatable to organisational contexts where competitive dynamics and goals are placed above social and common goals. For example, in the finance industry, venture capitalists have competitive dynamics among themselves where they seek to invest in the best start-ups, and the behaviours associated with this are more likely to be dominated by bridging and brokering among actors rather than more cohesive dynamics that are observed in collaborative settings (Hsu, 2006; Zhelyazkov, 2018). This assumption can be refuted if the relationship between entrepreneurs and venture capitalists is investigated, as more collaborative social dynamics may be observed; however, they are still unlikely to be very cohesive. A further look at the inquiry site shows increased validity due to the investigation of five organisations in different locations, with different resources and performance levels; however, they are all in the same professional, organisational and institutional domain. Therefore, consideration must be placed on this context's boundaries and transferability to others since healthcare organisations operate differently from industry and commercialized environments.

These situational and contextual factors are further confined when time is considered. This partnership commenced in 2015, five years before the global health crisis, and this study commenced in 2018. Therefore, healthcare institutions at local, regional and global levels are unlikely to have the same relational processes observed when this study was conducted two years prior. However, this difference poses an advantage, as there is data on each organisations' prior states, and these can act as benchmarks and comparators for future studies.

Overall, the investigation of five organisations that operate with varying cultures, challenges and opportunities allows this study to develop more robust explanations regarding social structures and the institutionalisation of new practices, as it highlights parallels and differences between sites to gain a deeper understanding of the social reality in different organisational contexts (Jupp,

2006; Bryman, 2012). Additionally, making comparisons across different contexts is beneficial for theorizing leading to more reliable and generalizable findings (Marczyk et al., 2005; Kumar, 2011; Bryman & Bell, 2015).

4.7 Research Methodology Summary

Clear protocols and guidelines regulate organisational studies and academic research. The third objective of this research is to explore the role of structural embeddedness with respect to the institutionalisation of new practices among actors. This research methodology provides details regarding the research strategy and design, the sample and site selection, collecting data, and the approach to analysis. The philosophical approach of the inquiry determines the research strategy. In this case, this study takes on a critical realist frame that combines the features from both positivism & interpretivism and accepts both quantitative and qualitative methodologies as modes of investigation and analysis. This philosophy also accepts that social connections and relationships can be the primary means of interpreting the social and organisational worlds. Therefore, examining relationships and drawing conclusions about the social and structural processes observed in each of these organisations becomes the core aspect of this research.

4.7.1 Research Strategy & Design Summary

This research adopts an egocentric network design as it was most appropriate to sample network data from large organisational networks by asking samples of participants to self-report their networks and describe their relationships with their most important contacts. This research design has four elements as it is *comparative, cross-sectional, non-experimental and quantitative.*

This research adopts an egocentric sampling strategy to gather data from the actors within each organisation. It is a purposive, non-probabilistic form of sampling since the sample's inclusion and exclusion criteria are well defined, and persons who met the inclusion criteria are included in the sample (Bethlehem, 2009; Fink, 2017). In this case, although well-defined group boundaries exist at the TGT, KPO and L4L levels, egocentric sampling methods were used to capture the relationships of persons engaged in improvement work in an organisational context rather than relationships within the context of the partnership. This sample includes clinical and non-clinical healthcare professionals at all levels of the organisation, including senior executives, clinical managers, consultants, matrons, nurses, pharmacists, radiologists, dieticians, physiotherapists and non-clinical management professionals.

4.7.2 Data Collection Summary

Table 12: Social Network Data Collection Summary

Social Network Data	NHS-A	NHS-D	NHS-C	NHS-K	NHS-E	Total
Respondents	**94**	**70**	**67**	**49**	**67**	**347**
No. Actors in each Network	**247**	**181**	**167**	**133**	**187**	**915**

The study uses two self-reporting socio-metric survey instruments to gather data to measure structural embeddedness and collect actor attribute data to measure actor-relation effects within each organisation. The first survey gathered social network data from the KPO & TGT via a paper-based socio-metric survey, and the second survey was administered via a web-based survey that captured L4L ego-networks and attributes data. The same surveys were administered to each organisation to maintain consistency and bolster the comparative framework. Altogether, 347 ego-centric networks were collected across the organisations, and 915 collaborators were identified (See Table 12).

4.7.3 Measures & Data Analysis Summary

Table 13: Summary of Measures & Analysis

Structural Embeddedness	Measure & Analysis	Examines
Network Characteristics	Network size, Density	The Extent of Connectivity among professionals.
	In- & Out- Degree Centralisation	The Extent of Centralisation Network Structure.
Reciprocity	Arc Reciprocity	Stability of Relationships within the network & among Professional Groups.
Bridging & Closure	Triad Census	The number of open & closed triadic configurations in the network.
	Triad Composition	The presence of professional role within triads.
	Gould & Fernandez Brokering Roles	The Extent of Brokering among professional groups.
Combined Examination of Structural & Relational Mechanisms	Model A ERGM: Purely Structural Model B ERGM: Structural & Actor-Relation Effects	The Presence of Structural Configurations associated with Reciprocity, Centrality, Brokering, Closure and actor-relation effects in the network.

After the network data was collected, the respondents' and collaborators names were anonymised and structured in Excel to conduct analysis. Adjacency matrices were constructed in Excel to record relational data, and each matrix was imported into UCINET, a social network analysis software package used by academics, to create the networks and conduct descriptive, connectivity and brokering analysis. Previous studies would limit their examination to these types of measures. However, recent developments in SNA, such as Exponential Random Graph Models (EGRM), have allowed further examination of networks' social structures and processes. ERGMs examine the structural embeddedness of actors, as it isolates distinctive structural motifs and simultaneously considers its influence on the overall network. This approach enables the simultaneous examination of reciprocity, centrality, brokering and closure mechanisms. The use of ERGMs allows researchers to explicitly model the observed organisation's networks against

theoretically informed and supported network configurations to estimate their effects. After the models are specified, and the configurations are determined, the model is estimated in the PNet software package, simulating and conducting the stochastic analysis of social networks (Wang, Robins, et al., 2009). In recent years, this modelling approach has been adopted by researchers to understand the social processes and network mechanisms associated with communication (Shumate & Palazzolo, 2010), knowledge and expertise (Brennecke & Rank, 2017), trade (Brailly et al., 2016; Hollway & Koskinen, 2016), leadership (White et al., 2014, 2016) and other areas of interest for social networks (Lusher, Johan, et al., 2013). A summary of measures and analysis is provided in Table 13.

4.7.4 Methodological Considerations, Limitations & Generalizability Summary

In this section, the considerations and limitations are summarised. First, an ego-centric research design is adopted; this limits data collection from the broader groups of participants but is most appropriate when targeted studies or large populations are involved. Accordingly, purposive sampling strategies are associated with boundary specification and determining focal participants. In some research, a purposive sampling strategy is seen as a limitation since it invites biases and representativeness issues within the study. In this case, the NHS-VMI partnership is a unique context and setting and was deemed appropriate to investigate the social networks of actors collaborating to embed new practices within their organisation. Similarly, each organisation has thousands of professionals; therefore, conducting a targeted study was the most appropriate approach.

The research design lacks a prior state, base case, or the selection of an organisational group that was not engaged in improvement work. As the social networks studied were designated to specific actors such as Lean for Leaders, RPIW participants, and members of the KPO and TGT, little attention was given to other groups to gain insight into the networks of actors who are not in the process of learning, applying and adopting new practices. Another limitation associated with this point is that this research has a cross-sectional research design, so there is no prior research or secondary study to validate network processes and mechanisms, as networks change over time, especially knowledge and information sharing networks (Snijders, 2017). As such, future research designs should consider including a case that is not engaged in improvement initiatives to investigate and acknowledge the differences or similarities between the two groups. Similarly, if the time, resources, and access allow, future research should consider a longitudinal research design feasibility to capture the social networks before the improvement work initiative and a few months after it has begun.

In terms of data collection, further limitations are identified and considered. As the primary data collection method is through self-reported surveys, non-sampling error emerges from survey

instruments and biases. Non-sampling errors include data collection and response biases associated with self-reporting, social desirability, and common method bias. These issues were addressed by conducting Quadratic Assignment Procedures (QAP) at varying network levels and values. A quadratic assignment procedure (QAP) was used to detect and test for differences in question responses and ratings while controlling for the underlying matrix structure. In this case, the ties between actors remain constant, but the ties' ratings are re-evaluated to examine the network's structural influence and the ratings attributed to an actor. The high levels of variability indicate a low degree of response bias and social desirability in terms of the rating for each of the five questions. Similarly, the results comparing valued data and the binary data below the threshold suggested by Podsakoff et al. (2003) indicate that common method bias is not an issue for this study.

The final data collection limitation relates to the incompleteness of data. As there were two modes of data collection, the social network data was collected effectively; however, the associated actor-relation data such as age, professional roles, tenure, and other attributes were not. The web-based survey had several attitudinal and behavioural questions regarding actor acceptance and engagement regarding the new practices and improvement work; however, this data was not collected from the paper-based respondents and could not be collected from the identified collaborators social network data collection. This incompleteness did not pose a serious issue to the research, but further analysis could have been conducted regarding actor sentiments if it were available. Therefore, future research would consider setting up a second data collection process to survey collaborators whom the original respondents nominated. Finally, due to the nature of data analysis and the model specification and estimation for ERGMs, the analysis was reduced to two questions, Q2 and Q5, to limit redundancy and the time required to conduct analysis.

In terms of ethics, both participant and researcher concerns are highlighted and addressed; and similarly, generalisability and transferability of the research results, findings, and conclusions are considered. This study focuses on the two latter forms of generalizability, analytic generalization and transferability, and the associated threats to validity, such as the sites, individuals, context, and study time. Overall, the investigation of five organisations that operate with varying cultures, challenges and opportunities allows this study to develop more robust explanations regarding social structures and the institutionalisation of new practices, as it highlights parallels and differences between sites to gain a deeper understanding of the social reality in different organisational contexts (Jupp, 2006; Bryman, 2012).

The next chapter, Chapter 5: Empirical Findings, presents the connectivity, centralisation, brokering, triadic and exponential random graph model results to develop findings on structural embeddedness in each organisational network.

Blank Page

Chapter 5: Empirical Findings

5.1 Introduction

In line with the research objectives, this chapter presents the empirical findings associated with the third objective related to the *exploration of* the structural embeddedness to institutionalise new practices among institutional actors. This chapter outlines the empirical findings of the research described in Chapter 3: Research Context and Chapter 4: Research Methodology, by examining the social networks of healthcare professionals in five organisations in the United Kingdom adopting the Virginia Mason Production System (VMPS), a lean methodology to facilitate continuous improvements and organisational change initiatives.

The research adopts a social network research design and strategy, which allows the systematic analysis of networks in each organisational context. The data was gathered using paper and web-based sociometric surveys to capture healthcare professionals' social networks and subsequently measure and evaluate these actors' structural embeddedness and associated relational mechanisms. Overall, data collection was focused on actors directly involved in the strategic planning and implementation of the articulated improvement initiatives. After collection, the data was anonymized and transformed into binary matrices to conduct data analysis, which included univariate analysis to describe the network's structure and stochastic analysis using exponential random graph models (ERGMs). ERGMs simulate probability distributions of the observed networks and decomposes the overall structure of an observed network to reveal the underlying social processes and microstructures that make up the network, based on the probability distribution of a fixed set of nodes or actors within the network (Robins, Pattison, et al., 2007; Lusher, Johan, et al., 2013). This analytical method is suitable to examine structural embeddedness in organisations as it allows researchers to make inferences or draw conclusions about the types of social processes that may have produced the network structure (van der Pol, 2019).

The results are presented in two main sections, where the univariate analysis results are presented first, with four sections covering the overall connectivity, centralisation, brokering and cohesion of each network. In the next section, ERGM results are described, focusing on connectivity, centrality, brokering, closure and actor-relation effects. A summary of the results is presented at the end of each section to highlight the parallels in the networks. Due to the scale of output generated, detailed results and procedures are provided in Appendix D. In the following chapter, Chapter 6: Discussion, the findings are analysed and synthesized to address the fourth objective, where a final comparison is presented, which seeks to *advance* institutional perspectives by illustrating how social relationships and embeddedness are associated with the institutionalisation of new practices.

5.2 Univariate Results

5.2.1 Connectivity Results

Table 14: Summary of Connectivity Results for the Five Organisations

		NHS-A	NHS-D	NHS-C	NHS-K	NHS-E
Network Size (Actors)		247	181	167	133	187
Number of Ties		389	273	269	194	279
Network Density		0.006	0.008	0.009	0.011	0.008
SD Density		0.08	0.091	0.098	0.105	0.089
Arc Reciprocity		0.149	0.154	0.134	0.103	0.093
No of Actors Professional Group	Nurses	81	38	53	31	36
	Drs & Consultants	31	29	12	15	19
	Allied Healthcare Pro.	37	27	34	24	34
	Clinical Professionals	149	94	99	70	89
	Non-Clinical & MGMT	98	87	68	63	98
No of Actors Partnership Roles	TGT	5	8	7	7	6
	KPO	8	9	8	6	7
	L4L	89	56	49	28	55
	RPIW	79	38	54	31	90
Professional Group Density	Nurses	0.010	0.010	0.016	0.012	0.017
	Drs & Consultants	0.018	0.017	0.023	0.029	0.026
	Allied Healthcare Pro.	0.018	0.028	0.012	0.027	0.021
	Non-Clinical & MGMT	0.011	0.015	0.023	0.023	0.013
Professional Group Arc Reciprocity	Nurses	0.158	0.071	0.044	0.103	0.045
	Drs & Consultants	0.167	0.146	0.167	0.2	0.138
	Allied Healthcare Pro.	0.122	0.065	0.083	0	0.189
	Non-Clinical & MGMT	0.145	0.195	0.184	0.108	0.077

The univariate statistics provide a general overview and description of the advice networks. An advice network is an informal instrumental network depicting goal-oriented or advice-based relationships. Therefore, the networks under examination provide insight into the extent of actors' connectivity, centralisation, brokering and cohesion regarding the exchange of formal and informal information about improvement work. Table 14 summarises the relevant univariate statistics for each organisation to understand the similarities and differences of the advice provision networks for the five organisational networks, and network graphs are constructed to visually depict the structure of each network (See Figures 15-19).

Network size measures the number of actors, whereas ***network density,*** provides a benchmark of the extent of connectivity among actors as a proxy for social cohesion. It compares the number of actors to the number of ties in the network. NHS-A has the largest network size with 247 actors,

389 ties, and a density of 0.006 (SD = 0.08). NHS-D and NHS-E are similar in size, 181 and 187 actors, respectively. NHS-D has 273 ties, and NHS-E has 279 ties, and they both have a density of 0.008; however, NHS-D has a slightly larger SD. Next, NHS-C has a network size of 167 with 269 actors and a density of 0.009 (SD =0.098), and NHS-K has a slightly smaller network with 133 actors, 194 ties, and a density of 0.011 (SD = 0.105). A high density indicates a high level of connectivity within a network: however, density is low across the networks as less than 1% of the networks' possible connections exist, and the SD is larger than the density result in each case. This result indicates that the data is not normally distributed, and there is a high level of variance regarding the distribution of ties. This finding may suggest that some actors have many connections, whereas other actors have significantly fewer ties. A second insight here is the extent of the differences; for example, NHS-A has the largest network size and the smallest density, and NHS-K has the smallest network size and the largest density. This result indicates that as the network size increases, the extent of connectivity decreases within the organisations. In Nakauchi et al. (2017) study on knowledge transfer processes, the network size was 609, with a density of 0.014 (SE = 0.171); therefore, these results are typical compared to other knowledge-based and information-related organisational studies.

To distinguish connectivity among professional roles, group densities were examined for professionals who share similar roles. In NHS-A, NHS-D, NHS-K and NHS-E, doctors, consultants and allied healthcare professionals have the highest group density, whereas, in NHS-C, doctors, consultants and non-clinical management professionals have the highest group density. This result indicates higher levels of connectivity among these groups. Conversely, nurses have the lowest group density in NHS-A, NHS-D and NHS-K, whereas allied healthcare professionals and non-clinical professionals have the lowest density in NHS-C and NHS-E; this result indicates lower levels of connectivity among these groups.

Network density, however, does not account for the directions of these relations. As these are directed networks, ***arc reciprocity*** indicates the proportion of ties reciprocated within the network, which shows how many persons have nominated each other as collaborators regarding improvement work. Arc reciprocity indicates the extent to which actors are mutually interacting with each other regarding improvement initiatives; therefore, this measure provides a proxy of mutual network connections. NHS-D has the highest proportion of reciprocated ties in the overall network, followed by NHS-A and NHS-C, whereas NHS-K and NHS-E have a lower proportion of ties than the other organisations.

Like group density, arc reciprocity was examined to determine the extent of reciprocity within each professional group. This connection lends insight to understand the extent to which actors are mutually interacting regarding improvement initiatives based on their professional roles. In

the nurses' professional group, NHS-A and NHS-K have the highest proportion of reciprocated ties among the networks. These results were above the mean of 0.084 (8.4%) compared to the other networks with a lower degree of reciprocity among nurses. NHS-D with slightly below the average, whereas NHS-E and NHS-C are almost half the average. This result indicates higher levels of reciprocity among nurses in NHS-A and NHS-K compared to the other organisations. The NHS-A result is surprising as nurses have the lowest density but the highest reciprocity compared to the other groups. This result indicates that although nurses are not as densely connected as other professional groups, there are greater mutual interactions and information sharing regarding improvement work among nurses in NHS-A.

The Doctors & Consultants professional group has the highest average of reciprocated ties 0.164 (16.4%); this result is greater than the overall network reciprocity. NHS-K, NHS-A and NHS-C have a higher-than-average level of reciprocity within this professional group. Similarly, reciprocity among doctors in NHS-A, NHS-C, NHS-K and NHS-E are higher than the overall network reciprocity. This result indicates that the degree of mutual interactions among doctors in these networks is higher than the other professional categories; and suggests a higher level of communication and cohesion among doctors than other professional groups.

Next, the allied healthcare professional's group (AHP) includes pharmacists and physiotherapists and has average reciprocity of 0.092 (9.2%). NHS-D and NHS-C have below-average reciprocity in this professional group, whereas there are no reciprocated relationships among allied healthcare professionals in NHS-K. Conversely, NHS-E has the largest proportion of reciprocated ties within their network, where reciprocity among AHP is double their overall network reciprocity. This result is surprising as the AHP is comparatively the lowest degree of reciprocity among the professional groups, yet it suggests a high level of interaction and cohesion among OHPs in NHS-E.

Finally, the non-clinical & management professional group has an average of 0.142 (14.2%) across the organisations. NHS-D, NHS-C and NHS-A have above-average reciprocity compared to the other networks. In these, network reciprocity is also the same or greater than the overall network reciprocity, which suggests that non-clinical & management professionals have a high degree of reciprocation when communicating and interacting regarding improvement work.

NHS-K and NHS-E relatively low proportions of reciprocated ties among non-clinical & management professional groups, either the same or less than the overall network. This result is surprising as this group is the largest professional category among the organisations, and NHS-A, NHS-D and NHS-C exhibit high levels of reciprocity among these professionals. A second reason this result is surprising is that most TGT and KPO actors, persons responsible for the strategic planning and implementation of the change initiative, are members of this group. This result

suggests a comparatively low degree of mutual interaction and communication among non-clinical & management professionals in NHS-K and NHS-E. This result is further highlighted when we compare NHS-D and NHS-E, which are similar and size and have the same density; we see that NHS-D has an arc reciprocity result that is 6% greater than NHS-E. It also has a lower degree of reciprocity and interaction than networks that are smaller in network size, for example, NHS-C and NHS-K. Overall, this indicates a low degree of interaction and reciprocity among healthcare professionals in the NHS-E network, and therefore a low degree of cohesion regarding improvement work.

Although group density among professional groups is higher than the overall network, it remains low, showing that connections and cohesion among professional roles are varied within each network. At the professional group level, density is higher, especially among doctors and allied healthcare professionals, suggesting dense connectivity and cohesion regarding new practices among the defined professional groups. These results are observed in NHS-A, NHS-D and NHS-K for both professional groups. Nurses' density is lowest among professional groups; however, there is a relatively high level of reciprocity among nurses in NHS-A, suggesting greater mutual connections among nurses when collaborating about new practices.

In terms of reciprocity and mutual connections within the network, doctors have the highest degree of reciprocity among the professional groups. In four networks, it is higher than the overall network reciprocity. Additionally, in NHS-A, reciprocity among nurses is higher than the overall network reciprocity, whereas, in NHS-D, NHS-C and NHS-E, reciprocity among non-clinical professionals is higher than the overall network reciprocity. This finding may also suggest that these professionals are more active regarding improvement work within their respective organisations. Overall, when comparing the organisations, these results indicate that reciprocity varies considerably across professional groups. For example, NHS-E and NHS-K both have low arc reciprocity in the overall networks; however, a different view is depicted when professional groups are isolated. These two organisations have the highest reciprocity in the Doctors and allied healthcare professionals' groups, even though they are the lowest overall.

5.2.2 Centralisation Results

Table 15: Centralisation Results Summary

	NHS-A	NHS-D	NHS-C	NHS-K	NHS-E
Outdegree Centralisation	2.6%	3.6%	5.7%	5.8%	6.2 %
Indegree Centralisation	10.4%	10.3%	12.4%	14.2%	6.8%
Outdegree Group Centralisation					
Nurses	23.5%	10.5%	20.2%	10.8%	16.1%
Drs & Consultants	18.5%	19.1%	7.7%	12.7%	13.2%
Allied Healthcare Professionals	14.3%	14.3%	16.5%	10.1%	12.4%
Non-Clinical & Management	22.1%	26.6%	31.3%	31.4%	28.1%
Indegree Group Centralisation					
Nurses	16.3%	14.0%	16.7%	14.7%	9.5%
Drs & Consultants	13.4%	13.2%	3.9%	5.1%	13.2%
Allied Healthcare Professionals	6.2%	4.5%	12.8%	6.4%	5.2%
Non-Clinical & Management	26.2%	23.4%	25.3%	18.6%	24.7%

To understand the extent to which a global network is centred around a specific focal point indegree and outdegree centralisation was examined for the network and professional groups. The centralisation statistics are scaled to percentages, where 100% indicates that all ties are connected through only one key actor, and 0% indicates that no actors in the network play a more central role than any other actor. The networks display low indegree and outdegree centralisation results that indicate a distributed network; when considering the whole network structure, most healthcare professionals have similar popularity and influence when providing information and collaborating regarding improvement work.

NHS-E, NHS-K and NHS-C have similar outdegree centralisation statistics, which are comparatively higher than NHS-A and NHS-D. This result indicates higher activity and information-seeking behaviours in the NHS-E, NHS-K and NHS-C networks than NHS-A and NHS-D. For example, NHS-E has nearly double the outdegree centralisation of NHS-D, which has a similar size and density. The indegree centralisation statistics are larger than the outdegree centralisation statistics for all the networks except NHS-E. First, this result suggests higher levels of incoming ties in these networks than outgoing ties, which suggests that actors in these networks tend to be receivers of information and advice, compared to NHS-E. Therefore, the difference in proportions between the outdegree and indegree centralisation indicates a higher degree of incoming ties and popularity in these networks.

When considering the professional groups in terms of outdegree and indegree centralisation, further insights are gained to understand the dynamics of popularity and information seeking within the networks. For example, the group outdegree centralisation is highest among non-clinical health professionals in all networks except NHS-A, where outdegree centralisation is

highest among nurses. Although these results are low, under 32%, indicating a lack of centralisation around one key actor, the outdegree centralisation for nurses in NHS-A and non-clinical professionals in the other networks is twice or three times greater than doctors and allied healthcare professionals, suggesting significantly higher levels of activity and information-seeking behaviours among nurses and non-clinical professionals. The group indegree centralisation follows a similar pattern, where there are much higher levels among non-clinical healthcare professionals, indicating that these actors are more popular sources of information regarding improvement work and new practices.

When we compare these results, it highlights similarities among the organisations. NHS-K and NHS-C display a higher propensity of incoming ties and many actors to refer to a few popular actors for information and advice; however, there is much less outgoing activity regarding actors who seek information or advice from several collaborators. This pattern is also seen in NHS-D and NHS-A as they also have similar indegree and outdegree centralisation patterns, albeit on a smaller scale compared to NHS-K and NHS-C. The large extent of incoming ties in NHS-K is surprising as this network has the smallest size, diameter, low reciprocity but a higher density than the other organisations. In contrast, the proportion of incoming and outgoing ties for NHS-E is approximately the same, yet it has the highest outdegree and the lowest indegree. This result exhibits very different characteristics from the other organisations. It is surprising as it indicates no centralisation of activity or information-seeking behaviours among actors, suggesting a lack of influential actors within the network and a more distributed or decentralized network structure.

The non-clinical healthcare professionals have higher group outdegree and indegree centralisation, suggesting higher popularity and information-seeking behaviours in this group. However, this finding is unsurprising as most TGT and KPO actors who have strategic roles regarding improvement work are included in the non-clinical healthcare professionals category. Additionally, more actors in the non-clinical healthcare professionals group than the other categories due to the decomposition of those professional roles. Therefore, this finding may be aligned with the categories' size and composition rather than other underlying relational dynamics.

5.2.3 Brokering Roles Results

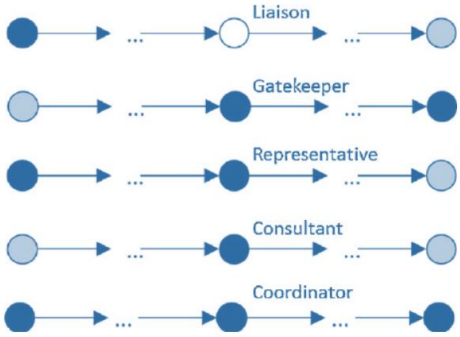


Figure 14: Graphical Representation of Gould & Fernandez Five Network Roles

To understand the extent of professional and partnership roles brokering within each network, the Gould and Fernandez brokering roles were used to examine group membership and tie direction in brokering relationships. Compared to traditional brokering measures, which do not distinguish actors' ties in the same or different groups, this distinction is crucial as it has varying implications regarding the nature and outcomes of improvement work and knowledge-sharing initiatives. This categorisation specifies the internal and external information flows and brokering activities within and outside professional groups and sheds light on relational mechanisms such as bridging and closure. The detailed results are outlined in Appendix D4 and the aggregation of brokering roles based on professional and partnership roles in the network are presented here.

The coordinator role was the most common brokering role for NHS-A, NHS-D and NHS-C. The coordinator and gatekeeper roles were performed somewhat equally in NHS-E. These results indicate higher degrees of intra-group brokering within these networks and higher degrees of information coming within a professional group than being shared outside of it. In NHS-A, NHS-D, NHS-C and NHS-E, the consultant role was the least observed brokering role, and this indicates a decreased tendency for a professional to share information with actors from the same professional group. NHS-K is different from the other networks in this regard as the coordinator and representative roles were least observed, and the gatekeeper, consultant and liaison roles were equally observed. This result indicates a lower degree of intra-group brokering among clinical professionals and higher intergroup brokering degrees among non-clinical management professionals within this network. At the network level, NHS-C has the highest percentage of actors performing a brokering role, 60%, where 37% are non-clinical management professionals. In NHS-E, 57% of the network performs a brokering role, and 36% are non-clinical management professionals. NHS-D and NHS-K have relatively fewer actors, 48% and 43%, respectively, and 29% of actors are non-clinical management professionals. Most brokering roles are performed by non-clinical management professionals in all the organisations except NHS-A, where clinicians

perform 31% of brokering roles, accounting for 54% of the network. This result is unique, indicating that clinical actors are more active regarding brokering improvement information than other organisations.

When partnership roles are examined, the TGT and KPO actors make up 4-6% of brokering roles within the network. This small percentage is expected as these actors make up less than 10% of the overall network. However, this result varies at the L4L and RPIW levels. In NHS-A and NHS-E, 23% of L4L and RPIW actors are in brokering roles, and NHS-C and NHS-D have 20% and 17%, respectively. NHS-K has only 7% in comparison, indicating that actors trained in the lean method are less likely to broker information about improvement work within this network.

Finally, when we compare betweenness centrality measures (See Appendix D3) and the brokering roles observed within the network, there are apparent differences, as the Gould & Fernandez roles detect double and nearly triple the extent of brokering activities in the organisational networks. Centrality examining brokering is based on actors' positions, whereas the Gould & Fernandez brokering roles examine intergroup and intragroup brokering behaviours (Table 16). Therefore, this approach allows this research to analyse relational mechanisms, such as brokerage patterns and the direction of relationships between groups in networks, which can generate insights regarding the relationships among professionals and the association with the institutionalisation of new practices.

Table 16: Summary of Brokering Roles by Professional & Partnership Role

Brokering Role	NHS-A		NHS-D		NHS-C		NHS-K		NHS-E	
Coordinator	35		27		28		10		27	
Gatekeeper	26		17		21		13		26	
Total No. Internal Roles (% Total Brokering Roles)	**61 (47%)**		**44 (51%)**		**49 (49%)**		**23 (40%)**		**53 (49%)**	
Representative	33		22		19		9		18	
Consultant	18		9		14		13		16	
Liaison	19		11		17		13		21	
Total External Roles (% Total Brokering Roles)	**70 (53%)**		**42 (49%)**		**50 (51%)**		**35 (60%)**		**55 (51%)**	
Total Brokering Roles	131		86		99		58		108	
% of Network	**54%**		**48%**		**60%**		**43%**		**57%**	
Betweenness Centrality	**25%**		**22%**		**23%**		**16%**		**24%**	
Professional Roles	**Total Brokers**	**% Network**	**Total Brokers**	**% Network**	**Total Brokers**	**% Network**	**Total Brokers**	**% Network**	**Total Brokers**	**% Network**
Nurses	32	13%	8	4%	28	17%	9	7%	9	5%
Doctors	21	9%	14	8%	4	2%	7	5%	17	9%
Allied Healthcare Professionals	21	9%	12	7%	6	4%	3	2%	14	7%
Clinical Roles	74	31%	34	19%	38	23%	19	14%	40	21%
Non-Clinical MGMT Roles	57	23%	52	29%	61	37%	39	29%	68	36%
Total Brokering Roles	**131**	**54%**	**86**	**48%**	**99**	**60%**	**58**	**43%**	**108**	**57%**
Partnership Roles										
TGT & KPO	10	4%	12	7%	12	7%	5	4%	11	6%
L4L & RPIW	56	23%	31	17%	34	20%	9	7%	43	23%

Total Partnership Roles	**66**	**27%**	**43**	**24%**	**46**	**28%**	**14**	**11%**	**54**	**29%**

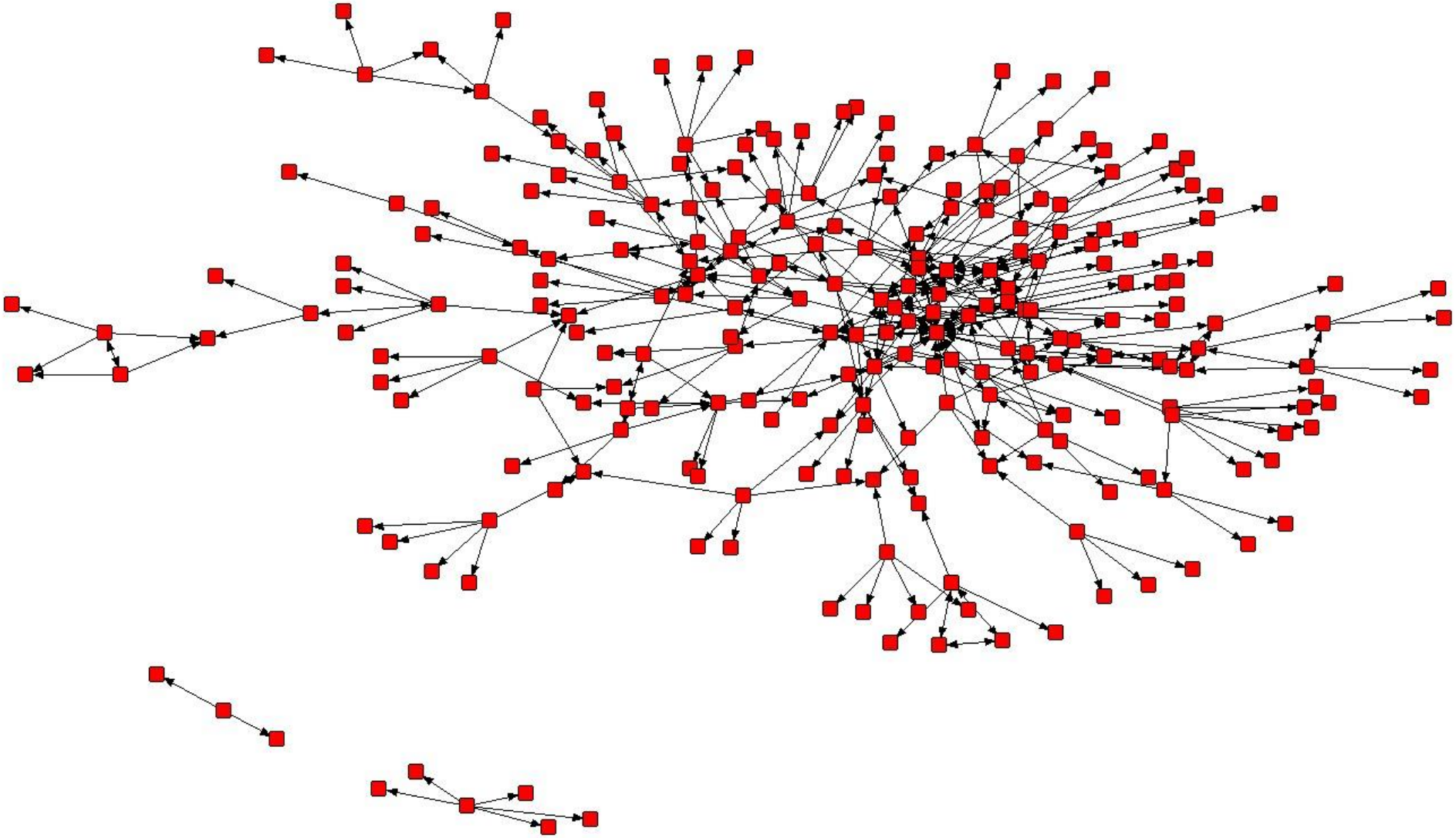


Figure 15: NHS-A Network Graph

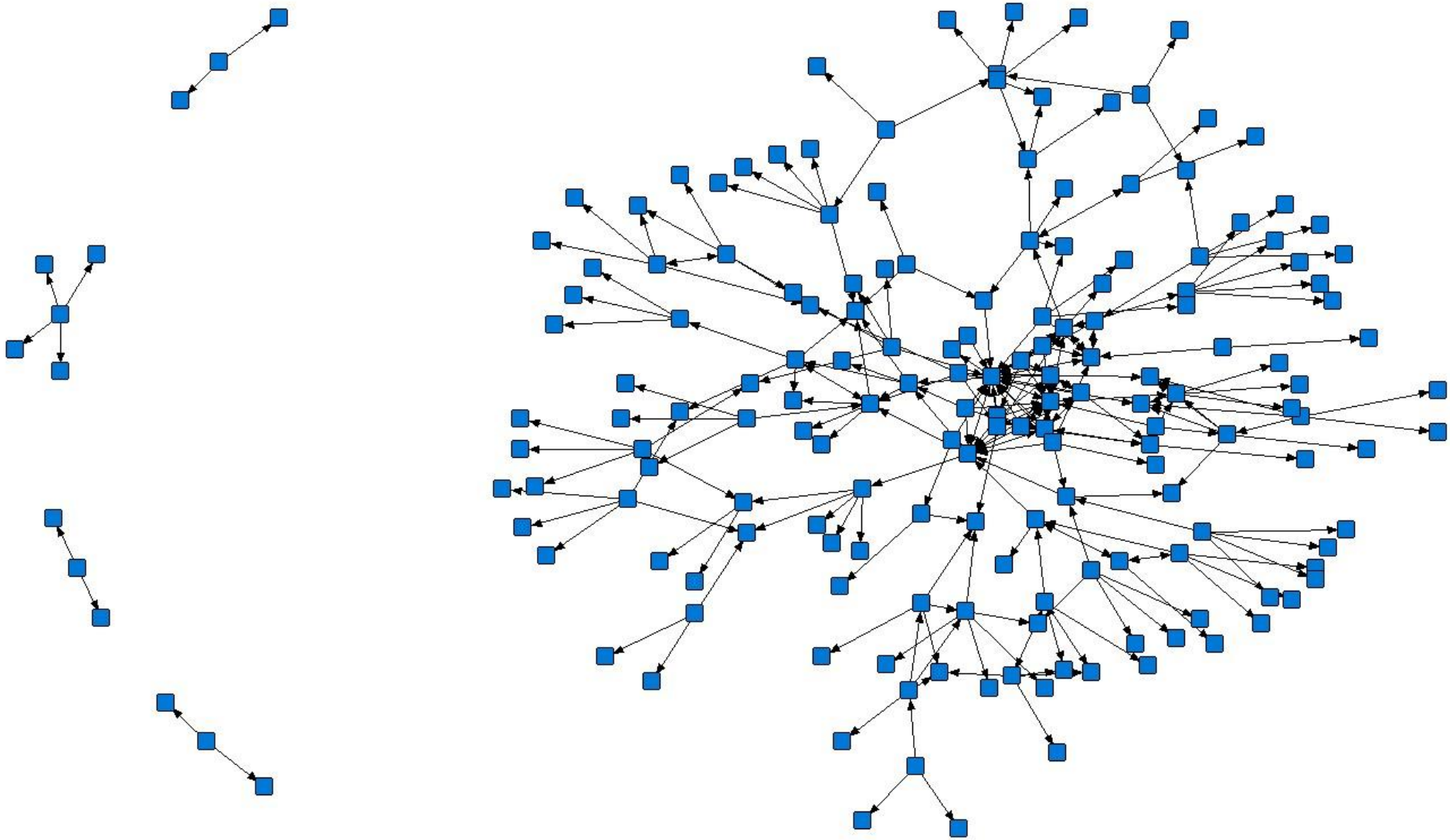


Figure 16: NHS-D Network Graph

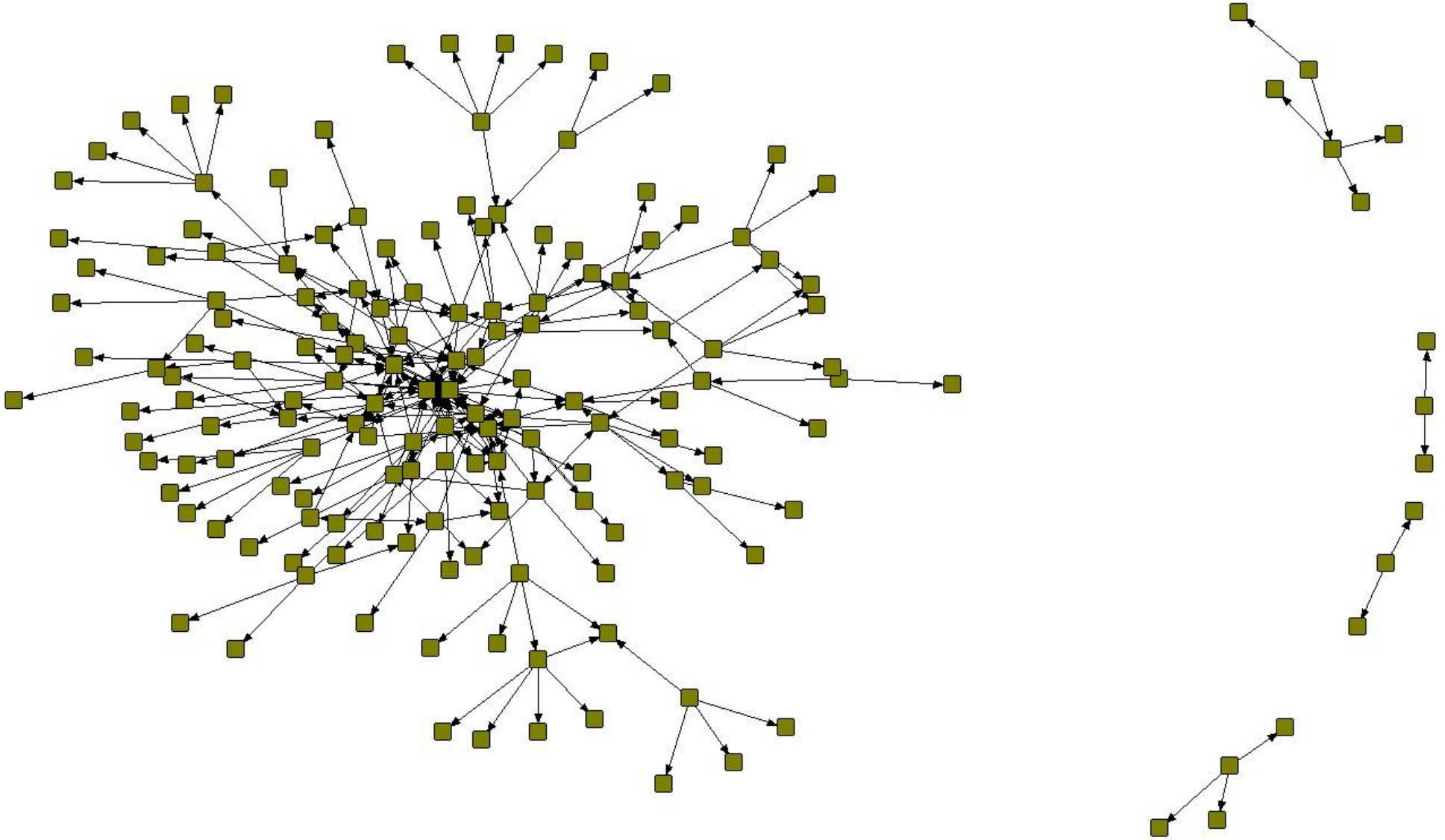


Figure 17: NHS-C Network Graph

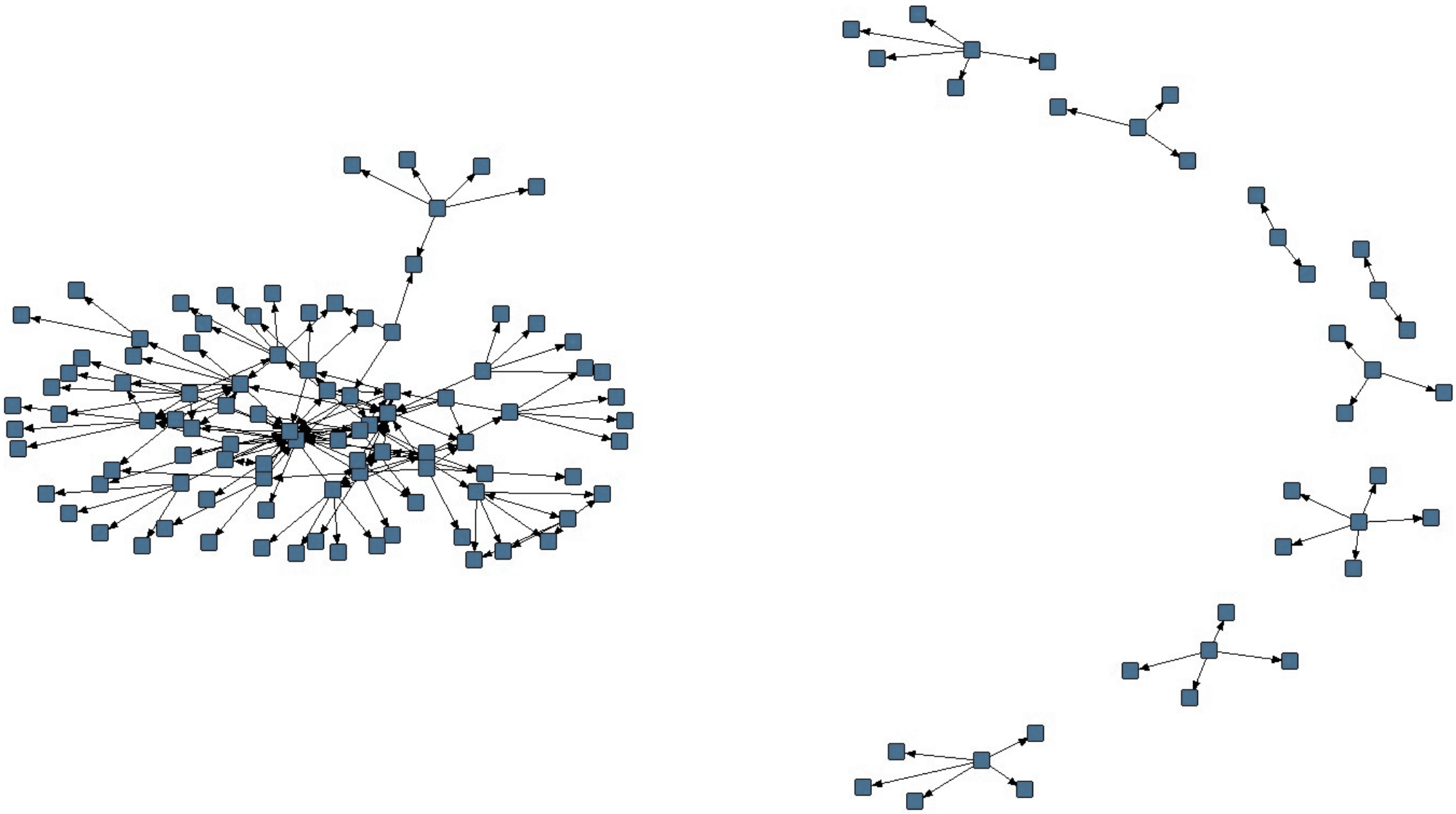


Figure 18: NHS-K Network Graph

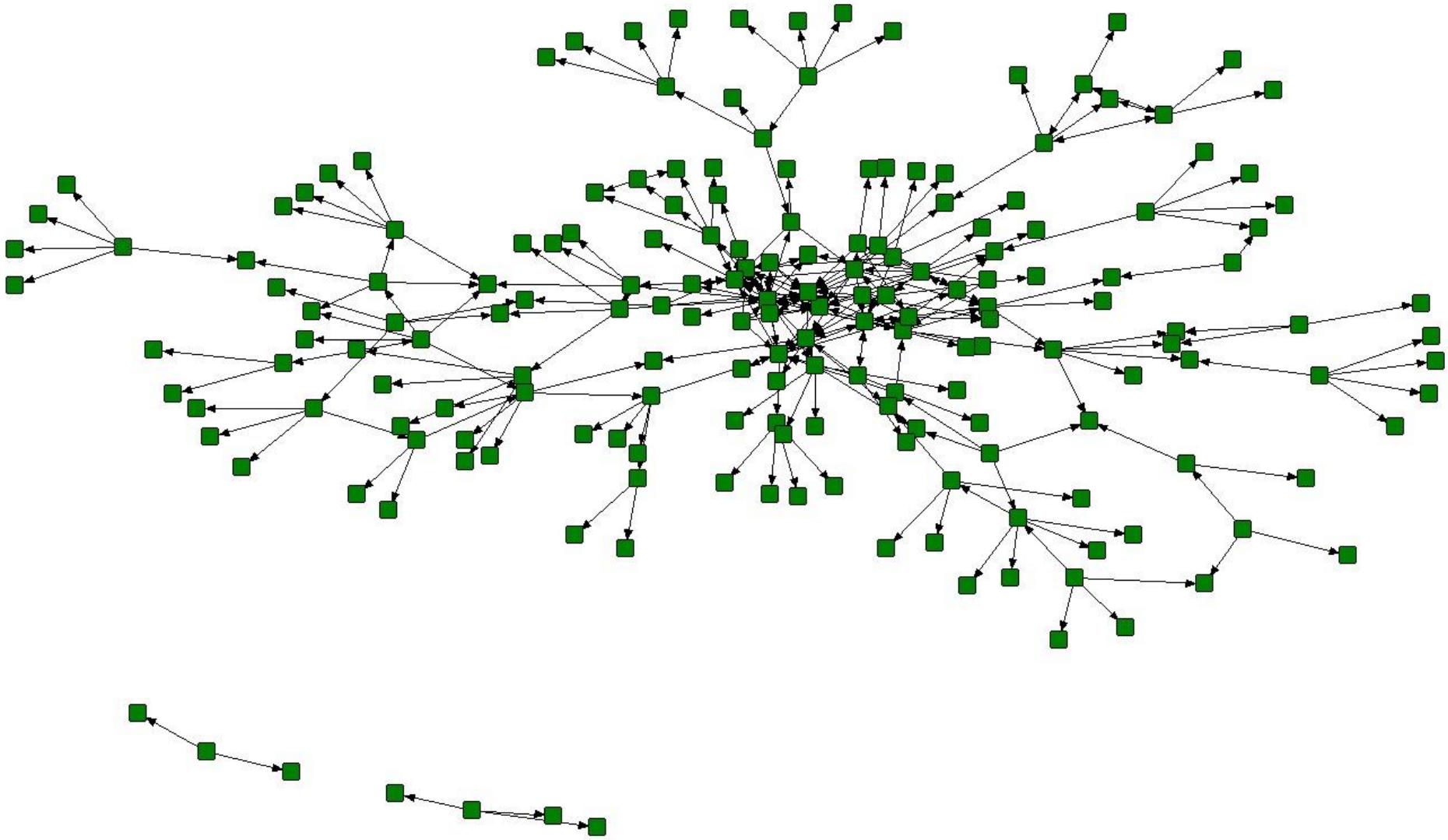


Figure 19: NHS-E Network Graph

5.2.4 Triad Results

Table 17: Clique Size & Composition of Cliques by Professional Role Results

	NHS-A		NHS-D		NHS-C		NHS-K		NHS-E	
Density	0.006		0.008		0.01		**0.01**		0.01	
Arc Reciprocity	0.149		**0.154**		0.134		0.103		0.093	
Network Size	247		181		167		133		187	
Composition of Triads (No & % of Unique Actors)										
Unique Actors	69	28%	50	28%	51	31%	33	25%	45	24%
Professional Roles										
Clinical	38	55%	20	40%	25	49%	9	27%	22	49%
Nurses	20	29%	4	8%	19	37%	5	15%	7	16%
Drs & Consultants	8	12%	8	16%	3	6%	3	9%	7	16%
Allied Healthcare Pro.	10	14%	8	16%	3	6%	1	3%	8	18%
Non-Clinical & MGMT	31	45%	30	60%	26	51%	24	73%	23	51%
Partnership Roles										
TGT	5	7%	7	14%	7	14%	7	21%	6	13%
KPO	6	9%	9	18%	7	14%	4	12%	7	16%
L4L	49	71%	27	54%	25	49%	14	42%	24	53%
RPIW	32	46%	13	26%	30	59%	19	58%	32	71%

Triads are the most basic subgroup size where each actor is connected to another. Theoretically, these measures provide insight into different forms of brokering and closure within the networks. Table 17 presents the number and composition of triads within a social network to determine the extent of triadic connectivity associated with professional and partnerships roles.

When taking a closer look at the composition of the triads within each network, the results show that NHS-C has the largest proportion of unique actors, with 31%, NHS-A and NHS-D both have 28% NHS-K and NHS-E have 25% and 24% respectively. Upon further examination, we see that 55% of actors are clinical professionals in NHS-A, 49% of clinical professionals NHS-C and NHS-E. Comparatively, NHS-K and NHS-D have larger non-clinical management professional compositions making up 73% and 60% of triads, respectively. This result indicates that NHS-K has the smallest proportion of clinical actors with 27%. At the clinical professional level, NHS-C and NHS-A have larger proportions of nurses within the triads than the networks, with 37% and 29%. Alternatively, the other professional groups make up 6-18% of the triads' remaining actors. These results indicate a higher presence of non-clinical management professionals within the triads, except NHS-A. This result is unsurprising since TGT and KPO actors are classified as non-clinical management professionals, have a strategic role in fostering the change initiative, and are crucial information sources regarding improvement work.

In addition to professional roles, the triads were also examined against the partnership roles categories. The TGT members strategically align improvement plans with organisational objectives, and the KPO are responsible for training professionals in the Lean methodology and supervising improvement work initiatives. Therefore, these actors plan and coordinate and their presence in triads would increase access to information about improvement work and build cohesion among connected actors. In NHS-A, TGT and KPO actors account for 16% of triad members, ranging between 27-33% in the other four networks. This result suggests that triads in NHS-A are not dominated by TGT and KPO actors as they make up less than 20% of actors; in comparison, in NHS-D and NHS-K, TGT and KPO actors make up over a third of members.

The distribution of L4L and RPIW participants varies. The L4Ls role is to apply and share the new methods and practices with colleagues to foster a culture of learning and change that leads to efficiencies and savings within their work environments. In NHS-A, L4Ls make up over 70% of triads, whereas the other networks have 54% or less. This result indicates that L4Ls in NHS-A have a relatively high presence in triads, which aids information sharing and advice within triads and builds cohesion among actors involved in improvement work. This finding also suggests that L4L in NHS-A, as their name suggests, leads or has a dominant role in improvement initiatives within their work environment. The other networks have a comparatively low presence ranging from 42-54%. This result suggests more sources of information and advice in triads from actors who are non-clinical professionals as they make up 51-73% of these. However, this limits information and advice from knowledgeable clinical sources within triads and may not support cohesion among L4Ls who are also clinical professionals.

Alternatively, RPIW participants display a different presence in the triads. The RPIW participants are involved with specific improvement initiatives that are implemented and tracked over a few months. This initiative may foster closure, and cohesive behaviours as persons who collaborate in an RPIW are more likely to engage with those actors about the targeted improvement activity and improvement work in general. NHS-E has the highest RPIW triad presence, 71%, and this finding is supported as NHS-E conducted 38 RPIWs which is double or more compared to the other networks. Surprisingly, NHS-K has an RPIW presence of 58%; however, they completed only 12 RPIWs, whereas NHS-D completed 21 RPIWs and had a triad presence of 26%. Therefore, the triad presence is not directly related to the number of RPIWs conducted; however, an association may exist.

NHS-D and NHS-E have the same network density, but NHS-D has fewer triads than NHS-E. However, when considering arc reciprocity, NHS-D has a greater likelihood to generates consensus and agreement within their network. NHS-A has the highest number of triads, the highest arc reciprocity among professional groups, and the highest degree of intra- and intra-

group brokering among the organisations. This combination enables NHS-A to have a greater likelihood to generate consensus and agreement regarding improvement work within their network, but specifically among clinical professionals. The NHS-C and NHS-K results indicate a greater likelihood of generating consensus and agreement regarding improvement work among non-clinical professionals, as higher reciprocity and brokering are present within these professional groups.

Table 18: Relevant Triad Census Results

Open Triads		**NHS-A**	**NHS-D**	**NHS-C**	**NHS-K**	**NHS-E**
012C Simple Connectivity (2 Ties) (Unreciprocated)		258	180	278	170	355
111D Reciprocated Incoming (3 Ties)		*116*	*118*	122	45	40
111U Reciprocated Outgoing (3 Ties)		102	61	83	36	83
201 Mutually Reciprocated (4 Ties)		11	12	9	3	1
Total Reciprocated Open Triads		**229**	**191**	**214**	**84**	**124**
Closed Triads						
030T Transitive Triad (3 Ties) (Unreciprocated)		36	32	48	24	61
120U Transitive Triad Up (Activity – 4 Ties)		15	9	8	13	11
120D Transitive Triad Down (Popularity - 4 Ties)		8	30	11	4	3
210 Mixed Triad (5 Ties)		13	14	3	2	0
Total Reciprocated Closed Triads		**36**	**53**	**22**	**19**	**14**

To delve deeper into this structure, a triad census was conducted to assess transitivity and the range of relationships within triads. These configurations represent varying forms of communication, interaction, and collaboration among groups of three actors. At a basic level, these configurations allow researchers to examine simple social microprocesses by illustrating connections among three actors, Actors A, B, and C (See Table 18). For example, at one end with a mixed triad (300), every actor within the triad is connected and provides and receives information from the others, whereas at the other, simple connectivity (012C) depicts two actors who are connected, and they act as messengers; however, there is no feedback loop or reciprocation within the group. The first four (4) configurations discuss the results for the open triads (012C, 111D, 111U, and 201), which represent three actors where only two are connected.

The next four (4) configurations will discuss the closed triads' results (030T, 120D, 120U and 210) where three actors are connected. Open triads are associated with brokering among actors, and closed triads are associated with closure within groups.

5.2.4.1 Open Triads & Brokering

The first open triad, 012C configuration, has two (2) ties, one incoming and one outgoing. It depicts simple and indirect connectivity, where Actor A receives information from Actor B and shares information with Actor C. In this case, NHS-E has the largest number of 012C configurations, 355. This result is surprising as NHS-D has a similar network but half as many configurations with 180 configurations, followed by NHS-K with 170, the least among the organisations. NHS-A and NHS-C have a similar number of these configurations with 258 and 278, respectively. In this case, of NHS-E, this result is consistent with their network's decentralized nature, where indegree and outdegree centrality are approximately the same. This result is also consistent with the large betweenness centrality score, as they have the largest number among the trusts. The 111D configuration represents reciprocated brokering behaviour, where 3 ties are present in an open triad, and practically it depicts a reciprocated relationship between Actors B and C, where Actor C receives information and advice from Actor A. NHS-C has the highest number of 111D configurations with 122, and NHS-D and NHS-A following closely with 118 and 116, respectively. NHS-K and NHS-E have the lowest number of configurations with 45 and 40, respectively. This result contrasts NHS-E's 012C (simple connectivity) result and indicates that while they have a higher degree of simple connectivity in their network, much of those relationships are not reciprocated, which reduce consensus building and agreement within the network. Therefore, compared to the other networks, NHS-E and NHS-K have fewer reciprocally tied actors and share improvement information received from connected actors.

Next, the 111U also represents reciprocated brokering behaviour in an open triad; however, it depicts a reciprocated relationship between Actors B & C, where Actor C provides Actor A with information and advice. In this case, NHS-A has the highest number of 111U configurations with 102, NHS-E and NHS-C both have 83, whereas NHS-D and NHS-K have 61 and 36, respectively. In contrast to the previous configuration, NHS-E has nearly double the number of 111U configurations, indicating a higher tendency to broker information to a third party rather than receive incoming information from a third party. This result is contrary to the other organisations' interactions, as there is a higher tendency to receive incoming information from a third party rather than brokering information to a third party.

The 201 configuration is the final open triad configuration, representing reciprocated brokering behaviour, where four ties are present. However, in this case, one actor is both a receiver and a provider of information to two disconnected parties. Here, Actors A and C are reciprocally tied to

and indirectly connected through Actor B; however, they are not connected in the network. In this case, Actors A and C provide and receive advice from Actor B, increasing the likelihood that they share the same information and advice regarding improvement work. Although reduced, NHS-D, NHS-A and NHS-C are higher than NHS-K and NHS-E, where the former organisations have 12, 11, and 9 configurations and the latter two have 3 and 1 configurations, respectively. This result further highlights a lack of unreciprocated relationships in NHS-K and NHS-E compared to the other organisations.

5.2.4.2 Closed Triads & Closure

This section presents the closed triads configurations (030T, 120D, 120U and 210), representing forms of closure and more complex interactions in triads. The Transitive Triad (030T) and Transitive Triad Up (120U) configurations represent closed triads where Actor A receives information and advice from Actors B and C. These configurations generally have a hierarchical basis, where one actor has more incoming or outgoing ties than the other two. However, the 030T configuration has three ties and an unreciprocated relational base between Actors B and C. In this triad, Actor A has two incoming ties, and Actor B has two outgoing ties, where Actor B interacts with Actors A and C, while Actor C also interacts with Actor A. In contrast, the 120U configuration has four ties and a reciprocated relational base between Actors B and C. Actor A also has two incoming ties in this triad, whereas Actor B and C are reciprocally tied, and each has one incoming and one outgoing tie. These configurations indicate activity spread or a triad's tendency to be formed based on a common actor. Practically, these depictions show one actor receiving information from two actors who either reciprocally or directly tied to each other. For the 030T, the unreciprocated social dynamic, NHS-E has 61, the most configurations among the organisations. However, this falls to 11 when considering reciprocated ties in the 120U configuration. This result highlights that although NHS-E has actors with many outgoing ties, as observed with the high outdegree centrality result; however, these relationships are not widely reciprocated. This pattern is seen with NHS-C, with 48 030T configurations and 8 120U configurations, and NHS-D with 32 030T configurations and 9 120U configurations. NHS-A and NHS-K differ from these three since at least half of the relationships are reciprocated, as NHS-A has 36 030T configurations and 15 120U configurations, and NHS-K has 24 030T configurations and 13 120U configurations.

The Transitive Triad Down (120D) configuration has four ties and represents the opposite relationship where one actor is tied to two actors who are reciprocally connected. In this case, Actor A has two outgoing ties to Actors B and C, while they are reciprocally tied to each other. Therefore, Actors B and C both have two incoming ties, and this depicts a relationship where a triad is formed due to two similar actors or where two actors share information received from a

common actor. In this case, NHS-D has 30 configurations, which is nearly ten times more than NHS-K and NHS-E, and nearly three times more than NHS-A and NHS-C. This finding suggests that NHS-D has a higher tendency for reciprocally tied actors to receive and share information and advice from a common actor compared to the other organisations. The Mixed Triad (210) has the features of both transitive and cyclic triads, where five ties are present in the triad. Actors A and C and Actors B and C are reciprocally tied in this configuration, while Actor A receives information and advice from Actor B. This configuration represents social interactions where two actors within the triad are both providers and receivers of information, and the third actor receives information from one of the reciprocally tied actors. This configuration is higher in NHS-D and NHS-A, which have 14 and 13, respectively, compared to the organisations which have 0 and 3. The 210 result suggests that NHS-D and NHS-A have a higher tendency for reciprocation in triads, and this indicates a higher level of cohesion in these organisations since this configuration has five ties among three actors.

When examining the degree of reciprocity in triads, there are differences among the networks. In terms of open triads NHS-A, NHS-C and NHS-D have the highest number of reciprocated brokering relationships, 229, 214 and 191, whereas NHS-K and NHS-E have half as many reciprocated relationships. Even though NHS-A is the largest network, NHS-C has a similar number of brokering relationships. Also, NHS-D and NHS-E are similar in size and density but vary when reciprocity is highlighted. This pattern is also observed in the closed triads; however, NHS-D, 53, has nearly four times as many reciprocated triads as NHS-E, 14. Even NHS-K, the smallest network, has a higher degree of reciprocity in closed triads than NHS-E. When NHS-D is compared to NHS-C and NHS-K, it has more than twice the reciprocated relationships in triads. Finally, when NHS-D and NHS-A are compared, it is clear that NHS-D, despite being smaller than NHS-A, still has higher reciprocity in closed triads. Therefore, NHS-A has a high degree of reciprocity among brokers, whereas NHS-D has high reciprocity in closed triads. These results are aligned with the overall network reciprocity results, as NHS-E has the lowest and NHS-D has the highest.

Overall, the open triad results show that NHS-D, NHS-A, and NHS-C are similar in terms of connectivity and reciprocity in terms of outgoing and incoming ties, whereas NHS-K and NHS-E highlight extremes. Here, NHS-E has a high tendency of outgoing rather than incoming ties and similarly a low presence of reciprocated relationships in their network. In contrast, NHS-K has low incoming, outgoing, and reciprocated relationships than the other four organisations. This finding suggests that when two actors are disconnected in NHS-D, NHS-A and NHS-C, there is still a high tendency to reciprocate and share information and advice regarding improvement work, whereas, in NHS-E, there is a higher tendency towards unreciprocated brokering. There is a

similar pattern regarding reciprocated ties in the closed triads as NHS-K and NHS-E have lower reciprocity even within closed triads; this limits the degree of cohesion within these networks.

When comparing the triad census results, NHS-D, NHS-A, and NHS-C have consistently higher reciprocity and brokering. The low levels of arc reciprocity confirm these results within the NHS-E and NHS-K networks and higher arc reciprocity within the NHS-A, NHS-D and NHS-C networks. Taken together, at the network level NHS-A, NHS-D and NHS-C have a higher degree of cohesion, reciprocity and brokering, which has the capacity to generate agreement regarding new practices, compared to NHS-K and NHS-E.

5.3 Exponential Random Graph Models (EGRMs) Results

In the following section, Model B results are presented and discussed so that structural and actor relation effects are consistently presented (See Table 20). Model A results are presented in Table 19 and referenced to display the similarity in results when actor-relation effects are not considered. For each organisational network, there are strong negative ***arc*** parameters for the density effect. This parameter measures the baseline propensity for a tie to be formed, and the significant negative parameters indicate that ties are rare and occur at random. The effects for NHS-A (*estimate* = -7.210, *SE* = 0.584, $p \leq 0.05$), NHS-D (*estimate* = -7.549, *SE* = 0.26, $p \leq 0.05$) and NHS-K (*estimate* = -6.471, *SE* = 0.289, $p \leq 0.05$) are similar, whereas NHS-E (*estimate* = -7.826, *SE* = 0.316, $p \leq 0.05$) has the largest estimate indicating it is rare for actors to create ties, whereas it is less rare in NHS-C (*estimate* = -2.952, *SE* = 0.293, $p \leq 0.05$). This result suggests that tie formation is rare, and some ties are more likely to be present in regular combinations with other ties. The direction and significance of these effects remain unchanged in Model A when actor-relation effects are considered.

There are positive ***reciprocity*** effects for NHS-D (*estimate* = 0.750, *SE* = 0.491), NHS-C (*estimate* = 1.606, *SE* = 0.421, $p \leq 0.05$) and NHS-K (*estimate* = 0.165, *SE* = 0.639), which indicate the tendency to form reciprocated ties among actors. In this case, the NHS-C estimate is large and significant, indicating that the odds of reciprocity regarding improvement work relationships are higher than the other networks. For NHS-D and NHS-K, the effect is not significant, suggesting that reciprocity is present but does not appear more than expected based on the ties' structure. For NHS-A and NHS-E, there are no reciprocity effects. In the case of NHS-E, this is understood from the triad census where there is a low presence of reciprocated relationships within the network; however, this is not the case in NHS-A. One explanation for this is that other structural effects in NHS-A replace reciprocity making it less dominant within the model. Like the arc effect, these effects are slightly smaller in Model A; however, significance and magnitude remain unchanged. Together, the negative arc estimates and low magnitude and significance of the reciprocity estimates suggest that actors consider establishing improvement work ties as costly

and may tend to form more one-sided improvement work relationships in the networks except for NHS-C, which has positive effects for both parameters.

5.3.1 Centrality Effects

Centrality and centralisation effects model activity and popularity and give some insight into the centralisation of power, influence, and popularity with the network. The two-out-star(***2-out-star***) parameter is positive and significant in NHS-D (*estimate* = 1.699, *SE* = 0.243, $p \leq 0.05$) and NHS-K (*estimate* = 1.552, *SE* = 0.198, $p \leq 0.05$); this suggests professionals' tendency to seek advice or information regarding improvement work from at least two collaborators. This effect is not observed in the other networks, indicating a lack of centralisation in these networks' outgoing ties and that actors in these networks do not commonly interact with only two actors. The three-out-star(***3-out-star***) parameter is small, negative and significant effects for all the networks. NHS-C (*estimate* = -0.065, *SE* = 0.015, $p \leq 0.05$) and NHS-E (*estimate* = -0.089, *SE* = 0.02, $p \leq 0.05$) have the smallest effect, whereas NHS-A (*estimate* = -0.316, *SE* = 0.043, $p \leq 0.05$), NHS-K (*estimate* = -0.543, *SE* = 0.081, $p \leq 0.05$), NHS-D (*estimate* = -0.831, *SE* = 0.122, $p \leq 0.05$) are larger but less than 1. This result indicates a tendency for actors to interact with three collaborators and the absence of centralisation in network activity or information seeking, and healthcare professionals tend to be relatively uniform in the number of choices of improvement work collaborators. These results also remain consistent in Model A.

Popularity Spread (AinS) is significantly negative in NHS-A (*estimate* = -1.493, *SE* = 0.236, $p \leq 0.05$), NHS-C (*estimate* = -0.933, *SE* = 0.171, $p \leq 0.05$) and NHS-K (*estimate* = -0.405, *SE* = 0.185, $p \leq 0.05$). These results indicate a decentralised approach to improvement-related collaboration and that most actors have similar popularity levels. Also, the network is not centralised on in-degree, and the estimates are greater than expected by chance. This parameter is not present in NHS-D and NHS-E, suggesting that unusual levels of in-degree centrality do not characterise these networks. In Model A, these effects remain unchanged for all networks. The ***activity spread (AoutS)*** estimate is positive and significant in NHS-A (*estimate* = 2.831, *SE* = 0.398, $p \leq 0.05$) and NHS-E (*estimate* = 1.614, *SE* = 0.267, $p \leq 0.05$). The large, positive estimates suggest network centralisation, where few actors are particularly active regarding outgoing contact and interaction with many collaborators. Practically, these actors either seek or provide improvement work information from many healthcare professionals. Compared to popularity spread, this result's magnitude is much larger and more dominant within these networks. This result also indicates that activity is centralised around a few key actors in NHS-A and NHS-E; however, these effects are not observed in the other three networks. These results also remain consistent in Model A. The difference between negative popularity spread and positive activity spread signifies a skewed network distribution where few actors nominate many actors as collaborators, seen in

the out-star and activity spread parameters. However, most actors still have similar popularity levels, as seen in the popularity spread estimate. In practical terms, many actors seek advice regarding new practices and improvements from many of their colleagues; however, these relationships are not concentrated around a few key actors at the network level.

5.3.2 Brokering Effects

Four additional star-based parameters were selected to examine bridging structure and brokering effects within the network, as these configurations have two levels of connectivity and an intermediary or brokering actor. ***Simple Connectivity (path2)*** has one incoming and one outgoing tie from an actor and is present in four networks with varying results, and this is aligned with the 012C Simple Connectivity structure in the triad census. Practically, it represents a broker receiving information from one source and sharing information with another actor. This parameter is not present in NHS-C, suggesting that simple brokering behaviours do not characterise this network. For the other four networks, this parameter is negative and non-significant. In NHS-D (*estimate* = -0.047, *SE* = 0.086), NHS-K (*estimate* = -0.081, *SE* = 0.047), NHS-A (*estimate* = -0.176, *SE* = 0.104) and NHS-E (*estimate* = -0.012, *SE* = 0.040), the estimate is negative and not significant, indicating that there is little evidence that people who send more ties also receive them; however, this does not occur more than expected. In Model A, the NHS-D (*estimate* = 0.20, *SE* = 0.08, $p \leq 0.05$) estimate is positive and significant, indicating a positive correlation between the incoming and outgoing ties, which suggests that actors who were the most popular sources of information and advice were also the most active in seeking advice from other actors. Similarly, in NHS-K (*estimate* = -0.11, *SE* = 0.04, $p \leq 0.05$), the estimate is negative and significant, indicating a negative correlation between the incoming and outgoing ties, suggesting that actors who send more ties do not receive incoming ties proportionally, which occurs more than expected. However, in Model B, none of the estimates is significant; this indicates that these effects' significance disappears when professional roles are considered.

The following three brokering roles model the depth of local connectivity among actors. The ***One-In-Alternating Out Star (1inAout-star)*** measures the extent to which a connected actor sends ties to multiple other actors; in this case, brokers have a low number of incoming ties and a high number of outgoing ties. Practically, this equates to an actor receiving information or advice about new practices from one actor disseminating information or advice across a broad range of contacts within the network. In a change initiative, this is an efficient means of spreading information within a network as fewer actors can reach large groups of actors. In NHS-A (*estimate* = 0.782, *SE* = 0.315, $p \leq 0.05$), the effect is positive, suggesting that actors have a higher tendency to share and disseminate information about new practices among multiple connected actors. In NHS-D (*estimate* = -0.442, *SE* = 0.211, $p \leq 0.05$), this effect is negative and significant, which

indicates that this behaviour is occurring within the network, but it occurs less than expected. These effects remain unchanged in Model A. The One-In-Alternating Out Star (1inAout-star) configuration also indicates formal and informal brokering relationships, such as superior and subordinate relationships, where one connected actor can efficiently communicate and distribute information across their network of contacts. This effect is expected in a healthcare setting to evidence communication and interaction between organisational leaders and their collaborative contacts; therefore, it is surprising that it is not observed in the other three networks.

The ***Alternating-in-One-Out Star (Ain1out-star)*** examines the extent to which a broker receives information from multiple actors and shares information with at least one other actor. In this case, actors have many incoming ties and a low number of outgoing ties indicating a higher tendency for the broker to receive information from multiple actors and broker information and advice to only one actor. Compared to the One-In-Alternating Out Star (1inAout-star) parameter, this effect is inefficient in terms of disseminating information across a large group; however, it is useful in modelling hierarchical effects such as bottom-up interactions where improvement work information is communicated from the lower levels of the organization to actors at higher levels of the organisation. This configuration can also indicate formal and informal superior and subordinate relationships but reflects unilateral information flows from several actors, which are brokered via a key actor. This effect is observed in NHS-A, NHS-C and NHS-E to varying degrees. In NHS-A (*estimate* = -0.152, *SE* = 0.279) and NHS-E (*estimate* = -0.014, *SE* = 0.158), this effect is negative and not significant, indicating that connectivity is neither stronger nor weaker than expected given the other effects in the model. This result suggests that information is less likely to be brokered through bottom-up interactions even though it is present within the network. In contrast, this effect is positive and significant in NHS-C (*estimate* = 0.512, *SE* = 0.129, $p \leq 0.05$), indicating a higher tendency for information to be brokered in this manner, and it occurs more than expected. These effects are not observed in NHS-D and NHS-K and remain unchanged in Model A.

The ***Alternating-in-Alternating Out Star (AinAout-star)*** indicates a brokering relationship where an actor who receives information and advice from multiple actors also shares information with multiple connected actors. Practically, this allows information and advice about new practices to be spread across a wide range of actors. Like the Alternating-in-One-Out Star (Ain1out-star), this effect is observed in NHS-A (*estimate* = -0.930, *SE* = 0.759), NHS-C (*estimate* = -2.391, *SE* = 0.266, $p \leq 0.05$) and NHS-E (*estimate* = -0.214, *SE* = 0.352). The main difference is the magnitude of these effects in NHS-A and NHS-C. While it is significant in NHS-C and non-significant in NHS-A, these estimates' magnitude is much larger than other brokering effects. This result indicates that higher degrees of this brokering activity are present in these networks than

NHS-E, where the estimate is substantially smaller. These effects remain relatively unchanged in Model A and are also not observed in NHS-D and NHS-K.

Of the four brokering effects examined, NHS-K has one observed effect, simple connectivity. This finding indicates no complex brokering relationships beyond actors who share improvement work information received from connected actors. NHS-D and NHS-C have two observed brokering effects. For NHS-D, the simple connectivity estimate is positive and significant, whereas the One-In-Alternating Out Star (1inAout-star) is negative and significant. This result suggests that simple brokering activities are more dominant than activities where information is brokered and disseminated to multiple actors from a single actor. In NHS-C, the Alternating-in-One-Out Star (Ain1out-star) and Alternating-in-Alternating Out Star (AinAout-star) parameters are both significant; however, the former is small and positive, and the latter is large and negative. This result indicates that bottom-up brokering relationships and unilateral information flow occur more than expected, and brokering among multiple connected actors occurs less than expected.

Three brokering parameters are present in NHS-E; however, none of these estimates is large or significant. This result suggests that although varying forms of brokering activities are present in this network, they do not occur more than expected, and the magnitude of these effects are weak compared to other parameters within the model. All the brokering parameters tested are present in NHS-A's network; however, three are negative and not significant, which indicates that they do not occur more than expected. The Alternating-in-Alternating Out Star (AinAout-star) has the largest magnitude of the four estimates, indicating that brokering among multiple actors has a strong effect within the model, compared to the other brokering effects even though it is negative. Finally, the One-In-Alternating Out Star (1inAout-star) is positive and significant, which indicates a high tendency for one actor to disseminate information or advice across a broad range of contacts within the network. In this case, it is beneficial for a change initiative, as it is an efficient means of communicating information about new practices across a wide range of healthcare professionals.

5.3.3 Closure Effects

Three configurations are used to model closure effects, including triads, clustering and transitivity in the network. ***Transitive Path Closure (AT-T)*** measures an actor's tendency to choose an improvement work collaborator who collaborates with their existing contacts. This structure is aligned with the 030T Transitive Triad in the triad census, where one actor has more incoming or outgoing ties than the other two. NHS-A (*estimate* = 1.98, *SE* = 0.093, $p \leq 0.05$) and NHS-C (*estimate* = 1.402, *SE* = 0.137, $p \leq 0.05$) have positive and significant estimates, indicating a high degree of hierarchical path closure and multiple triadic clusters in the network. This configuration indicates activity spread or a triad's tendency to be formed based on common

actors. It is associated with the social process of choosing friends of friends and is interpreted as a tendency for bridging structures to close when there are multiple independent paths between two collaborators. This result represents healthcare professionals' tendency to share collaboration partners, causing triads to emerge and closure to foster regarding improvement work.

Next, NHS-E (*estimate* = 1.121, *SE* = 0.141, $p \leq 0.05$) is characterised by ***Popularity Closure (AT-TD),*** a parameter that is aligned with the 120D Transitive Triad Down structure in the triad census and models the tendency for a high degree of closure to be present around actors similar in terms of their indegree or popularity. This effect is large and significant and indicates a high degree of status-based closure or triadic clusters in the network. The lack of reciprocity in NHS-E combined with popularity closure suggests that healthcare professionals form triads and cliques to give and receive advice regarding improvement work; however, these activities are hierarchical and not mutual. This result is surprising as the NHS-E network is not characterised by high levels of in-degree centralisation or popularity; however, triads emerge where it occurs. This finding suggests that closure is more likely to occurs around popular actors,

Finally, ***General Transitivity (AT-TDU)*** is a parsimonious parameter that captures three transitive triadic effects: path, activity, and popularity closure. Rather than modelling each of these effects separately, this parameter indicates a tendency for hierarchical-based network closure without distinguishing the three effects. NHS-D (*estimate* = 1.86, *SE* = 0.174, $p \leq 0.05$) and NHS-K (*estimate* = 1.516, *SE* = 0.215, $p \leq 0.05$) are characterised by Generalized Transitivity (AT-TDU). They both have large, positive, and significant estimates, which suggests a high degree of transitivity or triadic clusters in the network and provides evidence that closure occurs through three different processes with similar strengths. This result indicates multiple closure mechanisms among healthcare professionals regarding providing and receiving information about new practices.

Overall, these networks are considered complex as the structural models contain higher-order triangulation effects, indicating that these networks are characterised by high degrees but varying forms of network closure. When examining the closure effects individually, NHS-A and NHS-D have higher magnitudes, indicating that closure has a more substantial effect in their networks than the other three. From a social process view, closure effects are associated with social cohesion and collective action among actors and high degrees of indirect reciprocity and shared understandings within the network. However, this is not determined by closure alone, as other effects and mechanisms must also be considered. Altogether, these effects remain consistent in Model A, suggesting that homophily in professional roles and affiliations do not remove the influence of network closure.

5.3.4 Actor-Relation Effects

The previously discussed model parameters specify structural effects; however, further explanations are derived when examining attributes and the network's structural effects. In this section, actor-relation effects are used to highlight institutional effects by examining professional and partnership roles that jointly influence network structure. These results provide insights into the presence and dominance of institutional effects by dissecting relationships among actors based on their professional and partnership roles. In this case, ***Homophily*** models the tendency for ties to be more or less likely between actors similar in the professional and partnership hierarchy, and this was detected in four networks. In NHS-A, it was positive and observed among nurses (*estimate* = 0.726, *SE* = 0.138),

doctors and consultants (*estimate* = 0.814, *SE* = 0.144), however, it was significant among the allied healthcare professionals (*estimate* = 0.916, *SE* = 0.155, $p \leq 0.05$), non-clinical management professionals (*estimate* = 0.760, *SE* = 0.155, $p \leq 0.05$), and actors in leadership roles (*estimate* = 0.284 *SE* = 0.114, $p \leq 0.05$). This result indicates that actors in the same professional group or organisational status tend to communicate; however, it occurred more than expected among allied healthcare and non-clinical management professionals. The magnitude of these effects is small compared to the structural effects of NHS-A and do not affect their significance, indicating that homophily in professional roles does not dominate structural effects.

In NHS-D, homophily effects were also observed among all the professional groups, nurses (*estimate* = 1.224, *SE* = 0.322, $p \leq 0.05$), doctors and consultants (*estimate* = 0.868, *SE* = 0.444), the allied healthcare professionals (*estimate* = 1.341, *SE* = 0.201), non-clinical management professionals (*estimate* = 0.396, *SE* = 0.138, $p \leq 0.05$), and actors in leadership roles (*estimate* = 0.036 *SE* = 0.150); however, they were only significant among nurses and non-clinical management professionals. The magnitude of the nurse and allied healthcare professionals was large compared to other parameter estimates; this indicates a high tendency for actors in these professional groups to communicate and that these relationships have a dominant effect on the network.

In NHS-E, homophily is observed among all the professional roles nurses (*estimate* = 1.384, *SE* = 0.207), doctors and consultants (*estimate* = 1.721, *SE* = 0.4282, $p \leq 0.05$), the allied healthcare professionals (*estimate* = 1.335, *SE* = 0.180, $p \leq 0.05$), non-clinical management professionals (*estimate* = 0.647, *SE* = 0.129, $p \leq 0.05$), but not among those in leadership roles. These effects are significant among doctors and consultants, allied healthcare professionals, and non-clinical management professionals, indicating that these professionals communicate more than expected within the network. The magnitude of the nurses, doctors, and allied healthcare professionals' groups is large, even larger than the closure effect, indicating that interaction regarding

improvement work among these professional groups is more dominant than most of the structural effects observed. In NHS-K, homophily effects were only detected in the leadership (*estimate* = -0.164, *SE* = 0.190,) and allied healthcare professional groups (*estimate* = 1.222, *SE* = 0.223, $p \leq 0.05$). The estimate was negative and non-significant among leaders indicating that they communicate less than expected regarding improvement work. However, the allied healthcare professional group was large, positive, and significant, indicating that this group's interactions occur more than expected and have a dominant effect on the network.

Homophily effects were also tested to distinguish actors' tendency to communicate regarding improvement work due to similar partnership roles. The results revealed positive effects in NHS-K for the four partnership categories TGT (*estimate* = 0.384, *SE* = 0.303), KPO (*estimate* = 0.684, *SE* = 0.282, $p \leq 0.05$), L4L (*estimate* = 0.535, *SE* = 0.350) and RPIW (*estimate* = 1.046, *SE* = 0.201, $p \leq 0.05$); however, only interactions among those with KPO and RPIW were significant. This finding is unsurprising regarding the KPO team, as these actors work closely coordinating improvement work initiatives. However, the RPIW result is surprising as the large estimate indicates that RPIW participants' interactions have a dominant and significant impact on the network.

TGT, KPO and RPIW actors' tendency to communicate with each other is also detected, as these effects are all positive and significant in NHS-E. The TGT (*estimate* = 2.184, *SE* = 0.369, $p \leq 0.05$) and KPO (*estimate* = 1.384, *SE* = 0.348, $p \leq 0.05$) estimates are significantly larger than most of the structural effects and are larger than most of the professional role effects, indicating that the network is dominated by TGT and KPO interactions. A surprising finding is that there are no homophily effects among the L4L participants, and this group was the main category surveyed to conduct this research. This finding suggests that L4L actors in NHS-E are unlikely to interact with each other regarding improvement work and may have more diversity in their networks.

Similar partnership effects were observed in NHS-A (*estimate* = 0.622, *SE* = 0.136, $p \leq 0.05$) and NHS-D (*estimate* = 0.630, *SE* = 0.189, $p \leq 0.05$), as there are positive and significant estimates for RPIW actors. This result indicates that persons who are actively engaged in applying the lean methodology are interacting with each other. This effect was observed in the other two networks; however, interactions among the L4L participants in NHS-A (*estimate* = -0.208, *SE* = 0.138) and NHS-D (*estimate* = -0.128, *SE* = 0.220) occur less than expected as the estimates are negative and non-significant. This result suggests that although these interactions exist within the network, they are infrequent compared to professional roles. A surprising finding here is that TGT and KPO interactions do not dominate network interactions within these two organisations. The TGT and KPO roles involve the strategic coordination of improvement work, whereas the L4L and RPIW roles involve actors engaging with new practices in their work environment. This finding

indicates that NHS-A and NHS-D's networks are not dominated by strategic interactions when compared to NHS-K and NHS-E. Finally, no homophily effects were observed in NHS-C for the professional groups or the partnerships roles. This result indicates that NHS-C's network is not characterised by high levels of similarity among actors interacting regarding improvement work and suggests greater diversity in interactions and communication within this network.

Next, ***Sender Effects*** were considered to model the likelihood of an actor's attribute to encourage them to be more active and send more ties than others in the network. Sender effects were mostly observed in TGT, KPO and L4L partnership roles. The TGT sender effect is large and significant in NHS-D (*estimate* = 1.673, *SE* = 0.339, $p \leq 0.05$) and NHS-K (*estimate* = 1.038, *SE* = 0.312, $p \leq 0.05$), indicating that actors in these roles tend to have more outgoing connections. This result is unsurprising as TGT members are the strategic leads of the change initiative and are likely to make more connections when coordinating improvement work. This effect is positive and not significant in NHS-E (*estimate* = 0.831, *SE* = 0.300), which indicates that the tendency to have more outgoing tie and interactions exist but does not occur more than expected.

In NHS-D, KPO actors (*estimate* = 2.224, *SE* = 0.513, $p \leq 0.05$) have more outgoing ties and interactions within the network as this effect is also large, positive, and significant. This effect's magnitude is much larger than the other actor-relation effects and most of the structural effects, indicating that outgoing KPO ties have a dominant effect on the network activity and improvement related interactions in general. The L4L sender effects are positive and significant in NHS-C (*estimate* = 0.498, *SE* = 0.100, $p \leq 0.05$) and NHS-E (*estimate* = 1.367, *SE* = 0.207, $p \leq 0.05$), indicating that L4L actors send more ties to other actors regarding improvement work. This result is somewhat expected as Lean for Leaders initiate localised improvement activities to implement new practices within their professional environments and supports the notion that there are many outgoing ties to actors, but not connections with other L4Ls observed above. In NHS-C, sender effects were observed among those in clinical roles; however, these effects were small and not significant.

Sender effects model outgoing relationships and interactions, whereas ***Receiver Effects*** model an actor's likelihood of having more incoming connections or being more popular because of a specific actor attribute. In NHS-E, L4Ls (*estimate* = 0.043, *SE* = 0.166) in NHS-C and KPOs (*estimate* = 0.374, *SE* = 0.272) have positive and non-significant estimates, indicating that these actors receive more ties than other network actors: however, this does not occur more or less than expected. NHS-C nurses (*estimate* = -0.316, *SE* = 0.151, $p \leq 0.05$) have a negative and significant estimate, which indicates that they receive significantly fewer ties than expected. In NHS-D, positive and significant effects are observed for the TGT (*estimate* = 0.671, *SE* = 0.237, $p \leq 0.05$) and KPO (*estimate* = 0.884, *SE* = 0.215, $p \leq 0.05$) roles, indicating that these actors are more

popular and have more incoming communication and interactions regarding improvement work than other professional groups and actors. This result is both surprising and unsurprising. It is unsurprising as TGT and KPO actors can be perceived as more visible and popular actors regarding the coordination of improvement work due to their strategic decision-making and training responsibilities; however, it is surprising that this popularity dynamic is not observed in the other networks, where these hierarchical roles and strategic responsibilities also exist.

Overall, no sender or receiver effects were observed in NHS-A. This finding suggests that actors within this network are not likely to have more or fewer ties due to professional or partnership roles. This finding indicates a more distributed form of network activity and that actor roles do not increase or decrease communication regarding improvement work and new practices.

Each model's fit was examined based on the Goodness-of-Fit criteria specified by Lusher et al. (2013) and Robins (2011). All models achieved a convergence statistic value or t-ratio of less than 0.1 for the estimated parameters, suggesting reliable estimates. An adequately fit model supports the findings through good convergence statistics and goodness-of-fit ratios. For structural configurations not included in the models, t-ratios should be below 2 in absolute value to adequately reproduce the distribution of patterns in the observed network. The convergence values and goodness-of-fit ratios were less than 2 for parameters not estimated, indicating a plausible fit of the model and the specified parameter in most of the models, except NHS-A, which had a value between 3 and 5 for the 3-in-star and NHS-K, which has a value between 7 and 16 for the 3-in-star, indicating that the in-degree distribution for these two networks was heavily skewed and not adequately modelled. The models presented were retested several times and did not converge when modelling the 2- and 3- in-star parameters; however, these deficiencies have been observed in other ERGM studies (Wang, Sharpe, et al., 2009; Conaldi & Lomi, 2013; Lomi et al., 2014). Aside from this parameter which is not presented in the model estimations, the examined parameters met the criteria to justify an acceptable model fit for the observed networks. All Goodness-of-Fit statistics are detailed and presented in Appendix D5.

Table 19: Model A Parameter estimates (SEs) for Five Organisational Advice Networks

Model A: Purely Structural Effects	**NHS-A**			**NHS-D**			**NHS-C**			**NHS-K**			**NHS-E**		
Arc	-6.66	(0.53)	*	-6.94	(0.26)	*	-2.59	(0.29)	*	-6.60	(0.30)	*	-7.30	(0.29)	*
Reciprocity				0.70	(0.48)		1.52	(0.39)	*	0.25	(0.54)				
Centrality Effects															
2-out-star				2.16	(0.21)	*				1.75	(0.21)	*			
3-out-star	-0.28	(0.04)	*	-0.95	(0.11)	*	-0.06	(0.02)	*	-0.54	(0.09)	*	-0.09	(0.02)	*
Activity Spread [AoutS(2.00)]	3.34	(0.36)	*										2.25	(0.22)	*
Popularity Spread [AinS(2.00)]	-1.48	(0.22)	*				-1.03	(0.17)	*	-0.20	(0.16)				
Brokering Effects															
Simple Connectivity [path2]	-0.19	(0.11)		0.20	(0.08)	*				-0.11	(0.04)	*	-0.01	(0.02)	
One-In-Alternating Out Star [1inAout-star(2.00)]	0.86	(0.33)	*	-0.88	(0.21)	*									
Alternating-In-One-Out Star [Ain1out-star(2.00)]	-0.14	(0.27)					0.52	(0.13)	*				-0.09	(0.14)	
Alternating-in-Alternating Out Star [AinAout-star(2.00)]	-1.13	(0.76)					-2.50	(0.26)	*				-0.13	(0.34)	
Closure Effects															
Transitive Path Closure [AT-T(2.00)]	2.11	(0.08)	*				1.43	(0.13)	*						
Popularity Transitivity [AT-TD(2.00)]													1.59	(0.10)	*
Generalized Transitivity [AT-TDU(2.00)]				2.01	(0.15)	*				1.80	(0.19)	*			

Estimation was conducted using the Pnet package (Wang, Robins, et al., 2009)

Standard errors are given in parentheses.

**Significant Effect (p<= 0.05) of a parameter is observed if its parameter estimate equals at least twice its standard error (Lusher, Johan, et al., 2013).*

Table 20: Model B Parameter estimates (SEs) for Five Organisational Advice Networks

Model B: Structural & Actor-Relation Effects	NHS-A			NHS-D			NHS-C			NHS-K			NHS-E		
Arc	-7.210	(0.584)	*	-7.549	(0.282)	*	-2.952	(0.293)	*	-6.471	(0.289)	*	-7.826	(0.316)	*
Reciprocity				0.750	(0.491)		1.606	(0.421)	*	0.165	(0.639)				
Centrality Effects															
2-out-star				1.699	(0.243)	*				1.552	(0.198)	*			
3-out-star	-0.316	(0.043)	*	-0.831	(0.122)	*	-0.065	(0.015)	*	-0.543	(0.081)	*	-0.086	(0.020)	*
Activity Spread [AoutS(2.00)]	2.831	(0.398)	*										1.614	(0.267)	*
Popularity Spread [AinS(2.00)]	-1.493	(0.236)	*				-0.933	(0.171)	*	-0.405	(0.185)	*			
Brokering Effects															
Simple Connectivity [path2]	-0.176	(0.104)		-0.047	(0.086)					-0.081	(0.047)		-0.012	(0.040)	
One-In-Alternating Out Star [1inAout-star(2.00)]	0.782	(0.315)	*	-0.442	(0.211)	*									
Alternating-In-One-Out Star [Ain1out-star(2.00)]	-0.152	(0.279)					0.512	(0.129)	*				-0.014	(0.158)	
Alternating-in-Alternating Out Star [AinAout-star(2.00)]	-0.930	(0.759)					-2.391	(0.266)	*				-0.214	(0.352)	
Closure Effects															
Transitive Path Closure [AT-T(2.00)]	1.981	(0.093)	*				1.402	(0.137)	*						
Popularity Transitivity [AT-TD(2.00)]													1.121	(0.141)	*
Generalized Transitivity [AT-TDU(2.00)]				1.816	(0.174)	*				1.516	(0.215)	*			
Actor-Relation Effects															
Homophily (Professional - Nurse)	0.726	(0.138)		1.224	(0.322)	*							1.384	(0.207)	
Homophily (Professional - Drs)	0.814	(0.144)		0.868	(0.244)								1.721	(0.282)	*
Homophily (Pro. Allied healthcare Professionals Role)	0.916	(0.155)	*	1.341	(0.201)					1.222	(0.223)	*	1.335	(0.180)	*
Homophily (Pro. - Non-Clinical Management Role)	0.760	(0.134)	*	0.396	(0.138)	*							0.647	(0.129)	*
Homophily (Professional - Leadership Role)	0.284	(0.114)	*	0.036	(0.150)					-0.164	(0.190)				
Homophily (Partnership - TGT Role)										0.384	(0.303)		2.184	(0.369)	*
Homophily (Partnership - KPO Role)										0.684	(0.282)	*	1.384	(0.348)	*
Homophily (Partnership - L4L Role)	-0.208	(0.138)		-0.128	(0.220)					0.535	(0.350)				
Homophily (Partnership - RPIW Role)	0.622	(0.136)	*	0.630	(0.189)	*				1.046	(0.201)	*	0.280	(0.124)	*
Sender (Clinical Role)							0.127	(0.089)							
Sender (TGT Role)				1.673	(0.339)	*				1.038	(0.312)	*	0.831	(0.300)	
Sender (KPO Role)				2.224	(0.513)	*									
Sender (L4L Role)							0.498	(0.100)	*				1.367	(0.207)	*
Receiver (Nurse)							-0.316	(0.151)	*						
Receiver (TGT Role)				0.884	(0.215)	*									
Receiver (KPO Role)				0.671	(0.237)	*							0.374	(0.272)	

Receiver (L4L Role)			0.043 (0.166)		

Significant Effect (p<= 0.05)

Table 21: Results Summary

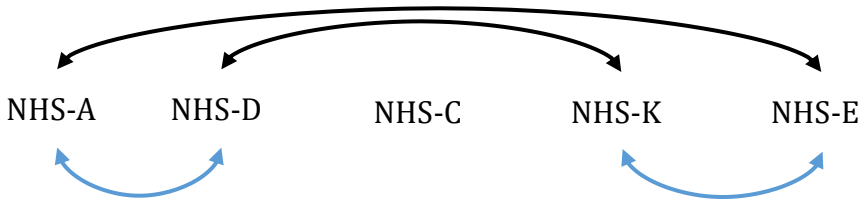
	NHS-A	NHS-D	NHS-C	NHS-K	NHS-E
Organisational Performance	☆Outstanding	Good	Good	●Requires improvement	●Inadequate
Improvement Progress					
Average Number of RPIWs	3.83	4.2	3.2	3	4.75
Avg. No. of RPIWs Standardised	0.06	0.63	-0.93	-1.24	1.48
Relative Progress	Average	Average	Below Average	Below Average	Above Average
Structural Embeddedness of Networks					
Network Size	247	181	167	133	187
Overall Network Reciprocity	0.149	0.154	0.134	0.103	0.093
Centralisation & Spread Summary					
Indegree & Outdegree Centralisation	Indegree > Outdegree	Indegree > Outdegree	Indegree > Outdegree	Indegree > Outdegree	Indegree ≈ Outdegree
ERGM Centralisation Structures	3/4	2/4	2/4	3/4	2/4
Bridging & Brokering Summary					
012C Simple Connectivity	258	180	278	170	355
Brokering Reciprocity Total	229	191	214	84	124
ERGM Brokering Structures	4/4	2/4	2/4	1/4	3/4
Brokering Roles % of Network	54%	48%	60%	43%	57%
Brokering Roles – Most Performed	Clinicians	Non-Clinical & MGMT	Non-Clinical & MGMT	Non-Clinical & MGMT	Non-Clinical & MGMT
Partnership Roles Brokering	27%	24%	28%	11%	29%
Closure Summary					
Transitive Triad	36	32	48	24	61
Closure & Reciprocity	36 High	53 Highest	22 Low	19 Low	14 Lowest
ERGM Closure Structures	Transitive Path Closure	General Transitivity	Transitive Path Closure	General Transitivity	Popularity Closure
% of Network in Triads	28%	28%	31%	25%	24%
Relationships Among Professionals Summary					
Professional Relationships	Homophily in all Professionals Groups (4/4)	Homophily in all Professionals Groups (4/4)	No Homophily (0/4)	Weak Homophily (1/4)	Homophily in all Professionals Groups (4/4)
Partnerships Relationships	Homophily in some partnership groups L4L & RPIW (2/4)	Homophily in some partnership groups L4L & RPIW (2/4)	No Homophily (0/4)	Homophily present in all Partnership Groups (4/4)	Homophily present in most Partnership Groups (3/4)

Sender Effects	No Sender Effects	Partnership Effects TGT & KPO	Professional & Partnership Effects - Clinical & L4L	Partnership Effects TGT Only	Partnership Effects TGT & L4L
Receiver Effects	No Receiver Effects	Partnership Effects TGT & KPO	Professional & Partnership Effects - Nurse & L4L	No Receiver Effects	Partnership Effects KPO

5.4 Synthesis of Results

This research seeks to understand the structural embeddedness of healthcare professionals in five organisational networks. Prior to this investigation, varying contextual influences are observed (See Table 21). First, there are differences in organisational performance, based on CQC ratings and differences in improvement progress, based on the number of the value stream and RPIWs conducted between 2015 and 2018. NHS-A, NHS-D and NHS-C are Outstanding and Good rated organisations, therefore delivering a high level of patient care. NHS-A and NHS-D have average improvement progress, as they conducted a similar number of values streams (6, 5), RPIWs (23, 21) and training a similar number of L4Ls (218,205). NHS-C, although rated Good, has below-average progress, as it trained fewer professionals (155) and conducted fewer RPIWs (16) than NHS-A and NHS-D. Alternatively, NHS-K and NHS-E present two extremes. NHS-K is rated "Requires Improvement", which is a poor CQC evaluation and below-average performance, having conducted the lowest number of value streams (4) RPIWs (12) and trained L4Ls (103) among the networks. NHS-E, however, has the lowest organisational performance rating, Inadequate but above-average progress, as it conducted the highest number of value streams (8) and RPIWs (38) among the networks. This is twice as many values streams as NHS-K and over three times as many RPIWs. One explanation for this dynamic is that since NHS-E was the lowest-performing organisation among the networks, it conducted more improvement initiatives to achieve an acceptable performance level. This research sought to uncover these variations through an embeddedness lens by investigating the structural and relationships mechanisms among the networks of professionals involved in improvement work. The analysis and results revealed synergies among the networks and broad themes that are important to understand the institutionalisation of new practices among professionals.

The first key finding of this research is that although the networks have different structures and underpinning mechanisms, there are surprising structural similarities. Although there are three high performing and two low performing organisations, the best and worst-performing networks are structurally similar (See Figure 20). NHS-A has nine structural motifs, and NHS-E has seven; however, they have no reciprocity motifs, no two-out-star motifs, and both have more than two brokering structures. The second best and second worse in terms of organisational performance also have some similarities. NHS-D and NHS-K have reciprocity, 2-out and 3-out star, simple connectivity and Generalized Transitivity motifs. NHS-C falls in the middle having structural features of both the higher and low performing organisations. This finding is aligned with the understanding that although it is a "Good" rated organisation, it also did not make similar improvement progress compared to NHS-A and NHS-D.



Structural Configurations					
Arc	×	×	×	×	×
Reciprocity		×	×	×	
Centrality Effects					
2-out-star		×		×	
3-out-star	×	×	×	×	×
Activity Spread	×			×	×
Popularity Spread	×		×		
Brokering Effects					
Simple Connectivity	×	×		×	×
One-In-Alternating Out Star	×	×			
Alternating-In-One-Out Star	×		×		×
Alternating-in-Alternating Out Star	×		×		×
Closure Effects					
Transitive Path Closure	×		×		
Popularity Transitivity					×
Generalized Transitivity		×		×	

Figure 20: Structural Similarities

The structural analysis of these advice networks revealed surprising similarities among high and low performing organisations. This revelation posed a question to understand what relational mechanisms were underpinning network structures. Differentiating interactions emerged at the overall network level and among professional groups to answer this question. From this perspective, some unique insights highlighted the differences within each organisational network.

5.4.1 Centralisation Findings

To understand the degree of incoming and outgoing relationships within a network or group, centralisation is used to detect activity and popularity effects, providing a starting point to understand the structure and interactions among professionals. In this case, centralisation depicts whether professionals tend to seek popular healthcare professionals as sources of information or advice or whether they have a high degree of outgoing activity and tend to seek information and advice from multiple actors.

When centralisation and spread effects are considered, NHS-D & NHS-K have a positive and significant 2-out star, and neither have activity spread parameters suggesting that professionals in these networks tend to seek information and advice in smaller groups of professionals.

Similarly, both networks outdegree is half the indegree centralisation. Therefore, these networks are characterised by a high degree of incoming and popularity ties and a low degree of outgoing and activity ties. Next, the 3-out-star parameter is negative and significant across the networks, suggesting that most actors are less likely to seek information from more than three professionals within their network. This result indicates an absence of centralisation in network activity or information seeking, and healthcare professionals tend to be relatively uniform in the number of choices of improvement work collaborators. This finding is confirmed as the outdegree centralisation is low across the networks compared to indegree centralisation. It also indicates that professionals are more selective when seeking information and advice about improvement work. These interactions are different in NHS-A & NHS-E as they have large, positive significant activity spread parameters, compared to negative 3-out-star, and this suggests a high degree of information seeking and outgoing ties in these networks. This result is surprising as NHS-A has the lowest outdegree centralisation among the networks, whereas NHS-E has the highest. A key distinction here is that NHS-E's outdegree is larger than its indegree, whereas NHS-A's outdegree is 25% of its indegree.

When NHS-D & NHS-E are compared, NHS-E has this highest outdegree centralisation among the networks and is double that of NHS-D, even though they are similar in size and network density. However, NHS-E also has the lowest indegree centralisation compared to the other networks. Thus, it is characterised by a relatively high degree of outgoing activity and a relatively low degree of incoming or popularity effects. The lack of a 2-out-star and popularity spread parameter suggests professionals in NHS-E have larger, decentralised group interactions. These interactions are different from NHS-D, where professionals interact in smaller groups as this network has no popularity or activity effects. Therefore, most NHS-E professionals are active when seeking information and advice about new practices; however, there are no professionals who are popular sources of information and advice in their network.

In comparison, NHS-A has a high degree of incoming ties that suggest high activity and popularity within their network. When univariate and descriptive statistics such as size and density are considered, NHS-E and NHS-D are alike. However, when relational mechanisms and interactions are considered, these two networks have very different social dynamics. This comparison emphasizes that combinations of structures and interactions within the network produce varying conditions for professionals to share information and advice about improvement work. It also underscores another key finding that similarities in structure do not equate to similarities in interactions and relationships.

NHS-A, NHS-C and NHS-K have negative popularity spread parameters; however, only NHS-K's is non-significant. This finding suggests that NHS-A and NHS-C professionals, who are popular

sources of information and advice, significantly affect the network; however, it tends to occur less than expected. Conversely, in NHS-K, professionals are more likely to have incoming ties and are popular sources of information and advice in the network; however, this does not have a strong or significant influence on the network. The popularity spread parameter is not present in NHS-D and NHS-E, suggesting that professionals with higher-than-expected popularity levels do not characterise these networks. This result is confirmed by the positive 2-out star and the negative 3-out star parameters in both networks. Combining these two parameters indicates that professionals are more likely to interact with two colleagues and less likely to interact with three. This finding suggests that healthcare professionals in NHS-D and NHS-K tend to interact in small groups seeking information and advice from close collaborators rather than seeking advice from popular professionals. NHS-C has different social dynamics as they have no 2-out-star or activity spread parameters. Their absence suggests that NHS-C professionals are unlikely to have only two collaborators and do not seek information and advice from many collaborators. This finding, combined with the negative popularity spread parameter, confirms that NHS-C professionals tend to seek information and advice about improvement work from popular professionals, although this is not common within their network.

The Activity Spread parameter is positive and significant in NHS-A and NHS-E. The large, positive estimates suggest that some professionals are particularly active regarding outgoing contact and interaction with many collaborators. Practically, this result indicates that some NHS-A and NHS-E professionals are very active in either seeking or providing improvement information to many other professionals. Compared to popularity spread, this result's magnitude is much larger, indicating that it is more dominant within these networks. These effects are not observed in the other three networks. This lack of an activity spread parameter in NHS-D and NHS-K further justifies the finding that professionals in these networks tend to interact in small groups regarding improvement work. It further highlights that NHS-A and NHS-E, the best and worst-performing in terms of organisational performance, both have good improvement progress and share similar features when professionals engage in improvement initiatives.

5.4.2 Bridging & Brokering Findings

In this research, bridging structures are examined through the ERGMs and open triad measures, indicating the presence and extent of brokering within the network. Bridging structures and brokering are associated with searching, acquiring, and sharing information and advice about improvement work and new practices in general. In this case, brokering allows professionals to inform their understanding of new practices by learning, sharing and receiving improvement information from network contacts. However, like other effects, brokering relationships are better understood when considered in the context of other network effects; therefore, other

structures and relational mechanisms are considered to understand these relationships in each network. When bridging structures and brokering relationships are magnified, other differences among professionals' interactions are observed.

The NHS-A network has all four bridging structures, Simple connectivity, Alternating-in-One-Out Star and Alternating-in-Alternating -Out Star are negative and non-significant, and the One-In-Alternating Out Star is positive and significant. Based on the previous descriptions, this indicates that multiple forms of brokering are present within the network, where professionals broker information and advice to and from several sources and collaborators. This result suggests that multifaceted brokering relationships are a distinctive feature of this network, where professionals are engaged in various interactions to receive and share information and advice with multiple collaborators. As previously mentioned, these higher-level parameters are associated with network spread and having multiple forms of brokering and is beneficial when attempting to disseminate information about new practices in the wider network. This finding is further supported by the high number of incoming, outgoing and reciprocated open triad structures, which also depict multi-directional and reciprocated brokering relationships.

The NHS-E network has three brokering structures; however, these are all non-significant. The Simple and Alternating-in brokering structures are associated with one or many incoming ties to a broker; this suggests that a broker receives information and advice from either one or several professionals, they can have high incoming and outgoing ties. In practical terms, some NHS-E brokers tend to share information from a single or several sources, but this does not significantly affect the network as these bridging structures are negative and non-significant. The lack of a One-in-Alternating-out star structure suggests the absence of efficient brokering behaviour. When the open triads are examined, NHS-E has the highest number of simple brokering structures (355), twice as many as NHS-D (180) and NHS-K (170); this confirms that there are very high levels of brokering activity; however, reciprocated incoming (40) and outgoing (83) brokering behaviours account for less than a quarter of the overall brokering structures. These results highlight a key finding for NHS-E, where they have a high degree of brokering, but these activities do not significantly affect the network and are mostly unreciprocated. Despite this, there are many brokering relationships in NHS-E that may support sharing information and advice about new practices.

The NHS-D network has two negative and significant bridging structures; the Simple Connectivity structure is and One-in-Alternating-out star parameters. These results suggest that some NHS-D professionals tend to broker information and advice from a single source to one or many professionals. This result suggests a high degree of simple brokering and a low tendency to broker information and advice to several collaborators, which is expected as NHS-D professionals

tend to collaborate in smaller groups. Despite this, these brokering forms have a significant effect on the network. First, the One-in-Alternating-out star indicates that brokers share information and advice with several collaborators, suggesting efficient information sharing transpires within this network. This interaction is beneficial when attempting to disseminate information about new practices in the wider organisational context. This finding is confirmed by the open triads as there are many reciprocated brokering relationships, and there are twice as many reciprocated incoming (118) brokering relationships observed than outgoing (61) brokering relationships. This finding is further supported as Alternating-in parameters are not present in NHS-D, confirming that outgoing brokering behaviours are not a key feature of this network. Also, this network has 12 mutually reciprocated brokering relationships, compared to NHS-E, which has 1. This finding further highlights the difference in interactions among professionals, despite similarities in size and density.

The NHS-C also has two significant bridging structures, one positive and negative. These are the opposite structures to NHS-D, the Alternating-in parameters associated with many incoming ties to an individual broker, who shares information and advice about new practices with other professionals. Together, these structures suggest popularity and activity effects among NHS-C brokers who share information and advice from several sources. With the Alternating-in-One-Out star, there is a higher degree of brokering where professionals receive information and advice from several professionals and share it with a single actor, as this effect is positive and significant. It has a hierarchical orientation as information is shared with brokered to one actor and may reflect a formal reporting structure. However, it is an inefficient brokering interaction when disseminating information about new practices in the wider network. The significantly negative Alternating-in-Alternating Out Star (AinAout-star) indicates that there is also brokering where information is received from and shared with several collaborators; however, it occurs less frequently. This structure is associated with network spread and is a beneficial form of interaction when disseminating information about new practices. As both structures are significant, these effects have a dominant effect on the network, influencing the sharing of information and advice about new practices. This finding is confirmed by the open triad structures as there is a high number of simple (278), reciprocated incoming (122), and outgoing brokering (83) relationships brokering structures, thereby confirming a high degree of incoming ties to brokers.

Finally, the NHS-K network has only one bridging structure, simple connectivity. This bridging structure is associated with an individual broker who receives information and advice from one actor and shares information with another actor. Therefore, few NHS-K brokers share and receive information and advice from only one actor, as this structure is negative and significant. This

result indicates a low degree of brokering due to the absence of significant higher-level brokering relationships and is supported as NHS-K has the least number of simple (170) and reciprocated incoming (45) and outgoing (36) brokering relationships. The lack of brokering structures also indicates very little information seeking and sharing activities, which does not support sharing information and advice about improvement work.

5.4.3 Closure Findings

From a social process view, closure effects are associated with social cohesion and collective action among professionals within the network. In this case, closure promotes shared understandings, engagement and adoption of new practices among closely connected groups of professionals; however, this is not determined by closure alone, as other effects and mechanisms may negate the benefits that emerge from closure.

The NHS-A and NHS-C network have positive and significant estimates of Transitive Path Closure. These structures have a dominant effect on the network as they are large and significant, indicating that closure tends to occur in these networks as professionals choose an improvement work collaborator who collaborates with their existing contacts. In the triad census, NHS-A has 36 transitive triads and 36 reciprocated triads. On the other hand, NHS-C 48 transitive triads and 22 reciprocated triads. Together NHS-A and NHS-C have a high number of triads which fosters closure and cohesion within the network; however, NHS-A has higher network reciprocity, and more reciprocated triadic relationships. Further, when centralisation and brokering relationships are considered, NHS-A has a higher degree of reciprocated brokering and both activity and popularity spread. With the high level of reciprocity in the network, NHS-C is still well-positioned to foster engagement and adoption of new practices; however, the lack of activity spread, having two bridging structures compared to NHS-A's four may reduce their capacity to do so. Together, this finding suggests that NHS-A has a higher degree of cohesion and can promote greater engagement and adoption of new practices among professionals compared to NHS-C.

Next, NHS-E has a significantly positive Popularity Closure parameter, and this suggests that closure is more likely to occur due to status-based or popularity effects. Therefore, compared to NHS-A and NHS-C, where professionals choose common collaborators, closure emerges in NHS-E around popular professionals. This finding suggests that professionals are more likely to be in a cohesive relationship with an actor who is a key source of information and advice about improvement work. In the triad census, NHS-E has 61 transitive triads and 14 reciprocated closed triads. Compared to NHS-A, which shares a similar structure, NHS-E has nearly twice as many transitive triads and less than half the reciprocated triads. Together, there is a high degree of closure in NHS-E but a low degree of reciprocity among NHS-E professionals, supported by the low reciprocity in the overall network. When the lack of reciprocity among brokering is

considered, it confirms that neither brokering or closure is mutual, and professional interactions may be status-based and hierarchical. Despite the high degree of closure, the lack of reciprocity and mutual interaction suggests a low degree of cohesion in NHS-E, which does not promote sustained interactions about improvement work among professionals in the long term.

Finally, NHS-D and NHS-K have a significantly positive General Transitivity parameter, and this suggests that closure can occur through one of three mechanisms, either path, activity, and popularity closure. Rather than modelling each of these effects separately, this parameter indicates a tendency for hierarchical-based network closure, which suggests different triadic clusters are present in the network. This result indicates multiple closure mechanisms among healthcare professionals in NHS-D and NHS-K regarding providing and receiving information about new practices. In the triad census, NHS-D has 32 transitive triads and 54 reciprocated closed triads, and NHS-K has 24 transitive triads and 19 reciprocated closed triads. As previously discussed, NHS-D and NHS-K have a similar structure based on the ERGM model configurations; however, they have very different brokering relationships, where NHS-K's relationships are mostly unreciprocated, and this pattern is also observed here. NHS-D has the most reciprocated closed triadic structures among the networks and nearly three times more than NHS-K.

Although NHS-D professionals tend to collaborate in small groups, it has the highest network reciprocity and a higher degree of reciprocated brokering relationships. Therefore, combined with the high number of closed triads, reciprocated triads and generalised transitivity, it has a high degree of cohesion and can promote greater engagement and adoption of new practices among professionals. NHS-K professionals also tend to collaborate in small groups; however, reciprocity among brokers and the overall network is low. With the low number of closed triads and the lowest number of reciprocated closed triads, NHS-K has a low degree of closure and cohesion, which does not promote sustained interactions about improvement work or new practices among professionals. This finding presents the same conclusion found when comparing NHS-A and NHS-E, which suggests that despite having similar network structures, reciprocity among brokers matters when sharing and seeking information and advice about new practices, and similarly reciprocity in triads matters to promote cohesion and shared understandings that support engagement and adoption of new practices.

5.4.4 Relationships Among Professionals Findings

Although the structural effects revealed similarities between the networks, when attention is placed on the relationships and interactions of healthcare professionals' further nuances in the networks are observed. When professional roles of nurses, doctors, allied healthcare professionals and non-clinical management professionals are considered as distinctions are made based on professional groups which have more incoming and outgoing interactions, more

brokering relationships and a greater presence in triads. By examining professional roles, institutional effects are considered, and relationships among professionals align to understand improvement work progress.

5.4.4.1 NHS-A Professional Roles

In NHS-A, positive homophily effects are found in all professional groups, suggesting actors from similar professional groups tend to form relationships. Here relationships among allied healthcare professionals and non-clinical and management professionals have a more pronounced effect on the network as these relationships are significant. Each NHS-A profession group has arc reciprocity between 0.122 and 0.158 which is high compared to NHS-E and NHS-K's overall network reciprocity. This result suggests a high degree of cohesion and intra-group collaboration as professionals mutually interact to share information and advice about improvement work. For nurses, doctors and allied healthcare professionals groups, the outdegree centralisation is larger than the indegree centralisation, suggesting that they are more active when seeking information and advice from other professionals. However, non-clinical and management professionals have a higher indegree than outdegree centralisation, which indicates that they have more incoming ties and are more popular sources of information and advice. This result is surprising as it is not observed in the other networks. In this network, 54% of professionals are brokers, where 31% are clinicians, and 23% are non-clinical management professionals, indicating that clinicians are more active brokers than non-clinical professionals. Similarly, clinicians represent 55% of triad members, indicating that they have a slightly higher presence in triads, and this would engender cohesion and shared understandings about new practices among clinicians specifically. Overall, nurses have the highest clinical brokering relationships and triad membership, suggesting that they are more involved in improvement work compared to doctors and allied healthcare professionals.

5.4.4.2 NHS-D Professional Roles

In NHS-D, homophily is also found in all professional groups; however, relationships among nurses and non-clinical and management professionals are significant, suggesting that they have a more pronounced effect on this network. The arc reciprocity among professionals varies in NHS-D as doctors (0.146) and non-clinical professionals (0.195) have high levels of reciprocity, whereas nurses (0.071) and allied healthcare professionals (0.065) have low levels of reciprocity. This result highlights a disparity in reciprocity among clinicians. Also, it suggests a high degree of cohesion and intra-group collaboration among doctors and non-clinical and management professionals, as they mutually interact to share information and advice about improvement work. Doctors and non-clinical professionals also have higher outdegree centralisation than

nurses and allied healthcare professionals, suggesting that they send more ties to seek and share advice about improvement work. Conversely, nurses have a higher indegree than outdegree, which suggests that they have more incoming than outgoing ties and that some nurses are popular sources of information and advice. This finding is supported as homophily among nurses is positive and significant; therefore, nurse relationships in NHS-D significantly affect the network. Also, the magnitude of nurse and allied healthcare professionals homophily was large compared to other parameter estimates. Together, these suggest a high tendency for professionals in these professional groups to communicate is higher than expected, and these relationships have a dominant effect on the network.

In NHS-D, 48% of professionals are brokers, where 19% are clinicians, and 29% are non-clinical management professionals, indicating that clinicians are less active as brokers than non-clinical professionals. This pattern is also seen for triad memberships as clinicians represent 40%, and non-clinical professionals are 60%. This dynamic supports the finding that relationships among non-clinical professionals have a significant effect on the network. Although this dynamic would engender cohesion and shared understandings about new practices among non-clinical professionals, which is less beneficial in a healthcare setting. Compared to NHS-A, nurses in NHS-D represent 4% of brokers and 8% of triad members, confirming that different relational mechanisms exist among the two top-performing organisations.

5.4.4.3 NHS-E Professional Roles

In NHS-E, positive homophily effects are found in all professional groups; however, they are significant for all professional groups, except nurses. In this network, relationships among doctors, allied healthcare professionals and non-clinical and management professionals have a more pronounced effect as these relationships are significant. Like NHS-D, reciprocity among professionals varies as nurses (0.045) and non-clinical professionals (0.077) have very low levels of reciprocity, whereas doctors (0.138) and allied healthcare professionals (0.189) have very high levels of reciprocity. These results also highlight a disparity in this network as there is a lower degree of cohesion among nurses and non-clinical professionals. Nurses, non-clinical and allied healthcare professionals all have an outdegree centralisation larger than the indegree centralisation, suggesting that these groups are actively seeking information and advice from other professionals. Doctors have the same indegree and outdegree, suggesting that they send and receive the same proportion of ties. This finding is different from the NHS-A and NHS-D networks, where at least one professional group had a higher indegree than the outdegree. When indegree is isolated, doctors (13.2%) receive more incoming ties than nurses (9.5%) and allied healthcare professionals (5.2%). This finding may suggest that since doctors are higher in the professional hierarchy than nurses and allied healthcare professionals, they tend to be more

popular sources of information and advice regarding improvement work. This finding is important as it is not observed in the other networks and signals this network has classical institutional dynamics. It is further supported as the magnitude of the homophily effects are even larger than the closure effect, indicating that the relationships among these professional groups regarding improvement work are more dominant than most of the structural effects observed. In this network, 57% of professionals are brokers, where 21% are clinicians, and 36% are non-clinical management professionals, indicating that clinicians have fewer brokering relationships than non-clinical professionals. Triads' composition indicates a similar level of involvement, as clinicians represent 49%, and non-clinical professionals represent 51%. Since non-clinical relationships are more prominent in this network, and there is a very low degree of reciprocity among these professionals, it limits the degree of cohesion that this network can realise.

5.4.4.4 NHS-K Professional Roles

In the NHS-K network, homophily is only found in the allied healthcare professionals' group, and it is positive and significant, suggesting that it has a pronounced effect on this network. The arc reciprocity among professionals varies as doctors (0.2) have a very high level of reciprocity, nurses (0.103) and non-clinical and management professionals (0.108) have relatively low levels of reciprocity, and no reciprocity is observed among allied healthcare professionals. For doctors, this finding suggests a high degree of mutual interaction and intra-group collaboration, and their relationships are dominant in this network. However, this finding is surprising for allied healthcare professionals as homophily is significant within this network, but there are no mutually reciprocated interactions.

In addition to the significant differences in the degree of reciprocity, indegree and outdegree centralisation vary significantly. First, non-clinical professionals (31.4%) have nearly three times the outdegree of clinical professionals (10.1-12.7%); this suggests that the former are much more active when seeking information advice. Second, nurses have a higher indegree than outdegree, which indicates that they are popular sources of information and improvement work advice. Nurses also have the highest indegree (14.7%) among the professional groups, whereas doctors (5.1%) and allied healthcare professionals (6.4%) have less than half compared to nurses. This result depicts different professional dynamics as doctors outdegree (12.7%) is more than double the indegree. In this case, doctors are more active when seeking information and advice, and but they are not popular sources of information and advice regarding improvement work.

Brokers and triads' composition is similar to NHS-D as non-clinical professionals have a dominant role in the network. In NHS-K, 43% of professionals are brokers, where 14% are clinicians, and 29% are non-clinical management professionals, indicating that clinicians have fewer brokering relationships than non-clinical professionals. This pattern is also seen for triad memberships as

clinicians represent 27%, and non-clinical professionals are 73%. Unlike NHS-D, which has high network reciprocity, this network has low network reciprocity, limiting cohesion among professionals. Even though doctors have the highest group reciprocity, it has poorly represented incoming, outgoing, brokering, and triadic relationships. Further, non-clinical professionals represent the highest degree of interactions but have low reciprocity. Together, these features would not engender cohesion and shared understanding about new practices in this network.

5.4.4.1 NHS-C Professional Roles

Finally, no homophily effects were observed in NHS-C for the professional groups or the partnerships roles. This result indicates that the NHS-C network is not characterised by similarities among professionals and suggests greater diversity in its interactions. Like NHS-D, the arc reciprocity among professionals varies as doctors (0.167) and non-clinical and management professionals (0.184) have high levels of reciprocity, whereas nurses (0.044) and allied healthcare professionals (0.083) have low levels of reciprocity. This result suggests a high degree of cohesion and intra-group collaboration among doctors and non-clinical and management professionals and a low degree of cohesion among nurses and allied healthcare professionals. In this network, all professional groups have more outgoing than incoming ties, which suggests that they are more active when seeking and sharing information and advice about improvement work. Despite the high reciprocity, doctors have the lowest indegree (3.9%) and outdegree (7.7%) centralisation among the professional groups, suggesting that they are not active or popular collaborators for improvement work. Nurses and allied healthcare professionals have a low degree of reciprocity but have more than double the indegree (16.7%, 12.8%) and outdegree (20.2%, 16.5%) of doctors. This pattern is different for non-clinical professionals as they have high reciprocity and the highest indegree (25.4%) and outdegree (31.3%) centralisation among the professional groups.

In NHS-C, 60% of professionals are brokers, 23% are clinicians, and 37% are non-clinical management professionals, indicating that clinicians have fewer brokering relationships than non-clinical professionals. NHS-E and NHS-C have the same triad membership where clinicians represent 49%, and non-clinical professionals are 51%. This result indicates a similar level of involvement; however, the lack of reciprocity among nurses and allied healthcare professionals limits the degree of cohesion that this network can realise. It also highlights that doctors have cohesive relationships due to their reciprocity, but they are not active or popular regarding improvement work. Conversely, non-clinical professionals also have cohesive relationships; however, their relationships dominate this network. This result is similar to NHS-D, where this dynamic would engender cohesion and shared understandings about new practices among non-

clinical professionals; however, it is less beneficial in a healthcare setting, which requires clinical practices to be more involved in improvement work.

Unlike the other networks, NHS-C observes sender and receiver effects among professional groups. Positive sender effects were found among clinical roles, suggesting that they send more ties regarding improvement work due to their clinical status; however, this was not significant. This result was confirmed as outdegree centralisation among clinicians is 44.4% compared to 31.3% among non-clinical management professionals. A negative receiver effect was observed, where nurses tend to receive fewer ties than expected, which is significant. In this case, nurses have a low density and reciprocity but a high indegree centralisation. Based on this comparison, the model estimated that even higher numbers of incoming ties should have been observed, but the realised ties were less than expected. Overall, this reveals disparities in professional dynamics, which may be aligned with the lack of homophily effects observed.

5.4.5 Partnership Relationships

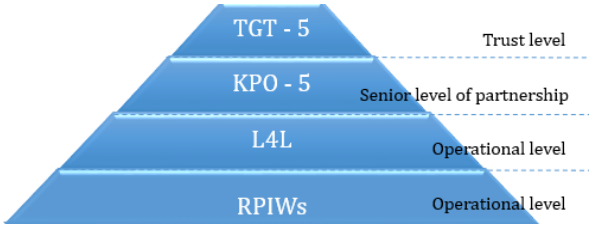


Figure 21: Partnership Structure

The professional roles examination was also extended to consider partnership roles, TGT, KPO, L4L and RPIW, which also have a key role in sharing and receiving information and advice about improvement work and brokering and cohesion among professionals. In this case, TGT and KPO actors are in strategic roles which plan and coordinate improvement work, and the L4L and RPIW roles engage, apply and implement the lean methodology within their work environment. This section focuses on partnership relationships to highlight further nuances among healthcare professionals' relationships and interactions, so distinctions are made based on incoming and outgoing interactions, more brokering relationships and presence in triads. Like professional roles, partnership roles can also represent institutional effects framed to understand improvement work progress further.

5.4.5.1 NHS-A Partnership Roles

In NHS-A, positive and significant homophily effects were found among RPIW actors, suggesting that professionals who underwent formal training in the lean methodology tend to interact with each other more than other partnership groups, which significantly affects the network. Alternatively, negative homophily effects were found among L4L participants; however, these relationships do not significantly affect the network. This finding suggests that L4L participants

seek each other as collaborators within the NHS-A network; however, it is not common. In this case, it can be inferred that since L4Ls are conducting improvement initiatives in various departments, they are more likely to make connections with diverse professionals. TGT and KPO actors represent 4% of brokers and 16% of triad members in the network; therefore, the lack of homophily among these actors suggests that their relationships do not have a dominant effect on the network.

In comparison, L4L and RPIW actors represent 23% of brokers, and L4Ls make up 71% of triads whereas, RPIW actors represent 46%. This result aligns with the homophily effects observed for L4L and RPIW actors suggesting that they play a dominant role in the network brokering information and fostering cohesion among professionals. Next, compared to other networks, no sender or receiver effects are observed in NHS-A. This finding may suggest a more distributed form of network activity and that neither partnership nor professional roles increase or decrease interactions regarding improvement work.

5.4.5.2 NHS-D Partnership Roles

NHS-D had the same result as NHS-A, where homophily was positive and significant among RPIW actors and negative and non-significant for L4L actors. This result has the same conclusion as NHS-A, where professionals who underwent formal training in the lean methodology tend to interact more than other partnership groups. Similarly, L4L also tend to interact, but this is not as common compared to RPIW participants. Unlike NHS-A, significant sender and receiver effects were observed among TGT and KPO actors, indicating that they are more popular and have more incoming and outgoing interactions regarding improvement work than other professional groups and actors. This result is both surprising and unsurprising. Unsurprisingly, TGT and KPO actors can be perceived as more visible and popular actors regarding the coordination of improvement work due to their strategic decision-making and training responsibilities. Therefore, they are more likely to receive more ties from professionals wanting to enquire, clarify and seek information about improvement initiatives. Similarly, these actors are also more likely to send more ties to actors because they are responsible for the strategic decision-making about training and implementing new practices. However, this finding is surprising as this popularity dynamic is not observed in the other networks, where these hierarchical roles and strategic responsibilities also exist. Compared to NHS-A, TGT and KPO actors represent 7% of brokers in this network, whereas L4L and RPIW actors represent 17%. In this case, NHS-A has more L4Ls and RPIW actors acting as brokers, whereas NHS-D has a higher proportion of brokers in the TGT and KPO roles. When triads are considered, TGT actors represent 14%, KPO actors represent 18%, L4L actors represent 54%, and RPIW actors represent 26%. Therefore, compared to NHS-A, TGT and KPO actors represent a higher proportion of triad members, whereas L4L and RPIWs

represent a lower higher proportion of triad members. Overall, this is aligned with previous findings where non-clinical professionals have a dominant role in the network, as TGT and KPO actors are also classified as non-clinical professionals.

5.4.5.3 NHS-C Partnership Roles

In NHS-C, no homophily effects were found at the partnership level; however, both sender and receiver effects are found among the L4L roles, where actors who have completed or are undergoing L4L training tend to send and receive more ties regarding improvement work. Both effects are positive; however, the sender effect is significant, and the receiver effect is non-significant. This result is surprising as it shows that the L4L actors in NHS-C have formed relationships to share information and advice about improvement work, as this was one of their expected roles; however, it was uncertain whether this was occurring. It is also surprising that both of these effects are not simultaneously observed in the other networks. This finding suggests and supports the lack of professional homophily within this network if actors form ties with persons who have undergone L4L training and perceive them to be more knowledgeable about the method. In this case, improvement work advice and information are not centred on professional group relationships and interactions observed in the other networks, but it is centred around persons who are more knowledgeable about the method. In this network, TGT and KPO actors represent 7% of brokers, whereas L4L and RPIW actors represent 20%, which is slightly higher compared to NHS-D; therefore, NHS-C has more L4Ls and RPIW actors acting as brokers. When triads are considered, TGT actors represent 14%, KPO actors represent 14%, L4L actors represent 49%, and RPIW actors represent 59%. In this case, NHS-C has fewer KPO and L4L actors in triads but more RPIW actors than NHS-D. Despite their presence, interactions among TGT, KPO and RPIW actors do not significantly impact the network.

5.4.5.4 NHS-K Partnership Roles

In NHS-K, positive homophily effects were found at all partnerships levels; however, they were was significant for the KPO and RPIWs actors. This result suggests that actors in KPO roles are more likely to interact with each other, and this is unsurprising as these actors work closely to implement and train persons in the lean method. For RPIW participants, homophily is large and significant compared to other partnership effects, and this suggests that professionals who underwent formal training in the lean methodology tend to interact with each other more than other partnership groups. The RPIW result is surprising as the large estimate indicates that RPIW participants' interactions have a dominant and significant impact on the network. Homophily among the TGT and L4L roles suggests that actors tend to form ties with each other; however, these effects do not significantly affect the network. Like NHS-D, which shares similar structural

features, NHS-K also has positive and significant TGT sender effects. As previously mentioned, this is unsurprising as these actors are likely to send more ties due to strategic decision making roles regarding the planning of improvement work. Although the partnership roles are well represented in the model, only 11% of the partnership actors are in brokering roles, 4% for TGT and KPO, and 7% for L4L and RPIW actors. This finding suggests that these actors are not active brokers in the network, and this is surprising as partnership roles are directly associated with the planning, training and implementation of improvement work.

TGT actors represent 21% of triad membership, which is the highest observed among the networks, as the others range from 7-14%. KPO actors represent 12% of triads, and L4L actors represent 42% which are low compared to other networks. RPIW actors represent 58% of triads which is similar to NHS-C. The large composition among TGT actors and the low proportion of brokers in partnership roles highlights the finding that actors in NHS-K are interacting in silos and the lack of intergroup interaction limits the sharing of information and advice from professionals who are supposed to be most knowledgeable.

5.4.5.5 NHS-E Partnership Roles

In NHS-E, positive and significant homophily effects are found in the partnership roles except for L4L actors. Strong effects are found among the TGT and KPO roles indicating that these actors tend to interact about improvement work, and the relationships among these actors have a significant effect on the network. However, the TGT and KPO estimates are significantly larger than most of the structural effects, and they are also larger than most of the professional role effects, indicating that the network is dominated by TGT and KPO interactions. Another surprising finding is that there are no homophily effects among the L4L participants, and this group was the main category surveyed to conduct this research. This finding suggests that these actors do not form ties with each other, and there may be diversity in their interactions.

Sender effects are found among the TGT and L4L roles. The TGT sender effect is non-significant, suggesting these actors are likely to send more ties; however, it does not significantly affect the network. The L4L effect is large and significant, indicating that L4L actors send more ties than other partnership groups as these actors have formed more outgoing relationships to share information and advice about new practices. This result confirms the previous observation, where there is more diversity in L4L interactions rather than homophily. Next, one receiver effect is observed among the KPO roles; however, this effect is not significant. This result suggests that these actors are likely to receive more ties from professionals who want to inquire, clarify, and seek information about improvement initiatives. NHS-E had the highest proportion of brokers in partnership roles, where 6% are TGT, and KPO actors and 23% are L4L and RPIW actors. Next, TGT actors represent 13% of triads, KPO actors represent 16%, and L4Ls represent 53% of triads;

however, RPIW actors represent 71% of triads members, which is the highest observed compared to the other networks. Overall, these results are aligned with the significance observed in the homophily and partnership effects.

5.5 Summary of Empirical Findings

5.5.1 Structural Embeddedness Summary

Table 22: Structural & Institutional Embeddedness Summary

Structural Embeddedness	**NHS-A**	**NHS-D**	**NHS-E**	**NHS-C**	**NHS-K**
Bridging	High	High	High	High	Lowest
Closure	High	High	High	High	Low
Institutional Embeddedness					
Professional Roles	High	High	High	None	Very Low
Partnership Roles: TGT & KPO	None	High	High	None	High
Partnership Roles: L4L & RPIW	High	High	High	None	High
Improvement Work Progress	**Good**	**Good**	**Very Good**	**Low**	**Lowest**

The analysis revealed several structural variations within and between the networks (See Table 22). For example, all the networks except NHS-K display a high degree of brokering and closure when triads, bridging structures and brokering roles are examined. Bridging structures and brokering are associated with searching, acquiring, and sharing information and advice about improvement work and new practices in general. In this case, brokering allows professionals to inform their understanding of improvement work by sharing and receiving improvement information from network contacts. On the other hand, closure is associated with social cohesion and collective action among professionals within the network. It promotes shared understandings, engagement and adoption of new practices among closely connected groups of professionals; however, this is not determined by closure alone, as other bridging and other mechanisms may negate the benefits that emerge from closure.

NHS-A, NHS-E, and NHS-C professionals tend to have large group interactions, varying degrees of popularity and activity spread and multifaceted brokering relationships within their networks. These are distinctive features where professionals engage in various patterns of interactions to receive and share information and advice with multiple collaborators. The key finding here is that professionals in these networks are very active in either seeking or providing improvement information to other professionals. Similarly, these networks have a high degree of triadic closure, making them well-structured to foster engagement and adoption of new practices. NHS-D and NHS-K have different relational dynamics where professionals tend to interact in small groups where they seek information and advice from close collaborators rather than seeking advice from popular professionals. However, brokering and closure vary significantly in these networks.

Although NHS-D professionals tend to collaborate in small groups, there is a high degree of bridging and closure evidenced by the high number of open and closed triads and generalised transitivity. Therefore, this network can promote engagement and the adoption of new practices among professionals. NHS-K, however, displays the lowest degree of bridging and closure among the five organisational networks. The lack of open triads and brokering motifs in comparison to NHS-D also reveals that very little information seeking and sharing activities occur among professionals, which does not support sharing information and advice about improvement work.

5.5.2 Professional Roles Summary

The structural analysis of these advice networks revealed surprising similarities among the organisations. However, these findings were insufficient to explain the differences observed in terms of improvement work progress. This revelation posed a question to understand what relational mechanisms were underpinning network structures. Differentiating interactions emerged among professional groups to answer this question, and some unique insights highlighted the differences within each organisational network. When the professional roles of nurses, doctors, allied healthcare professionals and non-clinical management professionals are considered, further distinctions are made about incoming and outgoing interactions, more brokering relationships and closure.

In each network, there are different relational dynamics among professional groups. For example, in all the networks except NHS-E, nurses are the most popular clinical professional group regarding information and advice about improvement work. In NHS-E, however, doctors are the popular clinical collaborators. Also, in NHS-A, NHS-C and NHS-E, nurses are the most active clinical professional group, whereas doctors are more active in NHS-D and NHS-K. When brokering roles are considered, over 30% of brokering roles are occupied by clinicians in NHS-A, whereas in the other networks, only 14-23% of brokering roles are occupied by clinicians. When triad membership is considered, non-clinical and management professionals tend to make up a slightly larger proportion of triads in NHS-D, NHS-C and NHS-K. In NHS-E, the composition is evenly distributed, whereas, in NHS-A, there are more clinicians in triads than non-clinical professionals. Overall, this suggests that clinical professionals drive improvement in NHS-A improvement work, whereas improvement work is driven by non-clinical professionals in the other four networks. Finally, positive homophily effects are observed with varying degrees among professional groups in most of the networks. In NHS-A, NHS-D and NHS-E, there is a high degree of homophily in professional groups, suggesting that professionals' roles and affiliations can emerge as institutional effects that have varying consequences for these networks' improvement work. However, institutional effects are not observed in NHS-C and are only found

among allied healthcare professionals in NHS-K. This finding suggests that other relational dynamics may be underpinning improvement initiatives.

5.5.3 Partnership Roles Summary

The professional roles examination was also extended to consider partnership roles, TGT, KPO, L4L and RPIW, which also have a key role in sharing and receiving information and advice about improvement work and brokering and cohesion among professionals. In this case, TGT and KPO actors are in strategic roles which plan and coordinate improvement work, and the L4L and RPIW roles engage, apply and implement the lean methodology within their work environment. There are mixed results regarding the partnership relationships, as homophily, sender and receiver effects are found in varying degrees in each network. Compared to the other networks, no sender or receiver effects are detected among the NHS-A professional and partnership groups; this finding suggests that these groups do not have more relationships and interactions that impose a significant effect due to their professional and partnership status. Similar partnership effects were observed in NHS-A and NHS-D, as there are positive and significant estimates for L4L and RPIW actors. This result indicates that persons who are actively engaged in applying the lean methodology are interacting with each other. This effect was observed in the NHS-K and NHS-E networks; however, interactions among the L4L participants in NHS-A and NHS-D occur less than expected. This result suggests that although these interactions exist within these networks, they are infrequent compared to professional roles. A surprising finding here is that TGT and KPO interactions do not dominate network interactions within these two organisations. The TGT and KPO roles involve the strategic coordination of improvement work, whereas the L4L and RPIW roles involve actors engaging with new practices in their work environment. This finding indicates that NHS-A and NHS-D's networks are not dominated by strategic interactions when compared to NHS-K and NHS-E.

Next, there is homophily among all the partnership roles in NHS-K, which suggests that relationships are concentrated among actors directly involved in improvement work; however, there is less mutual interaction among actors who have the same professional background. Similarly, NHS-K has a very low presence of partnership brokers, and this indicates that actors at strategic levels of the partnership and those trained in the lean method are less likely to broker information about improvement work within this network. Finally, since professional roles and partnership roles overlap, further examination is required to determine the extent of persons who are clinical or non-clinical professionals and their professional role is associated with their partnership involvement.

This analysis and comparison of five organisational networks emphasized that combinations of structures and interactions within the network produce varying conditions for professionals to

share information and advice about improvement work. This chapter's results and findings underscore a key theme that similarities in structure do not equate to similarities in professional interactions and relationships. In the next chapter, Chapter 6: Discussion, these findings are analysed and synthesized in relation to theory to address the fourth objective, which seeks to advance institutional perspectives by illustrating the role of embeddedness with respect to the institutionalisation of new practices in organisations.

Chapter 6: Discussion

6.1 Introduction

This chapter addressed the fourth and final research objective, which seeks to *advance* institutional perspectives by illustrating the role of structural and institutional embeddedness with respect to the institutionalisation of new practices in organisations. This chapter briefly reviews the literature presented in Chapter 2: Literature to establish the context to interpret and relate the findings to micro-institutional perspectives. This work is positioned in the microfoundations of institutions which seeks to understand the link between institutions and collective actors. One specific concern in the microfoundations agenda is understanding the nature of behavioural and communication processes that are likely to affect micro-institutional change (Tolbert & Zucker, 2019). By considering the microfoundations of institutions, greater attention has been placed on understanding the role of agents and collective actors within organisations and their association with micro-institutional change processes. This agenda focuses on understanding the ways individual and collective behaviour can support or challenge institutions (Powell & Colyvas, 2008; Roulet et al., 2019) due to increased recognition of how institutions are shaped by people on the ground (Hallett & Hawbaker, 2019; Powell, 2019). This perspective also highlights the actors whose everyday actions and interactions are responsible for carrying out and supporting practice changes (Smets et al., 2018; Zucker & Schilke, 2019).

As such, this research set out to examine the role of embeddedness when actors attempt to institutionalise new practices within their organisations. When a social network lens is cast on micro-institutional change, it reveals that the traditional institutional view of embeddedness is limited and conflated. Social network theory has produced detailed accounts of how embeddedness and network structures influence organisational outcomes. However, the traditional focus on macro-level theories restricted institutionalists efforts to examine the microprocesses of change in institutions (Cardinale, 2018; Powell & Rerup, 2018; Harmon et al., 2019). The traditional consensus is that embeddedness either enables or constrains actors and their ability to enact change. However, this work addresses a long-standing problem in institutional theory. It illustrates that the lack of embeddedness among institutional actors decreases the likelihood of micro-institutional change, rather than constrains it.

This study proposes three main contributions to the existing research on micro-institutional change. First, this research demonstrates that when embeddedness is decomposed into structural and institutional elements, varying combinations emerge that provide insight into the influence embeddedness has on the institutionalisation of new practices. This research found that structural and institutional embeddedness among actors is a fundamental source and necessary precondition for micro-institutional change and shows that varying forms of embeddedness are

related to and become enablers or barriers when actors attempt to institutionalise new practices to stimulate change.

This finding led to this research's second contribution, where three collective accounts of micro-institutional emerge. These accounts extend and diverge from existing accounts of actors' attempts to enact micro-institutional change. Two accounts, Non-Collaborative and Non-Institutional, decreased the likelihood of micro-institutional change. In the non-collaborative form of embeddedness, structures and interactions among institutional actors do not encourage sharing information or advice about new practices, nor support consensus among institutional actors to engage in new practices. Non-Institutional embeddedness, on the other hand, does have the structural foundation among actors to collaborate and generate consensus about new practices; however, it lacks an institutional frame to engender change among institutional actors in similar professions. Collective Institutional Embeddedness addresses the gaps observed in the Non-Collaborative and Non-Institutional Embeddedness as both structural foundations support collaboration and interaction that share information and generate consensus about new practices among actors who share similar institutional frames, and this increases the likelihood of micro-institutional change. The third contribution of this study is that it offers an alternative conception of micro-institutional change by illustrating that change or lack thereof is associated with social interactions and relationships among actors. It explicitly delivers a socialised and collective account of micro-institutional change by considering complex social processes and diverse actors within institutions, where existing literature has been criticised for over-socialised and heroic narratives that ignore actors' purposive efforts.

6.2 Embeddedness & The Institutionalisation of New Practices in Organisations

In institutional theory, there has been a long-standing puzzle regarding the embeddedness of actors and the microprocesses of institutional change. As mentioned in the literature review, there is a deep-rooted case where actors who are embedded in institutional structures are unlikely to initiate, enact or engage in institutional change initiatives as institutional mechanisms tend to replicate, rather than change, existing arrangements (Powell & DiMaggio, 1991; Garud et al., 2007). However, this wrongly portrays actors as over-socialised and subject to institutional norms without question and not purposive agents who can question and re-evaluate institutional rules and practices. Therefore, the key issue here is that we know that this occurs despite this argument's theoretical strength. This revelation suggests that our understanding of micro-institutional change and the embeddedness of actors is lacking.

From an institutional perspective, embeddedness is the degree to which actors and their actions are linked to or shaped by their social and institutional context (Reay et al., 2006; Hinings & Tolbert, 2008; Schneiberg & Lounsbury, 2008; Godwyn & Gittell, 2012). The institutional entrepreneurship literature attempted to consider embeddedness from a micro perspective, and it diversified the institutional accounts of embeddedness and change by providing a more inward-looking, actor-centric and micro-oriented account of change (Greenwood et al., 2008; Powell & Colyvas, 2008). However, the institutional entrepreneurship narrative focused on the organisation's upper levels and ignored the actors responsible for enacting and engaging with new practices. This notion became problematic as studies focused on individual actors, and from our understanding of institutions, it is unlikely that a few actors can engender and enact change (Battilana et al., 2009; Tracey et al., 2010; Lockett et al., 2012, 2014). Therefore, this depiction became an impractical and unrealistic representation of micro-institutional change and did not explain micro-institutional change or the process of institutionalising new practices among a collective of actors. More specifically, we have little understanding of how actors use their embeddedness in their attempts to influence changes within their organisational environment when new practices are introduced.

The institutionalisation of new practices is a complex phenomenon in organisations due to existing institutions, norms and practices, making some organisations resistant to improvement initiatives and other change-oriented and developmental endeavours (Greenwood & Suddaby, 2006; Kennedy & Fiss, 2009; Smets et al., 2012). At the micro-level, the institutionalisation of new practices requires the interactions and negotiations of various institutional actors to legitimate and enact new practices (Zilber, 2006; Lounsbury & Crumley, 2007; Sahlin & Wedlin, 2008; Bridwell-Mitchell, 2016). When the practice becomes widely accepted, it no longer needs to be

legitimised, and actors cease talking or thinking about them because they are now a normal facet of their daily work. This process is known as micro-institutional change, where change depends on the extent to which communication and socialisation, "as well as cohesion and diversity in community interactions allow actors to generate widely shared understandings about the technical and social requirements of new work practices" (Bridwell-Mitchell, 2016, p. 162).

From, this perspective the institutionalisation of new practices is influenced by the interactions and embeddedness of institutional actors. In response to these theoretical shortcomings of traditional institutional embeddedness perspectives, further attention was placed on viewing embeddedness as a foundation that supports change opportunities (Reay et al., 2006, p. 977). Accordingly, Scott et al. (2000) argue that the extent of micro-institutional change is influenced by the "nature and extent of relations among actors in an organisation or field" (pg. 24). By shifting the perspective, the role of actors embeddedness and interactions could also be seen as a facilitator and mechanism of micro-level change rather than a barrier that inhibits it (Powell & Colyvas, 2008; Zucker & Schilke, 2019). Together, these points are aligned with the first objective which sought to clarify the role and importance of embeddedness regarding micro-institutional change and the institutionalisation of new practices. This objective highlighted issues when considering embeddedness as a problem or constraint and reframed it as a mechanism to support actors in their attempts to change institutions.

Since the traditional institutional perspectives were ill-equipped to frame embeddedness as a mechanism to support change, the second objective of this research sought to *critically evaluate* embeddedness from a social network perspective to understand the institutionalisation of new practices within an organisational context. A social network view of embeddedness draws on a relational perspective, where patterns of interactions and relationships matter because actors take on identities and give meaning to social action through their relatedness to others (White & Mohr, 2008; Kilduff & Brass, 2010). Based on this view, it was argued that the social network view of embeddedness has always focused on the study of social institutions, where networks become a linkage mechanism that bridges micro-level systems of social interaction to the meso and macro levels of organisational and institutional fields (White & Mohr, 2008; Tasselli et al., 2015). This connection presents an assumption that social relationships are the building blocks of institutions and networks, as they are concerned with the influence of embeddedness and social structures among actors (Owen-smith & Powell, 2008; Powell & Oberg, 2018). When discussed in this way, institutions' social networks provide insight into the micro-level processes that influence institutional change (Owen-smith & Powell, 2008; Gibson & Vom Lehn, 2018; Hallett & Hawbaker, 2019). Further, when a social network lens is cast on micro-institutional change, it revealed that the traditional institutional view of embeddedness constraining action is limited and conflated.

In general, there are many forms of embeddedness, which confound whether it would be an opportunity and constraint for change; however, these perspectives are not discussed or presented in much of the institutional discourse. Therefore, social relationships and interactions are conceptualised to represent structural forms of embeddedness by adopting a social network lens. Structural embeddedness focuses on examining the social patterns and structures that emerge within the network to understand the specific social processes present in a network (Dacin et al., 1999; Moran, 2005; Kilduff & Brass, 2010).

In this case, the micro-level dynamics of institutional change and structural embeddedness were theoretically debated and empirically examined to broaden the scope and understanding of new practices' institutionalisation in two ways. When examining closure and bridging at the structural level, a macro view of social relationships can investigate collective action through a network's overall embeddedness and the global presence or absence of cohesive group or bridging structures within the network. Second, by drawing on Simmel's notion of the triad, various forms of triadic structures, such as closed and open triads, can be investigated to understand the extent and nature of embeddedness within networks and groups. These angles lead to more detailed views of embeddedness among institutional actors and more nuanced views of the relational mechanisms associated with social structures and the implications regarding the institutionalisation of new practices.

Taken together, this forms the basis of this research's theoretical position, which suggests that varying degrees of interaction and embeddedness among actors play a determining role in the institutionalisation of new practices (Reay et al., 2006; Smets et al., 2012, p. 899; Raffaelli & Glynn, 2014). This theoretical position promoted the third research objective, which sought to *explore* the role of structural embeddedness in relation to the institutionalisation of new practices among institutional actors. In adopting a structural conceptualisation of social embeddedness, a systematic investigation of two mechanisms, bridging and closure, is permitted to examine embeddedness and professional networks' structural characteristics. Each organisation in this study had the same change-oriented resources, training and funding; however, they also have varying levels of progress regarding the extent of change and organisational performance. This examination confirmed that the different patterns of interaction among institutional actors and the presence of closure and bridging within networks have contrasting implications to institutionalise new practices. This revelation segues into the fourth and final objective of this research, which seeks to synthesise and critique the findings of this study with existing prior studies to *advance* institutional perspectives by illustrating the role and importance of structural embeddedness to institutionalise new practices in organisations.

6.2.1 Structural Embeddedness

Previous research found that two structural forms, closure and bridging, have varying consequences for sharing information among actors (Burt, 2001; Reagans & McEvily, 2008); however, it was unclear what role these structures have to institutionalise new practices. Closure emerges from closed triadic structures where actors are directly connected to members of a subgroup, and closely-knit ties are more likely to endorse behaviours or actions, in this case, new practices, if they share joint partners (Simmel, 1955). Closure among institutional actors also promotes normative justification and influences the professionalisation of practice, which further encourages practitioners and organisations to adopt and implement new practices (DiMaggio & Powell, 1983; Smets et al., 2012). Accordingly, the link between closure and the institutionalisation of new practices is that closure engenders strong social pressures that foster familiarity and shared values that determine the way actors create, use and share new practices (Kogut & Zander, 1996; Nahapiet & Ghoshal, 1998; Cook & Brown, 1999; Brown & Duguid, 2001; Burt, 2001; Tortoriello et al., 2012). Bridging is facilitated actors broker information or advice between disconnected actors and groups that emerge from closure among actors (Mehra et al., 2001; Oh & Kilduff, 2008; Fang et al., 2015).

The key mechanism associated with closure and bridging structures is the triad (Krackhardt & Kilduff, 2002), which represents complex social and relational processes among three actors. Generally, a closed triad represents closure among actors, and alternatively, an open triad is associated with brokering between actors (Krackhardt & Kilduff, 2002; Tortoriello & Krackhardt, 2010; Simmel, 2011). When the group size increases, embeddedness is understood based on the degree of interaction, triadic relationships and connectivity among actors (Rivera et al., 2010). Therefore, in networks with a high degree of structural embeddedness, we would expect to find a high presence of both bridging and closure. In this case, a high degree of bridging would be associated with a high number of simple brokering structures or open triads and at least one of the three high-level bridging structures, which represent complex brokering relationships. Similarly, in networks with a high degree of closure, a high number of closed triadic structures are present. In this study, there are four networks with high structural embeddedness and one network with a low structural embeddedness, and evidence was evidence that forms of structural embeddedness influence new practices' institutionalisation differently. This study confirms that a high degree of structural embeddedness is more likely to be associated with greater progress when institutionalising new practices; however, these effects varied due to the degree of institutional embeddedness among actors.

Structural Embeddedness	Institutional Embeddedness	Institutional Actors
•High •Low	•High •Low •No	•Enactors •Applied Change Agents •Strategic Change Agents

Figure 22: Summary of Embeddedness Categories

6.2.2 Institutional Embeddedness

This research takes the position that institutions are relational and reflect patterns of interaction among institutional actors (Powell & Oberg, 2018). Accordingly, professional networks reflect active forms of engagement, where networks are made up of practitioners who embody practices and the widely shared understandings of institutions, and relational ties function as institutional carriers that offer exposure to and transport practices within an institutional context (Scott, 2003; Raffaelli & Glynn, 2014). As previously mentioned in the literature review, institutional actors are diverse organisational actors who function as carriers, creators, facilitators and enactors of institutional practices. These actors encompass differing ways of knowing and doing within the same organisational culture and institutional environment (Lindkvist, 2005; Evans & Scarbrough, 2014). Therefore, when considering the process and likelihood of institutionalising new practices, institutional embeddedness among actors needs to be a key consideration.

As previously mentioned, this study's research context is a healthcare setting which is generally seen as highly institutionalised settings where social actors create, enact and reproduce different roles, responsibilities and practices associated with medical professionalism (Battilana & Casciaro, 2012). The healthcare field is a diverse, multi-professional context where patterns of interactions among professionals have become a prominent issue for delivering care, managing operations, improving safety and other related outcomes (Tasselli, 2014).

Therefore, it is important to distinguish embeddedness among institutional actors for two key reasons. First, in their initial training and daily practice, healthcare professionals develop normative and social networks that guide their professions' norms and stable conduct (Scott et al., 2000). Second, if practitioners are carriers of institutions (Smets et al., 2012, 2018), then professional networks and the relationships between actors would promote the acceptance, legitimacy and normative justification of practices (DiMaggio & Powell, 1983; Smets et al., 2012; Raffaelli & Glynn, 2014; Gray et al., 2015).

Also discussed in the literature review was the need for a revised model of the actor, that captures actors who have an awareness of and engage with institutional alternatives while considering the implications of social interactions among said institutional actors. To address this point, three classifications of actors are specified to frame the institutional embeddedness in relation to the actor interactions and the institutionalisation of new practices. The first classification is ***enactors,***

and this label represents the broad group of institutional actors who are professionals or practitioners within an institutional setting and apply new and established practices in their everyday work but may have varying degrees of awareness regarding the aims and specifics of the institutional change process.

The second classification is ***applied change agents,*** and this category represents institutional actors who are practitioners that have been trained in new practices and led change initiatives in their work environments. This category is aligned with the L4L and RPIW participants of this study, where practitioners are actively involved, aware and engage in the institutionalisation of new practices. The third classification is ***strategic change agents***, and this label represents the TGT & KPO actors in this study who are actively involved in training enactors and applied change agents, as well as planning or coordinating change initiatives but are not enacting new practices in their everyday work. Therefore, these actors have a high awareness of the institutional change process but low engagement with new practices as a part of their daily work.

Enactors	Applied Change Agents	Strategic Change Agents
•Varied Awareness of Institutional Change Process. •High Engagement with new Practices.	•High Awareness of Institutional Change Process. •High Engagement with new Practices.	•High Awareness of Institutional Change Process. •Low Engagement with new Practices.

Figure 23: Groups of Institutional Actors

The distinction among these actor groups is critical to understanding embeddedness as a foundation that supports the institutionalisation of new practices, as varying degrees of interactions among these groups act as mediators for micro-institutional change. These distinctions are also aligned with a revised model of the actor, as they capture purposive agents who have varying degrees of awareness and involvement in change processes, and also varying degrees of engagement with new practices. As previously discussed in the literature review, awareness and engagement with new practices would likely influence an actor's sense of agency regarding their actions, their interactions with others, thus lending some insight into the link between the inhabited institutionalism literature and social network theory.

For example, if the inhabited institutionalism literature argues that social interactions are vital to understanding institutions by providing a meso-sociological lens (Hallett & Hawbaker, 2019); then distinguishing between actors provides some insight into the types of interactions and social structures observed based on actors' awareness and involvement in an institutional change process. This dynamic emerged from the findings as varying degrees of institutional embeddedness were observed among the professionals. This finding also highlighted that social

structure and institutional structure were distinctive among institutional actors. Meyer & Vaara (2020) argued that thinking about institutions and social actors as separate entities is problematic; however, the research findings suggest that *they are separate* as interactions in a social, relational or communicative space, are distinct from interactions in an institutional space. Overall, these points suggest that the social networks and interactions of institutional actors act as meso-level structures which bridge the micro-macro and actor-institution divide and provide a context and framing to understand different types of institutional actors, micro-institutional change processes, and institutions more generally.

Additionally, institutional actors produce professional networks that develop through actors' interactions and relationships who mimic and modify practices in their everyday interactions. Therefore, distinctions among actor groups and the relationships and interactions among those actors play a vital role to institutionalise new practices since social and professional networks influence collective interpretations more deeply than individual actors (Reay et al., 2006; Beckert, 2010a; Smets et al., 2012, p. 899). This research found strong evidence for varying degrees of interactions within the institutional space of each organisational network. These are categorised as ***High, Low, and No Institutional Embeddedness*** *(See Figure 22)*.

High Institutional Embeddedness was observed when homophily, sender, and receiver effects are present among enactors, applied or strategic change agents. This is more likely to be associated with an increased sense of agency regarding micro-institutional change processes among institutional actors. However, Low and No Institutional Embeddedness were also observed when homophily, sender and receiver effects are rarely present or absent among enactors, applied or strategic change agents. These forms of embeddedness are more likely to be associated with a decreased or limited sense of agency regarding micro-institutional change processes among institutional actors.

Therefore, the classification of actor groups and distinctions in institutional embeddedness adds to our understanding by showing that embeddedness variations have contrasting consequences regarding institutionalising new practices. Further, the division of actor groups and embeddedness allows collective accounts of micro-institutional change to be maintained, avoiding accusations of reductionism and methodological individualism (Meyer & Vaara, 2020). Ultimately, the interplay of distinctive social and institutional structures gave rise to three collective accounts of micro-institutional change, when structural mechanisms are considered: ***non-collaborative, non-institutional, and collective institutional embeddedness***. Table 23 outlines structural and institutional embeddedness combinations, as they emerged from the findings and their association with new practices' institutionalisation.

6.3 Forms of Embeddedness & the Institutionalisation of New Practices

6.3.1 Non-Collaborative Embeddedness

The first account, ***non-collaborative embeddedness***, is observed in NHS-K, where actors have a low degree of structural embeddedness and a high degree of institutional embeddedness. This form of embeddedness derives its name from the lack of closure and bridging among institutional actors, which does not foster collaborative and collective interactions that support the process of institutionalising new practices. In NHS-K, closure primarily exists among strategic and applied change agents rather than across the network of actors involved in the change initiative. Therefore, the lack of closure does not foster a sense of belonging, trust or engender strong social pressures to encourage practitioners to adopt or exchange and information and advice about new practices.

In this case, strategic and applied change agents make connections among themselves, but rarely with enactors to share information and advice about new practices. This finding is confirmed as strategic and applied change agents in NHS-K represent 11% of brokering relationships within the network, whereas the other networks with high structural embeddedness ranged from 27-29%. Similarly, this network had the lowest number of open triads and one simple bridging and no complex brokering forms, whereas the others had between two and four. This disparity further confirms the lack of structural embeddedness among NHS-K actors and provides support for a non-collaborative account of micro-institutional change, where actors are not interacting to institutionalise new practices.

Alternatively, there is a high degree of institutional embeddedness among strategic change agents and applied change agents as homophily is present, but these actors are isolated from enactors of new practices. Based on the high degree of embeddedness among strategic change agents and the lack of interactions among enactors, it can be argued that this network is factionalised and uncooperative since strategic change agents operate in silos and are largely disconnected from enactors. These relationships would not engender engagement or generate consensus about new practices.

This behaviour is aligned with traditional micro-institutional change perspectives, where a high degree of interaction is observed among institutional entrepreneurs. From this perspective, strategic change agents are also institutional entrepreneurs; actors envision alternative practices and mobilise resources to create new or transform existing institutions (Battilana, 2006). Similarly, strategic change agents have legitimated identities within their institutional field as some are clinical directors; therefore, these actors have high positions within the organisation and high positions within the institutional field. However, their efforts are limited to introducing

change initiatives since strategic and applied change agents are mostly separated from the enactors of new practices. This finding highlights another synergy with the institutional entrepreneurship literature, where positions among actors determine the extent and likelihood of change within an environment. The behaviour of the strategic and applied change agents is also be aligned with collective institutional entrepreneurship, where entrepreneurs operate in small groups to changes institutions (Dorado, 2013); however, the limitation of this work is that it failed to account for the interactions of everyday professionals who are not managing and coordinating the change initiative. However, this research does account for enactors and practitioners' relationships; therefore, the embeddedness observed in NHS-K cannot be categorised as collective institutional entrepreneurship. The distinction here also highlights that institutional effects, such as differences in logics around new practices, or power dynamics among enactors and change agents, may hinder the institutionalisation of new practices.

This finding is also consistent with Birdwell-Mitchell's (2016) comparative study, where interactions among small groups of disconnected actors did not support information about new practices and policies to be widely shared and limited shared understandings among teachers. In this study, there was also a low degree of brokering among actors, and patterns of interactions did not support the change initiative's aims. Similarly, this work observed that actors' "*interactions occurred in numerous and relatively small communities, which as a result were diverse and also fragmented except for connections made by boundary spanners or by the formal orchestration of administrators…. however, these two features also weakened the socialisation pressures needed to spread alternative practices (Coleman, 1988) (Page 186)*". Therefore, the low degree of embeddedness among enactors, the high degree of embedded among strategic change agents and the lack of structural embeddedness among actors, in general, does not increase the likelihood of institutionalising new practices as the foundational relationships such as bridging, which brokers information and advice about new practices are very low within this network. Overall, non-collaborative embeddedness does not foster collective action to institutionalise new practices and constrains the likelihood of micro-institutional change.

6.3.2 Non-Institutional Embeddedness

The second account, ***non-institutional embeddedness***, is observed in NHS-C, where actors have a high degree of structural embeddedness and a low degree of institutional embeddedness. This account derives its name from the lack of embeddedness among enactors, applied and strategic change agents, which is unlikely to support the process of institutionalising new practices. It is characterised by diverse collaborative interactions that support cooperation among actors, but they are largely uncoordinated among the professionals and change agents responsible for

institutionalising new practices. This dynamic highlights a lack of collective action among professional groups, as there are no distinctive interactions enactors. This current research is unable to explain why this is the case, and further investigation is required to delve deeper into this network's structure. However, the lack of institutional embeddedness may be associated with professional groups being disengaged from common goals, and the diversity of interactions is not focused on the institutionalisation of new practices.

This finding diverges from Bridwell-Mitchell's (2016) findings where large group interactions created multiple points of information within the community and generated strong social pressures and widely shared understandings about new policies and practices. Like NHS-C, the actors in this study displayed a high degree of closure and bridging where large groups of teachers shared information and rapidly adjusted their practices as information was widely diffused within their community. However, this result is not realised in the context of this research, as NHS-C had low progress when compared to other organisations. One explanation for this variation is linked to the degree of institutionalisation among teachers compared to healthcare practices. While it is argued that academic and healthcare settings are institutionalised, it can also be argued that differences in context and the application of practices between professional groups mediate the effects of structural embeddedness among institutional actors concerning the institutionalisation of new practices.

This distinction can be aligned with the communities of practice literature, where institutional actors' relatedness cultivates interdependent roles, identities, and behaviours that guide the practical understandings of their daily work (Wenger, 1998; Brown & Duguid, 2001; Raffaelli & Glynn, 2014). As previously mentioned, in a highly institutionalised setting such as healthcare, actors have prominent identities formed in their initial training and daily practice, which further guide their professions' norms and stable conduct (Scott et al., 2000). In the case of teachers in the Bridwell-Mitchell study, structural embeddedness and the context and application of new practices may have been supported by similarities in background and training, which may have fostered peer learning and socialisation around new policies. Whereas in this study, structural embeddedness supported interactions among diverse professional groups, but dissimilarities in nurses, doctors, allied healthcare professionals and other non-clinical management professionals' backgrounds and responsibilities are exacerbated as no homophily was detected among actors in the same professional group. This strongly suggested that actors from the same professional group where unlikely to interact with each other.

Therefore, due to the high degree of structural embeddedness and low degree of institutional embeddedness among enactors, applied, and strategic agents, it can be argued that this network

is structurally collaborative but institutionally disjoint. In this case, the high degree of bridging and closure among actors emphasises collaborative interactions, but a lack of institutional embeddedness among enactors limits the degree of consensus generated about new work methods among actors in similar professional groups. Overall, non-institutional embeddedness, which is characterised by a high degree of structural and low degree of institutional embeddedness, was less likely to engender collective action among enactors and change agents in similar professional groups to institutionalise new practices and decreased the likelihood of micro-institutional change.

6.3.3 Collective Institutional Embeddedness

The third account, ***collective institutional embeddedness***, is observed in NHS-A, NHS-D and NHS-E, and derives its name from the high degree of structural and institutional embeddedness among enactors, applied and strategic change agents, which fosters collaboration, engagement, and collective action that supports institutionalising new practices. A high degree of structural embeddedness provides a foundation to support the institutionalisation of new practices since actors' relationships support interactions as closure promotes normative justification and influences the professionalisation of practice. Further, it encourages practitioners to adopt and implement new practices, and similarly, a high degree of bridging facilitates sharing information and advice about new practices within and across professional groups. This discovery highlights a key finding of this work, where a high degree of structural embeddedness, in this case, the presence of both bridging and closure, supports new practices' institutionalisation. Next, there are three exemplars of institutional embeddedness, which further justify the role of embeddedness in relation to new practices.

The first variation is ***enactor-driven***; as its name suggests, enactors have more prominent relationships in the network. This variant is observed in NHS-A, where most brokering roles and cohesive relationships are held by clinical professionals and actors who are actively engaging with new practices in their everyday work. In comparison, there is a relatively low influence of strategic change agents as they make up 16% of positions in closed triads, compared to 28-33% observed in other networks. Additionally, applied change agents represent more than 70% of triads positions, compared to the 42-54% observed in other networks. While there is evidence that strategic change agents are active in the network, they do not have a dominant role within NHS-A. This behaviour, however, is observed in NHS-E, where strategic change agents have a significant role within the network, and this variation of institutional embeddedness is ***strategically-driven.*** This finding is supported as the interactions among strategic change agents are significantly larger than most of the structural effects. They are also larger than most

professional role effects, indicating that strategic change agent interactions dominate the network. Like NHS-A, this network also has a high degree of interactions among enactors; however, they are smaller when compared to the prominence of strategic change agents. This network also observed the highest degree of progress institutionalising new practices. The third variant of institutional embeddedness is ***joint collaboration,*** where no change-oriented group supersedes another. This behaviour is observed in NHS-D, where there is a high degree of interaction among both enactors and change agents. In this case, homophily effects are observed among enactors and applied change agents, and significant sender and receiver effects are observed among strategic change agents. Despite the variations of institutional embeddedness, each of these cases has above-average levels of progress in terms of institutionalising new practices. This finding supports this work's core argument that a high degree of structural and institutional embeddedness are key mechanisms underpinning the institutionalisation of new practices.

This finding presents a significant contribution to this work as it deviates from traditional perspectives in institutional theory by suggesting that the presence of embeddedness does not constrain the institutionalisation of new practices. However, it is the lack of embeddedness that constrains the opportunities for change. This finding is aligned with Bridwell-Mitchell's (2016) explanation of collaborative institutional agency where the socialisation, patterns of interactions and shared understandings among diverse non-elite actors mediates the effects of micro-institutional change and the acceptance of new practices; however, there are clear distinctions.

This study confirms that the degree of interaction and socialization in networks has a bearing on the institutionalisation of new practices. In this research, socialization and peer learning can be inferred through the degree of homophily observed among enactors, applied and strategic change agents. When homophily is positive and significant in an institutional group, we can infer a high degree of interactions and relationships that significantly affect the network and the likelihood of micro-institutional change. Similarly, structural embeddedness highlights the extent of interactions among actors, which establishes the context of and likelihood of peer learning among and socialization among institutional actors.

While this work delves deeper into Bridwell-Mitchell's (2016) second mechanism regarding patterns of interaction, cohesion and diversity, and it shows collaborative agency alone is not sufficient to institutionalise new practices. This is observed in the first two accounts presented. In non-collaborative embeddedness, there is a high degree of collaborative agency among strategic and applied change agents; however, these collaborative behaviours do not extend to or observed among the enactors or non-elite actors within the network. In non-institutional

embeddedness, there is also a high degree of interactions and socialization among non-elite actors. Arguably, this form of embeddedness is most aligned with Birdwell-Mitchell's (2016) conceptualised of diverse non-elite actors interacting to institutionalise new practices.

Further, this study asserted that large cohesive groups were better oriented to institutionalise new practices; however, the notion of collective institutional embeddedness shows that group size has little consequence when specific interactions among institutional actors are examined and specified. First, NHS-D and NHS-K are both characterised by small group interactions; however, the former is characterised by high structural embeddedness with a high degree of brokering relationships compared to the latter, characterised by low structural embeddedness. In this case, high structural embeddedness is aligned with a greater propensity to increase peer learning and socialization around new practices. Similarly, NHS-A, NHS-D and NHS-C are all characterised by large group interactions and a high degree of structural embeddedness; however, NHS-C is characterised by is mostly characterised by no institutional embeddedness, decreasing the propensity to generate shared understandings and build consensus among institutional actors in similar professional groups.

Next, this notion of collective institutional embeddedness diverges from collaborative institutional agency as this study considers both elite and non-elite actors, as strategic change agents are typically constituent elements of micro-institutional change initiatives. Therefore, their presence must be considered within the context of enactors and practitioners who use new practices in their everyday work. Therefore, this perspective has a collective orientation that extends beyond purely collaborative interactions of non-elite actors. It further diverges from collaborative institutional agency as structural embeddedness identifies patterns that induce collaborative and non-collaborative interactions among actors. Ultimately, this work shows that multiple forms of bridging and closure are required to share information and advice about new practices and generate consensus among practitioners and enactors. It also highlights that institutional and structural embeddedness operates in tandem and the presence or absence of each mechanism has a significant bearing on how institutional actors collaborate and engage with new practices in their everyday work. Overall, collective institutional embeddedness is characterised by a high degree of structural and institutional embeddedness. This form fosters collective action among enactors and change agents in similar professional groups to institutionalise new practices and increases the likelihood of micro-institutional change.

Accordingly, this provides an alternative conception of micro-institutional change by illustrating that change or lack thereof is associated with social interactions and relationships among actors as it considers complex social processes and the diverse actors within institutions. Existing

literature has been criticised for over-socialised and heroic narratives that ignore actors' purposive efforts; however, this work explicitly delivers a socialised and collective account of micro-institutional change. This contribution is aligned with the microfoundations agenda in institutional theory, which seeks to explore the links between institutions and individuals. According to Tolbert & Zucker (2019), one specific concern in microfoundations agenda is to understand the nature of behavioural and communication processes that are likely to affect micro-institutional change, "not only "institutional entrepreneurs" but also anyone who has on-going interactions with others" (Tolbert & Zucker, 2019, p. 4) to reshape and transform institutions. This study answers this call by drawing on a social network view of embeddedness to understand relationships and interaction and their association with micro-institutional.

The focus on microfoundations acknowledges that lower levels of social structure, for example, social interactions and collective behaviours, fundamentally influence higher levels of the institutional sphere. This perspective is based on the view that individual actions, interactions and behaviours amplify (Gray et al., 2015), accumulate (Smets et al., 2018) or trickle up (Haack et al., 2019; Hwang & Colyvas, 2019) to the organisational and field levels, supporting the notion that macro-level phenomena are both the consequence and result of individuals and organisations affecting institutions (Coleman, 1986; Udehn, 2002). Overall, the combination of these processes results in a shift, where change amplifies from the micro to macro levels through the process of enacting, sharing, supporting and participating in the practice itself (Smets et al., 2012). When actors encounter new practices, they tend to provide information and seek advice from colleagues to understand the purpose, relevance, and suitability of new practices within their immediate work environment. This research shows that social interactions influence the institutionalisation of new practices through professional norms and relationships, thereby providing an alternative explanation of institutional processes based on social relationships among diverse institutional actors.

6.4 Future Research

As with all research projects, there are limited time and resources to produce results and findings; therefore, no study is without limitations. First, this work's emphasis was structural embeddedness, where the unit of analysis is the triad. However, this work observed reciprocity effects distinguishing the high and low performing organisations, where Good and Outstanding rated organisations had consistently higher levels of overall brokering and closure reciprocity than low-performing organisations. Reciprocity and shared relationships between actors are associated with the stability of interactions over time (Rivera et al., 2010; Block, 2015). Likewise, unreciprocated ties are seen as unstable, with the possibility of becoming reciprocated or remaining disconnected in the long term. A large body of literature exemplifies that institutional

actors are connected by shared norms, knowledge and understandings that determine the appropriate actions and practices within that institutional domain (Brown & Duguid, 1991; Davis & Greve, 1997; Schneiberg & Lounsbury, 2008; Chandler & Hwang, 2015). Research also points to the importance of reciprocity and closure as it builds interpersonal trust, which garners support for undertakings that are new to the institutional domain (Aldrich & Fiol, 1994). Therefore, reciprocity becomes a mediator to determine the persistence and acceptance of new practices. Since reciprocity is a dyadic construct, it requires a relational embeddedness frame rather than a structural embeddedness lens to appropriately examine the implications of reciprocity to institutionalise new practices or their association with organisation performance.

Second, this research was multifaceted in that there were inter-professional and inter-partnership relationships among institutional actors. However, this study examined each of these at the same level; however, theoretically, they operate at two different levels. Professional relationships in an institutional setting are indicative of the macro-level institutional structures, whereas change initiative relationships are likely to have a meso-level orientation. This dynamic may lead to questions of whether interactions influence embeddedness or whether institutional embeddedness influences interactions. It could also suggest that some form of multi-level embeddedness may influence interactions and social relationships that are not being considered. Recent developments in ERGMs now facilitate multi-level network analysis on intergroup and intragroup dynamics; therefore, further research is required to facilitate this examination.

Table 23: Typology depicting Forms of Embeddedness & the Institutionalisation of New Practices

<table>
<tr><th colspan="2">Form of Embeddedness</th><th>Non-Collaborative Embeddedness</th><th>Non-Institutional Embeddedness</th><th>Collective Institutional Embeddedness</th></tr>
<tr><td>Mechanism of Embeddedness</td><td></td><td>Not Structurally Embedded</td><td>Not Institutionally Embedded</td><td>Both Structurally & Institutionally Embeddedness</td></tr>
<tr><td>Structural Embeddedness</td><td>Bridging & Closure</td><td>Low Embeddedness</td><td>High Embeddedness</td><td>High Embeddedness</td></tr>
<tr><td rowspan="3">Institutional Embeddedness</td><td>Enactors</td><td>Low Embeddedness</td><td>No Embeddedness</td><td>High Embeddedness</td></tr>
<tr><td>Applied Change Agents</td><td>High Embeddedness</td><td>Low Embeddedness</td><td rowspan="2">Varied Degrees of Embeddedness
• Change Agent-Led
• Joint/Mutual Collaboration</td></tr>
<tr><td>Strategic Change Agents</td><td>High Embeddedness</td><td>No Embeddedness</td></tr>
<tr><td colspan="2">Effect of Structure & Relationships on the Institutionalisation of New Practices</td><td>Low Likelihood</td><td>Low Likelihood</td><td>High Likelihood</td></tr>
</table>

6.5 Discussion Summary

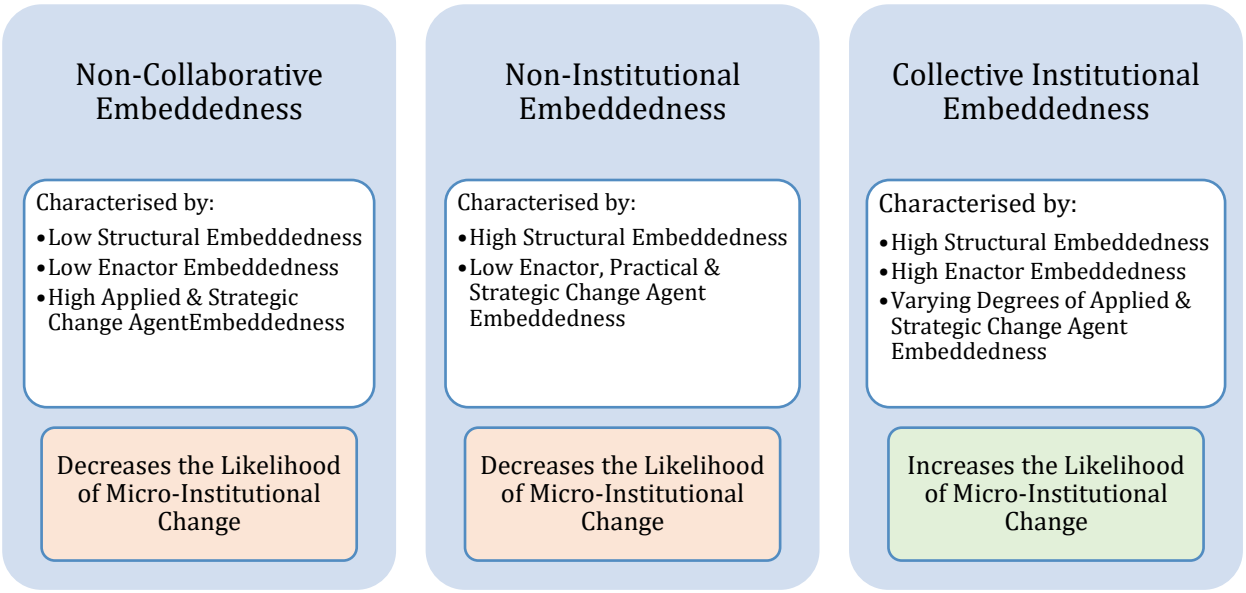


Figure 24: Collective Accounts of Micro-Institutional Change

The findings of this study propose three main contributions to the existing research on micro-institutional change. First, it provides an answer to the question presented in the literature review that queried the role of embeddedness to institutionalise new practices. As previously mentioned, if institutions are patterns of social activity that shape and sustain individual and collective roles, behaviours and experiences, and embeddedness provides a link to understand actors' relationships and interactions, *how does micro-institutional change occur?* Traditional arguments assume a singular form of embeddedness that constrains organisational actors and limits the likelihood of micro-institutional change; however, this is not the case. This research demonstrates that when embeddedness is decomposed into structural and institutional elements, varying combinations emerge that provide insights into the link between embeddedness and micro-institutional outcomes. This research found that structural and institutional embeddedness among actors is a fundamental source and necessary precondition for micro-institutional change. It shows that varying forms of embeddedness are related to and become enablers or barriers when actors attempt to institutionalise new practices to stimulate change.

This finding led to this research's second contribution: three collective accounts that extend and diverge from existing accounts of actors' attempts to enact change. Two accounts, Non-Collaborative and Non-Institutional, decreases the likelihood of micro-institutional change. In non-collaborative embeddedness, structures and interactions among institutional actors do not encourage sharing information or advice about new practices, nor support consensus among institutional actors to engage in new practices. Non-Institutional embeddedness, on the other

hand, does have the structural foundation among actors to collaborate and generate consensus about new practices; however, it lacks an institutional frame to engender change among institutional actors in similar professions. Collective Institutional Embeddedness addresses the gaps observed in the Non-Collaborative and Non-Institutional Embeddedness as both structural foundations support collaboration and interaction that share information and generate consensus about new practices among actors who share similar institutional frames and this increases the likelihood of micro-institutional change (See Figure 23).

In the past, institutional entrepreneurship was presented as a promising way to account for institutional change that emerged from actors within an institutional setting (Battilana, 2006; Battilana et al., 2009; Lockett et al., 2012); however, these narratives focused on the organisation's upper levels and ignored the actors responsible for enacting and engaging with new practices, thus making our understanding of micro-institutional change biased and limited. The shift towards a more collective narrative was further supported since even within the context of institutional entrepreneurship; institutional entrepreneurs must engage with and interact with other members of the field to bring about change (Dorado, 2005; Garud et al., 2007; Hardy & Maguire, 2008; Battilana et al., 2009). The institutional entrepreneurship literature is traditionally aligned with a small group of elite actors whose understandings, interests and activities are associated with envisioning and creating institutions (Dorado, 2005; Battilana, 2006). However, this study highlights that micro-institutional change is determined by complex, distributed social and institutional processes that foster collective action among a highly diverse set of institutional actors. Therefore, the embeddedness and interactions of actors become an essential component of micro-institutional change.

Birdwell-Mitchell (2016) produced a collective account of micro-institutional change; however, this perspective ignored elite actors, such as institutional entrepreneurs, to focus on professionals who enact practices in their everyday work. While this narrative delivered a more pragmatic understanding of institutionalising new practices, strategic change agents are involved in change initiatives; therefore, they must also be considered in any discussion about institutional change. However, this work emphasised non-elite actors, whereas a host of actors are responsible for producing micro-institutional change. Unlike Birdwell-Mitchell (2016), this study considered both elite and non-elite actors as the extent to which new practices are shared and accepted relies on a "multiplicity of actors to interactively produce institutional change" (Lounsbury & Crumley, 2007). Likewise, our understanding of the micro-level forces of change is incomplete if we ignore one group of actors in favour of another. Therefore, this work strikes a balance between these two extremes and accounts for a more practical, realistic, and inclusive dialogue regarding actors, embeddedness and the institutionalisation of practices. This perspective also depicts a less

dramatic process of micro-institutional change, in comparison to the grander representations such as institutional entrepreneurship, by describing changes in practice as a modest process, as the institutionalisation of new practices, occurs through relationships among relevant actors within the context of their everyday work.

This study's final contribution is that it provides an alternative conception of institutional change by illustrating that change or lack thereof is associated with social interactions and relationships among actors as it considers complex social processes and the diverse actors within institutions. Existing literature has been criticised for over-socialised and heroic narratives that ignore actors' purposive efforts; however, this work explicitly delivers a socialised and collective account of micro-institutional change. This contribution is aligned with the microfoundations agenda in institutional theory, which seeks to explore the links between institutions and individuals. This program aims to understand "patterns of behaviour in a collectivity and individual-level cognitions and behaviours that produce and change those collective patterns (Tolbert & Zucker, 2019, p. 4)." Therefore, in addition to representing enduring social structures that embody normative activities and practices; institutions denote general patterns of behaviour within a collectivity, and one of the aims of this agenda is to understand the processes and social interactions that produce changes in shared cognitions and patterns of behaviour, that result in new and transformed institutions (Barley & Tolbert, 1997; Tolbert & Zucker, 2019; Zucker & Schilke, 2019). According to Tolbert & Zucker (2019), one specific concern in microfoundations agenda is to understand the nature of behavioural and communication processes that are likely to affect micro-institutional change, "not only "institutional entrepreneurs" but also anyone who has on-going interactions with others" (Tolbert & Zucker, 2019, p. 4) to reshape and transform institutions. This study answers this call by drawing on a social network view of embeddedness to understand relationships and interaction and their association with micro-institutional change. It explores the role of structural and institutional embeddedness among collectives of actors to institutionalise new practices in organisations, as embeddedness provides an established frame of reference to understand institutional outcomes. Overall, this study revealed that various forms of embeddedness and interactions among actors influenced the likelihood micro-institutional change, where a lack of social structure and embeddedness constrained actors attempts to enact micro-institutional change.

These contributions address the fourth and final objective of this research. The findings are synthesised and aligned with prior studies to *advance* institutional perspectives by illustrating that structural embeddedness and institutional embeddedness are necessary elements to institutionalise of new practices in organisations. In the next chapter, Chapter 7: Conclusion, this study is summarised, and the research objectives are addressed.

Blank Page

Chapter 7: Conclusion

7.1 Introduction

Broadly, this work sought to understand institutions' microfoundations through a social network lens by interrogating the link between embeddedness and micro-institutional change. In particular, this research aimed to advance an understanding of embeddedness and the institutionalisation of new practices among actors. Therefore, the specific research objectives of this research were to:

1. *Clarify and discuss the importance of embeddedness with regards to micro-institutional change.*
2. *Critically evaluate the notion of embeddedness from a social network perspective to understand the institutionalisation of new practices within an organisational context.*
3. *Explore the role of structural and institutional embeddedness with respect to the institutionalisation of new practices among institutional actors.*
4. *Advance institutional perspectives by illustrating the role of embeddedness with respect to the institutionalisation of new practices in organisations.*

First, this chapter revisits the research objectives stated above, summarises the results and findings of this work and offers conclusions based on the findings. Most importantly, this study's theoretical contributions are presented, detailing how it extends existing literature and add to the debate of micro-institutional change in organisations. Next, this chapter addresses the general limitations and future research proposed for this study, specifically by extending this work beyond the actor-level to a multi-level analysis. This extension would support theorising our understanding of multi-level embeddedness and how it influences institutional outcomes by examining interactions and interdependencies at multiple network levels. This work would further add to the literature on the micro-dynamics of institutional change in a more holistic way by examining the combined influence of professional and change-oriented embeddedness, by conducting research that provides a more distinct examination of professional roles, social relationships, and micro-institutional change. Finally, this research concludes by reflecting on whether the stated research objectives have been addressed.

7.2 Research Objectives: Summary of Findings & Conclusions

7.2.1 Research Objective 1: Embeddedness & The Institutionalization of New Practices

This study's first objective sought to *clarify* the role and importance of embeddedness regarding micro-institutional change. The paradox of embedded agency questioned how actors change institutions, as traditional institutional perspectives have acknowledged that is it unlikely for them to do so, since institutional mechanisms tend to replicate, rather than change, existing arrangements (Powell & DiMaggio, 1991; Garud et al., 2007). A key argument, in this case, is that the notion of change occurring within a highly institutionalised setting contradicts an institution's meaning and existence (Dacin et al., 2002; Greenwood & Suddaby, 2006). However, despite our theoretical understanding of this process, we know it occurs. One assumption in this perspective is that an embedded actor would not be motivated to envision or be aware of alternatives because of the taken-for-granted qualities that make up institutions (Seo & Creed, 2002; Battilana et al., 2009). However, this wrongly portrays actors as over-socialized and subject to institutional norms without question. DiMaggio and Powell (1983) criticized early theorists for associating institutional embeddedness with a lack of reflection and absence of agency when organisational actors are purposive agents who can question and re-evaluate institutional rules and practices.

In response to these theoretical shortcomings, further attention was placed on understanding embeddedness rather than viewing it as a problem; it was viewed as a solution that serves as the foundation to support change opportunities (Reay et al., 2006, p. 977). Scott et al. (2000) provide some insight into the role of actors in shaping institutions. They conceptualize institutions as patterns of social activity that shape collective and individual experiences because they define ways of actors behaving, relating and interacting with others (Bellah et al., 2011). When viewed in this way, actors are seen as carriers and agents of institutional norms and practices (Scott et al., 2000). As carriers, both individual and collective, institutional actors embody, reproduce and preserve norms and practices within the field; whereas as agents, actors have varying capacity to shape and "exercise power to affect and alter the existing systems and rules" (Scott et al., 2000, p. 172). Whether as carriers or agents, these actors have varying roles, responsibilities and identities that further influence their behaviours and practice. Thus, Scott et al. (2000) argue that institutional change occurs at the microlevel and the "nature and extent of relations among actors in an organisation or field, influences change and transformation" (pg. 24).

Similarly, if institutions are patterns of social activity that shape and sustain individual and collective roles, behaviours and experiences (Scott, 2003; Schneiberg & Lounsbury, 2008; Battilana et al., 2017), embeddedness provides a key link between actors' relationships and micro-institutional change, rather than a problem or paradox to be solved. By changing the

perspective, the role of actors, embeddedness and interactions could also be seen as facilitators and mechanisms of micro-level change rather than a barrier that inhibits it (Powell & Colyvas, 2008; Zucker & Schilke, 2019).

However, existing literature presented two extremes. At one end, there are over-socialized accounts of actors who lack agency, are constrained by their institutional environments, and do not envision and enact change (Felin et al., 2012). At the other extreme, there are heroic accounts of actors who single-handedly envision and enact institutional change, despite their embeddedness and the surplus of forces responsible for institutions' persistence and stability. These contrasting perspectives suggest that traditional views regarding the embeddedness of actors are exaggerated and conflated and that by distinguishing forms of embeddedness, we can argue that it does not constrain agency or action, but it serves as fabric to support change (Garud et al., 2007; Cardinale, 2018; Harmon et al., 2019). As a result, the explanations of how actors' embeddedness is related to and becomes a driver for micro-institutional change remains limited and underspecified. When we assume that embeddedness and interactions are related to the likelihood of micro-institutional change (Garud et al., 2007); a counter-argument was presented which explains that it is *due* to the interplay of actor embeddedness and institutional structure that actors can change the institutions in which they are a part of (Reay et al., 2006; Bridwell-Mitchell, 2016; Cardinale, 2018). Addressing these objectives highlighted inconsistencies when considering institutional views and prompted a shift, where embeddedness supports actors' attempts to change institutions.

7.2.2 Research Objective 2: Institutional & Social Network Views of Embeddedness

Since the traditional institutional perspectives were ill-equipped to frame embeddedness as a mechanism to support change, the second objective of this research sought to *critically evaluate* embeddedness from a social network perspective to understand the institutionalisation of new practices within an organisational context. In this case, embeddedness was repositioned from an institutional, which constrains actors' attempts to institutionalise new practices to a social network view where embeddedness contributes to the institutionalisation of new practices in different ways. A social network view of embeddedness draws on a relational perspective, where patterns of interactions and relationships matter because actors take on identities and give meaning to social action through their relatedness to others (White & Mohr, 2008; Kilduff & Brass, 2010). From this perspective, social interactions and relationships give rise to social structures which shape and explain organisational outcomes and processes, such as knowledge sharing (Hansen, 1999; Phelps et al., 2012; Brennecke & Rank, 2016), learning (Zappa & Robins, 2016), productivity (Reagans & Zuckerman, 2001), innovation (Lee, 2010; Vedres & Stark, 2010).

Based on this view, it can be argued that the social network view of embeddedness has always focused on the study of social institutions, where networks become a linkage mechanism that bridges micro-level systems of social interaction to the meso and macro levels of organisational and institutional fields (White & Mohr, 2008; Tasselli et al., 2015). This connection presents an apparent assumption that social relationships are the building blocks of institutions and networks, as they are concerned with the influence of embeddedness and social structures among actors (Owen-smith & Powell, 2008; Powell & Oberg, 2018). When a social network lens is cast on micro-institutional change, it reveals that the traditional institutional view of embeddedness constraining action is limited and conflated. In general, there are many forms of embeddedness, which confound whether it would be an opportunity and constraint for change; however, these perspectives are not discussed or presented in much of the institutional discourse. Therefore, social relationships and interactions are conceptualised to represent structural forms of embeddedness by adopting a social network lens. Structural embeddedness focuses on examining the social patterns and structures that emerge within the network to understand the specific social processes present in a network of institutional actors (Dacin et al., 1999; Moran, 2005; Kilduff & Brass, 2010).

In that case, the micro-level dynamics of institutional change and structural embeddedness can then be theoretically debated and empirically examined to broaden the scope and understanding of new practices' institutionalisation in two ways. Firstly, when examining closure and bridging at the structural level, a macro view of social relationships can investigate collective action through a network's overall embeddedness and the global presence or absence of cohesive group or bridging structures within the network. Second, by drawing on Simmel's notion of the triad, various forms of triadic structures, such as closed and open triads, can be investigated to understand the extent and nature of embeddedness within networks and groups. These perspectives lead to more detailed views of embeddedness and social structure among institutional actors. Together, these structures and relationships provided insights and implications to understand the institutionalisation of new practices, an essential process underlying micro-institutional change.

Ultimately, addressing the second objective revealed the synergies between institutional and social network theory provided an opportunity to explore the two domains and gain insight into the role of embeddedness in institutionalised settings. This alternative perspective contributes to the study of embeddedness and institutional change processes and develops a deeper understanding of embeddedness and institutions in general.

7.2.3 Research Objective 3: Exploring Structural & Institutional Embeddedness

When the first and second objectives were addressed, they explicated the linkages between embeddedness and the institutionalisation of new practices and some theoretical inconsistencies were recognised. This promoted the third research objective, which sought to explore the role of structural embeddedness in relation to the institutionalisation of new practices among actors. Empirical data collected from five healthcare organisations were examined to explore associations between the structural embeddedness of professionals attempting to enact change in their organisations and the institutionalisation of new practices. Prior to the description and discussion of the results, it is worth noting once again that healthcare organisations are very complex organisations, and this work is not an attempt to describe or explain the performance or functioning of the entire organisation. This work aims to study and explain the embeddedness of actors, and the associated microprocesses as it relates to their efforts to engage with new practices that support organisational change initiatives.

To date, only two studies have directly investigated the relationship between social network structures and the features associated with institutional change processes and initiatives (Battilana & Casciaro, 2012; Raffaelli & Glynn, 2014). Battilana et al. (2012) used social network analysis to understand the initiation and adoption of new practices in organisations. Raffaelli & Glynn (2014) explored the microprocesses of practice diffusion in relational networks but focused on understanding how organisational characteristics influenced adopting different practices. These are the only known quantitative studies that draw on social network concepts to understand micro-institutional processes, and only the former is focused on the micro-level of analysis. Bridwell-Mitchell's (2016) qualitative study examined the pattern of interactions among actors to understand micro-institutional change. Consequently, what is missing from Battilana et al. (2012) and Bridwell-Mitchell's (2016) studies is a systematic understanding of the structural embeddedness and patterns of interaction within social networks and how they are associated with the institutionalisation of new practices within organisations. This study's methodological approach was novel as Exponential Random Graph Models (ERGMs) were used to specify and estimate social relationships. It also supported the examination of joint effects between actor roles and network relationships to understand institutional embeddedness, professional affiliations and interactions among change agents. Although ERGMs is an emerging methodological approach, this research presents the first study to apply ERGMs models to the study of institutions in general and micro-institutional change.

A structural conceptualisation of social structure supports the systematic investigation of mechanisms within a network which reveals patterns of interaction that have varying

implications for the institutionalisation of new practices. In this research, two mechanisms, bridging and closure are examined to understand the institutionalisation of new practices among organisational actors. The analysis revealed several structural variations within and between the networks. For example, all the networks except NHS-K display a high degree of brokering and closure when triads, bridging structures and brokering roles are examined. Bridging structures and brokering are associated with searching, acquiring, and sharing information and advice about improvement work and new practices in general. In this case, brokering allows professionals to inform their understanding of improvement work by sharing and receiving improvement information from network contacts. On the other hand, closure is associated with social cohesion and collective action among professionals within the network. It promotes shared understandings, engagement, and adoption of new practices among closely connected groups of professionals; however, this is not determined by closure alone, as other bridging and other mechanisms may negate the benefits that emerge from closure.

For example, NHS-A, NHS-E, and NHS-C professionals tended to have large group interactions, varying degrees of popularity and activity spread and multifaceted brokering relationships within their networks. These are distinctive features where professionals engage in various patterns of interactions to receive and share information and advice with multiple collaborators. The key finding here is that professionals in these networks are very active in either seeking or providing improvement information to other professionals. Similarly, these networks have a high degree of triadic closure, making them well-structured to foster engagement and adoption of new practices. NHS-D and NHS-K have different relational dynamics where professionals tend to interact in small groups where they seek information and advice from close collaborators rather than seeking advice from popular professionals. However, brokering and closure vary significantly in these networks. Although NHS-D professionals tend to collaborate in small groups, there is a high degree of bridging and closure evidenced by the high number of open and closed triads and generalised transitivity. Therefore, this network can promote engagement and the adoption of new practices among professionals. NHS-K, however, displays the lowest degree of bridging and closure among the five organisational networks. One key finding that emerged from the analysis underscores a key theme that similarities in structure do not equate to similarities in professional interactions and relationships or progress when institutionalising new practices.

Overall, by addressing this objective, the findings revealed that various forms of embeddedness and interactions among actors influenced the likelihood of micro-institutional change. Most importantly, it revealed that a lack of social structure and embeddedness constrained actors' attempts to enact micro-institutional change.

7.2.4 Research Objective 4: Advancing Institutional Theory

The fourth objective was addressed by synthesising this research's findings with existing theory to illustrate the role of embeddedness and the institutionalisation of new practices, thereby a*dvancing* institutional perspectives of micro-institutional change. The findings of this study propose three main contributions to the existing research. First, it provides an answer to the question presented in the literature review that queried the role of embeddedness to institutionalise new practices. Traditional institutional arguments assume a singular form of embeddedness that constrains organisational actors and limits the likelihood of micro-institutional change; however, this is not the case. This research demonstrates that when embeddedness is decomposed into structural and institutional elements, varying combinations emerge that explain the influence embeddedness has on institutional outcomes. This research found that structural and institutional embeddedness among actors is a fundamental source and necessary precondition for micro-institutional change. It shows that varying forms of embeddedness are related to and become enablers or barriers when actors attempt to institutionalise new practices to stimulate change.

This answer and the findings of this research led to the second contribution: three collective accounts that extend and diverge from existing accounts of actors' attempts to enact change. The findings show that two collective accounts, Non-Collaborative and Non-Institutional, decrease the likelihood of micro-institutional change. Networks characterised by non-collaborative embeddedness revealed that structures and interactions among institutional actors do not encourage sharing information or advice about new practices, nor support consensus among institutional actors to engage in new practices. Non-Institutional embeddedness, on the other hand, does have the structural foundation among actors to collaborate and generate consensus about new practices; however, it lacks an institutional frame to engender change among institutional actors in similar professions. Collective Institutional Embeddedness addresses the gaps observed in the Non-Collaborative and Non-Institutional Embeddedness as both structural foundations support collaboration and interaction that share information and generate consensus about new practices among actors who share similar institutional frames and this increases the likelihood of micro-institutional change.

This study's final contribution is that it provides an alternative conception of institutional change by illustrating that change or lack thereof is associated with social interactions and relationships among actors as it considers complex social processes and the diverse actors within institutions. Existing literature has been criticised for over-socialised and heroic narratives that ignore actors' purposive efforts; however, this work explicitly delivers a socialised and collective account of micro-institutional change. This contribution is aligned with the microfoundations agenda in

institutional theory, which seeks to explore the links between institutions and individuals. This program aims to understand "patterns of behaviour in a collectivity and individual-level cognitions and behaviours that produce and change those collective patterns (Tolbert & Zucker, 2019, p. 4)." According to Tolbert & Zucker (2019), one specific concern in microfoundations agenda is to understand the nature of behavioural and communication processes that are likely to affect micro-institutional change, "not only "institutional entrepreneurs" but also anyone who has on-going interactions with others" (Tolbert & Zucker, 2019, p. 4) to reshape and transform institutions. This study answers this call by drawing on a social network view of embeddedness to understand relationships and interaction and their association with micro-institutional change. It explores the role of structural and institutional embeddedness among collectives of actors to institutionalise new practices in organisations, as embeddedness provides an established frame of reference to understand institutional outcomes. Overall, this study revealed that various forms of embeddedness and interactions among actors influenced the likelihood micro-institutional change, but most importantly it underscored that a lack of social structure and embeddedness constrained actors' attempts to enact micro-institutional change.

7.3 Limitations

As with all research projects, there are limited time and resources to produce results and findings; therefore, no study is without limitations. In this section, the considerations and limitations are summarised. First, an ego-centric research design is adopted; this limits data collection from the broader groups of participants but is most appropriate when targeted studies or large populations are involved. Accordingly, purposive sampling strategies are associated with boundary specification and determining focal participants. In some research, a purposive sampling strategy is seen as a limitation since it invites biases and representativeness issues within the study. In this case, the NHS-VMI partnership is a unique context and setting and was deemed appropriate to investigate the social networks of actors collaborating to embed new practices within their organisation. Similarly, each organisation has thousands of professionals; therefore, conducting a targeted study was the most appropriate approach.

Next, the research design lacks a prior state, base case, or the selection of an organisational group that was not engaged in improvement work. As the social networks studied were designated to specific actors such as Lean for Leaders, RPIW participants, and members of the KPO and TGT, little attention was given to other groups to gain insight into the networks of actors who are not in the process of learning, applying and adopting new practices. Another limitation associated with this point is that this research has a cross-sectional research design, so there is no prior research or secondary study to validate network processes and mechanisms, as networks change over time, especially knowledge and information sharing networks (Snijders, 2017). As such,

future research designs should consider including a case that is not engaged in improvement initiatives to investigate and acknowledge the differences or similarities between the two groups. Similarly, if the time, resources, and access allow, future research should consider a longitudinal research design feasibility to capture the social networks before the improvement work initiative and a few months after it has begun.

The final methodological limitation relates to the incompleteness of data. As there were two modes of data collection, the social network data was collected effectively; however, the associated actor-relation data such as age, professional roles, tenure, and other attributes were not. The web-based survey had several attitudinal and behavioural questions regarding actor acceptance and engagement regarding the new practices and improvement work; however, this data was not collected from the paper-based respondents and could not be collected from the identified collaborators social network data collection. This incompleteness did not pose a serious issue to the research, but further analysis could have been conducted regarding actor sentiments if it were available. Therefore, future research would consider setting up a second data collection process to survey collaborators whom the original respondents nominated.

7.4 Future Research

Finally, several opportunities can be developed to build on this research and further uncover the nuances of micro-institutional change; however, two are presented. First, this work's emphasis was structural embeddedness, where the main unit of analysis is the triad. However, this work observed reciprocity effects distinguishing the high and low performing organisations, where Good and Outstanding rated organisations had consistently higher levels of overall brokering and closure reciprocity than low-performing organisations. Reciprocity and shared relationships between actors are associated with the stability of interactions over time (Rivera et al., 2010; Block, 2015). Likewise, unreciprocated ties are seen as unstable, with the possibility of becoming reciprocated or remaining disconnected in the long term. A large body of literature exemplifies that institutional actors are connected by shared norms, knowledge and understandings that determine the appropriate actions and practices within that institutional domain (Brown & Duguid, 1991; Davis & Greve, 1997; Schneiberg & Lounsbury, 2008; Chandler & Hwang, 2015). Research also points to the importance of reciprocity and closure as it builds interpersonal trust, which garners support for undertakings that are new to the institutional domain (Aldrich & Fiol, 1994). Therefore, reciprocity becomes a mediator to determine the persistence and acceptance of new practices. Since reciprocity is a dyadic construct, it requires a relational embeddedness frame rather than a structural embeddedness lens to appropriately examine the implications of reciprocity to institutionalise new practices or their association with organisation performance.

Second, this research was multifaceted in that there were inter-professional and inter-partnership relationships among institutional actors. However, this study examined each of these at the same level; however, theoretically, they operate at two different levels. Professional relationships in an institutional setting are indicative of the macro-level institutional structures, whereas change initiative relationships are likely to have a meso-level orientation. This dynamic may lead to questions of whether interactions influence embeddedness or whether institutional embeddedness influences interactions. It could also suggest that some form of multi-level embeddedness may influence interactions and social relationships that are not being considered. Recent developments in ERGMs now facilitate multi-level network analysis on intergroup and intragroup dynamics; therefore, further research is required to facilitate this examination.

References

Aldrich, H. E. and Fiol, C. M. (1994) 'Fools Rush in? The Institutional Context of Industry Creation', *Academy of Management Review*, 19(4), pp. 645–670.

Alvesson, M. and Sandberg, J. (2011) 'Generating research questions through problematization', *Academy of Management Review*, 36(2), pp. 247–271.

Anderson, G., Reyna, I. and Kraft, R. (2020) *NASA, European Space Agency Formalize Artemis Gateway Partnership*.

Anjos, F. and Reagans, R. E. (2013) 'Commitment, Learning, and Alliance Performance: A Formal Analysis Using an Agent-Based Network Formation Model', *The Journal of Mathematical Sociology*, 37(1), pp. 1–23.

Aral, S. and Van Alstyne, M. (2011) 'The diversity-bandwidth trade-off', *American Journal of Sociology*, 117(1), pp. 90–171.

Archer, M. (2013) 'Critical Realism', *Critical Realism*.

Argote, L., McEvily, B. and Reagans, R. (2003) 'Introduction to the Special Issue on Managing Knowledge in Organizations: Creating, Retaining, and Transferring Knowledge', *Management Science*, 49(4), pp. v–viii.

Arora, S., Ge, R., Sachdeva, S. and Schoenebeck, G. (2012) 'Finding overlapping communities in social networks: Toward a rigorous approach', *Proceedings of the ACM Conference on Electronic Commerce*, pp. 37–54.

Barley, S. (2008) 'Coalface Institutionalism', in *The SAGE Handbook of Organizational Institutionalism*, pp. 492–518.

Barley, S. and Tolbert, P. S. (1997) 'Institutionalization and Structuration: Studying the Links between Action and Institution', *Organization Studies*, 18(1), pp. 93–117.

Barney, J. and Felin, T. (2013) 'What Are Microfoundations?', *Academy of Management Perspectives*, 27(2), pp. 138–155.

Battilana, J. (2006) 'Agency and institutions: The enabling role of individuals' social position', *Organization*, 13(5), pp. 653–676.

Battilana, J. (2010) 'The Enabling Role of Social Position in Diverging from the Institutional Status Quo: Evidence from the UK National Health Service', *Organization Science*, 22(4), pp. 817–834.

Battilana, J., Besharov, M. and Mitzinneck, B. (2017) *On Hybrids and Hybrid Organizing: A Review and Roadmap for Future Research*. 2nd edn, *The SAGE Handbook of Organizational Institutionalism*. 2nd edn. London: SAGE Publications Ltd.

Battilana, J. and Casciaro, T. (2012) 'Change Agents, Networks, and Institutions : A Contingency Theory of Organizational Change', *Academy of Management*, 55(2), pp. 381–398.

Battilana, J., Leca, B. and Boxenbaum, E. (2009) 'How Actors Change Institutions: Towards a Theory of Institutional Entrepreneurship', *Academy of Management Annals*, 3(1), pp. 65–107.

Beckert, J. (2010a) 'How do fields change? the interrelations of institutions, networks, and cognition in the dynamics of markets', *Organization Studies*, 31(5), pp. 605–627.

Beckert, J. (2010b) 'Institutional Isomorphism Revisited: Convergence and Divergence in Institutional Change', *Sociological Theory*, 28(2), pp. 150–166.

Beckman, C. M., Schoonhoven, C. B., Rottner, R. M. and Kim, S. J. (2014) 'Relational Pluralism in De Novo Organizations: Boards of Directors as Bridges or Barriers to Diverse Alliance Portfolios?', *Academy of Management Journal*, 57(2), pp. 460–483.

Bellah, R., Madsen, R., Tipton, S., Sullivan, W. and Swidler, A. (2011) *Good Society*. Knopf Doubleday Publishing Group.

Berger, P. and Luckmann, T. (1966) *The Social Construction of Reality*. London: Penguin Books.

Bethlehem, J. (2009) *Applied Survey Methods: A Statistical Perspective*. 1st edn. New Jersey: John Wiley & Sons Inc.

Bhaskar, R. (2008) *A Realistic Theory of Science.* 1st edn. Oxon: Routledge.

Bitektine, A. and Haack, P. (2015) 'The "macro" and the "micro" of legitimacy: Toward a multilevel theory of the legitimacy process', *Academy of Management Review*, 40(1), pp. 49–75.

Bitektine, A., Haack, P., Bothello, J. and Mair, J. (2020) 'Inhabited Actors: Internalizing Institutions through Communication and Actorhood Models', *Journal of Management Studies*, 57(4), pp. 885–897.

Bizzi, L. (2013) 'The Dark Side of Structural Holes: A Multilevel Investigation', *Journal of Management*, 39(6), pp. 1554–1578.
Block, P. (2015) 'Reciprocity, transitivity, and the mysterious three-cycle', *Social Networks*, 40(January 2015), pp. 163–173.
Borgatti, S. P. and Cross, R. (2003) 'A Relational View of Information Seeking and Learning in Social Networks', *Management Science*, 49(4), pp. 432–445.
Borgatti, S. P., Everett, M. G. and Freeman, L. C. (2002) *Ucinet for Windows: Software for Social Network Analysis.* Harvard, MA: Analytic Technologies.
Borgatti, S. P., Everett, M. G. and Johnson, J. (2013) *Analyzing Social Networks*. 1st edn. London: Sage Publications.
Bouty, I. (2000) 'Interpersonal and Interaction Influences on Informal Resource Exchanges between R & D Researchers across Organizational Boundaries', *Academy of Management Journal*, 43(1), pp. 50–65.
Boxenbaum, E. and Jonsson, S. (2008) 'Isomorphism, Diffusion and Decoupling', in *The SAGE Handbook of Organizational Institutionalism*. 1st edn. London: SAGE Publications Ltd, pp. 78–98.
Boxenbaum, E. and Jonsson, S. (2017) 'Isomorphism, Diffusion and Decoupling: Concept Evolution and Theoretical Challenges', in *The SAGE Handbook of Organizational Institutionalism*, pp. 78–98.
Brailly, J., Favre, G., Chatellet, J. and Lazega, E. (2016) 'Embeddedness as a multilevel problem: A case study in economic sociology', *Social Networks*. Elsevier B.V., 44, pp. 319–333.
Brass, D. J., Galaskiewicz, J., Greve, H. R. and Tsai, W. (2004) 'Taking stock of networks and organizations: A multilevel perspective', *Academy of Management Journal*, 47(6), pp. 795–817.
Brennecke, J. and Rank, O. (2016) 'The interplay between formal project memberships and informal advice seeking in knowledge-intensive firms: A multilevel network approach', *Social Networks*. Elsevier B.V., 44, pp. 307–318.
Brennecke, J. and Rank, O. (2017) 'The firm's knowledge network and the transfer of advice among corporate inventors—A multilevel network study', *Research Policy*. Elsevier B.V., 46(4), pp. 768–783.
Bridwell-Mitchell, E. N. (2016) 'Collaborative Institutional Agency: How Peer Learning in Communities of Practice Enables and Inhibits Micro-Institutional Change', *Organization Studies*, 37(2), pp. 161–192.
Brown, J. S. and Duguid, P. (1991) 'Organizational Learning and Communities-of-Practice: Toward a Unified View of Working, Learning, and Innovation', *Organization Science*, 2(1), pp. 40–57.
Brown, J. S. and Duguid, P. (2001) 'Knowledge and Organization: A Social-Practice perspective', *Organization Science*, 12(2), pp. 198–213.
Bryman, A. (2012) *Social Research Methods*. 4th edn. Oxford: Oxford University Press.
Bryman, A. and Bell, E. (2015) *Business Research Methods*. Fourth. London: Oxford University Press (OUP).
Buch-Hansen, H. (2014) 'Social Network Analysis and Critical Realism', *Journal for the Theory of Social Behaviour*, 44(3), pp. 306–325.
Burns, J. and Nielsen, K. (2006) 'How do embedded agents engage in institutional change?', *Journal of Economic Issues*, 40(2), pp. 449–456.
Burt, R. S. (1992) 'Social Structure of Competition', *Structural Holes The social structure of competition*, pp. 1–49.
Burt, R. S. (2001) 'Structural Holes versus Network Structure as Social Capital', in Lin, N., Cook, K., and Burt, R. S. (eds) *Social Capital: Theory and Research*, pp. 31–56.
Burt, R. S. (2004) 'Structural Holes and Good Ideas', *American Journal of Sociology*, 110(2), pp. 349–99.
Burt, R. S., Kilduff, M. and Tasselli, S. (2013) 'Social network analysis: Foundations and frontiers on advantage', *Annual Review of Psychology*, 64(January 2016), pp. 527–47.
Cannella, A. A. and McFadyen, M. A. (2016) 'Changing the Exchange', *Journal of Management*, 42(4), pp. 1005–1029.
Cardinale, I. (2018) 'Beyond Constraining and Enabling: Toward New Microfoundations for Institutional Theory', *Academy of Management Review*, 43(1), pp. 132–155.
Carley, K. M. (2001) 'Computational Approaches to Sociological Theorizing', in Turner, J. (ed.) *Handbook of Sociological Theory*. New York: Kluwer Academic/Plenum Publishers, pp. 69–84.
Carley, K. M. (2002) 'Computational organization science: a new frontier.', *Proceedings of the National*

Academy of Sciences of the United States of America, 99 Suppl 3(1), pp. 7257–62.
Carpenter, M. A., Li, M. and Jiang, H. (2012) 'Social Network Research in Organizational Contexts: A Systematic Review of Methodological Issues and Choices', *Journal of Management*, 38(4), pp. 1328–1361.
Carrington, P. J., Scott, J. and Wasserman, S. (2005) *Models & Methods in Social Network Analysis*. 1st edn. Edited by M. Granovetter. Cambridge University Press.
Cartwright, N. and Montuschi, E. (eds) (2014) *Philosophy of Social Science: A New Introduction*. First. Oxford: Oxford University Press.
Chandler, D. and Haunschild, P. (2018) 'Institutional-Level Learning: Learning as a Source of Institutional Change', in *The SAGE Handbook of Organizational Discourse*, pp. 624–649.
Chandler, D. and Hwang, H. (2015) 'Learning From Learning Theory: A Model of Organizational Adoption Strategies at the Microfoundations of Institutional Theory', *Journal of Management*, 41(5), pp. 1446–1476.
Cheng, H., Niu, M.-S. and Niu, K.-H. (2014) 'Industrial cluster involvement, organizational learning, and organizational adaptation: An exploratory study in high technology industrial districts', *Journal of Knowledge Management*, 18(5), pp. 971–990.
Coleman, J. (1988) 'Social Capital in the Creation of Human Capital', *American Journal of Sociology*, 94, pp. 95–120.
Coleman, J. S. (1986) 'Social Theory, Social Research, and a Theory of Action', *American Journal of Sociology*, 91(6), pp. 1309–1336.
Conaldi, G. and Lomi, A. (2013) 'The dual network structure of organizational problem solving: A case study on open source software developmen', *Social Networks*, 35(2), pp. 237–250.
Contandriopoulos, D., Lemire, M., Denis, J. J.-L. and Tremblay, E. (2010) 'Knowledge Exchange Processes in Organizations and Policy Arenas: A Narrative Systematic Review of the Literature', *Milbank Quarterly*, 88(4), pp. 444–483.
Contractor, N., Wasserman, S. and Faust, K. (2006) 'Testing multi-level, multi-theoretical hypotheses about network in 21st century network forms: An analytic framework and empirical example', *Academy of Management Review*, 31(3), pp. 681–703.
Cook, S. and Brown, J. (1999) 'Bridging epistemologies: The generative dance between organizational knowledge and organizational knowing', *Organization Science*, 10(4), pp. 381–400.
Corley, K. G. and Gioia, D. a (2011) 'Building Theory about Theory: What Constitutes a Theoretical Contribution?', *Academy of Management Review*, 36(1), pp. 12–32.
CQC, C. Q. C. (2020) *About Us - Our Purpose and Role*.
Crilly, T., Jashapara, A. and Ferlie, E. (2010) 'Knowledge Mobilisation : A Scoping Review of the Literature', *Information Systems Journal*, p. 307.
Croft, C., Currie, G. and Lockett, A. (2015) 'The Impact of Emotionally Important Social Identities on the Construction of a Managerial Leader Identity: A Challenge for Nurses in the English National Health Service', *Organization Studies*, 36(1), pp. 113–131.
Crossley, N., Bellotti, E., Edwards, G., Everett, M. G., Koskinen, J. and Tranmer, M. (2017) *Statistical Analysis Of Network Dynamics*, *Social Network Analysis for Ego-Nets*.
Czarniawska, B. (2009) 'Emerging institutions: Pyramids or anthills?', *Organization Studies*, 30(4), pp. 423–441.
Dacin, M. T., Goodstein, J. and Scott, W. R. (2002) 'Institutional theory and institutional change: Introduction to the special research forum', *Academy of Management Journal*, 45(1), pp. 45–57.
Dacin, M. T., Ventresca, M. J. and Beal, B. D. (1999) 'The embeddedness of organizations: Dialogue & directions', *Journal of Management*, 25(3), pp. 317–356.
Daniel, B. K. and Harland, T. (2018) *Higher Education Research Methodology: A Step- by- Step Guide to the Research Process*. First. New York: Taylor & Francis Group.
David, R. J., Sine, W. D. and Serra, C. K. (2017) 'Institutional Theory and Entrepreneurship : Taking Stock and Moving Forward', in *The SAGE Handbook of Organizational Institutionalism*, pp. 671–687.
Davis, G. F. and Greve, H. R. (1997) 'Corporate elite networks and governance changes in the 1980s', *American Journal of Sociology*, 103(1), pp. 1–37.
Davis, J. P., Eisenhardt, K. M. and Bingham, C. B. (2007) 'Developing Theory Through Simulation Methods', *Academy of Management Review*, 32(2), pp. 480–499.
Deephouse, D. L., Bundy, J., Tost, L. P. and Suchman, M. C. (2018) 'Organizational Legitimacy: Six Key

Questions', *The SAGE Handbook of Organizational Institutionalism*, pp. 27–52.
Deephouse, D. L. and Suchman, M. (2008) 'Legitimacy in Organizational Institutionalism', in *The SAGE Handbook of Organizational Institutionalism*, pp. 49–77.
DiMaggio, P. J. and Powell, W. W. (1983) 'The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields', *American Sociological Review*, 48, pp. 147–160.
Dorado, S. (2005) 'Institutional entrepreneurship, partaking, and convening', *Organization Studies*, 26(3), pp. 385–414.
Dorado, S. (2013) 'Small Groups as Context for Institutional Entrepreneurship: An Exploration of the Emergence of Commercial Microfinance in Bolivia', *Organization Studies*, 34(4), pp. 533–557.
Dunn, W. N. (1977) 'Social Network Theory', *Research in Progress*, 4(3), pp. 453–461.
Easterby-Smith, M., Thorpe, R., Jackson, P. R. and Jaspersen, L. J. (2018) *Management and Business Research*. 6th edn. London: Sage Publications.
Emirbayer, M. and Mische, A. (1998) 'What is agency?', *American Journal of Sociology*, 103(4), pp. 962–1023.
Erwin, D. G. and Garman, A. N. (2010) 'Resistance to organizational change: Linking research and practice', *Leadership and Organization Development Journal*, 31(1), pp. 39–56.
Evans, J. M., Grudniewicz, A., Baker, G. R. and Wodchis, W. P. (2016) 'Organizational context and capabilities for integrating care: A framework for improvement', *International Journal of Integrated Care*, 16(3), pp. 1–14.
Evans, S. and Scarbrough, H. (2014) 'Supporting knowledge translation through collaborative translational research initiatives: "Bridging" versus "blurring" boundary-spanning approaches in the UK CLAHRC initiative', *Social Science and Medicine*. Elsevier Ltd, 106, pp. 119–127.
Fang, R., Landis, B., Zhang, Z., Anderson, M. H., Shaw, J. D. and Kilduff, M. (2015) 'Integrating Personality and Social Networks: A Meta-Analysis of Personality, Network Position, and Work Outcomes in Organizations', *Organization Science*, (December), p. 150430111317009.
Felin, T. and Foss, N. (2019) 'Microfoundations for institutional theory?', *Research in the Sociology of Organizations*. Emerald Publishing Limited, 65B, pp. 393–408.
Felin, T., Foss, N. J., Heimeriks, K. H. and Madsen, T. L. (2012) 'Microfoundations of Routines and Capabilities: Individuals, Processes, and Structure', *Journal of Management Studies*, 49(8), pp. 1351–1374.
Ferlie, E., Crilly, T., Jashapara, A. and Peckham, A. (2012) 'Knowledge mobilisation in healthcare: A critical review of health sector and generic management literature', *Social Science and Medicine*. Elsevier Ltd, 74(8), pp. 1297–1304.
Finch, T. L., Mair, F. S., Odonnell, C., Murray, E. and May, C. R. (2012) 'From theory to "measurement" in complex interventions: Methodological lessons from the development of an e-health normalisation instrument', *BMC Medical Research Methodology*, 12, pp. 1–16.
Finch, T. L., Rapley, T., Girling, M., Mair, F. S., Murray, E., Treweek, S., McColl, E., Steen, I. N., May, C. R. and Abstract (2013) 'Improving the normalization of complex interventions: measure development based on normalization prcess theory (NoMAD): study protocol', *Implementation Science*, 8(1), pp. 43–1748.
Fink, A. (2017) *How to Conduct Surveys: A Step-by-Step Guide*. 6th edn. SAGE Publications.
Fleetwood, S. (2014) 'Bhaskar and Critical Realism', in Adler, P., du Gay, P., Morgan, G., and Reed, M. (eds) *The Oxford Handbook of Sociology, Social Theory, and Organization Studies*. Oxford University Press, pp. 182–219.
Fleming, L., Chen, D. and Mingo, S. (2002) 'Collaborative Brokerage, Generative Creativity, and Creative Success', *Administrative Science Quarterly*, 52(3), pp. 443–475.
Forster, D. A., Newton, M., McLachlan, H. L. and Willis, K. (2011) 'Exploring implementation and sustainability of models of care: Can theory help?', *BMC Public Health*. BioMed Central Ltd, 11(SUPPL. 5), p. S8.
Furst, S. A. and Cable, D. M. (2008) 'Employee Resistance to Organizational Change: Managerial Influence Tactics and Leader-Member Exchange', *Journal of Applied Psychology*, 93(2), pp. 453–462.
Gabbay, J. and le May, A. (2004) 'Evidence based guidelines or collectively constructed "mindlines"? Ethnographic study of knowledge management in primary care.', *BMJ (Clinical research ed.)*. BMJ Publishing Group, 329(7473), p. 1013.
Garcelon, M. (2010) 'The Missing Key : Institutions , Networks , and the Project of Neoclassical

Sociology *', *Sociological Theory*, 28(3), pp. 326–353.
Garud, R., Hardy, C. and Maguire, S. (2007) 'Institutional Entrepreneurship as Embedded Agency: An Introduction to the Special Issue', *Organization Studies*, 28(7), pp. 957–969.
Gask, L., Rogers, A., Campbell, S. and Sheaff, R. (2008) 'Beyond the limits of clinical governance? The case of mental health in English primary care', *BMC Health Services Research*, 8, pp. 1–10.
Gibson, W. and Vom Lehn, D. (2018) *Institutions, Interaction and Social Theory*. Red Globe Press, Macmillian Press.
Giuliani, E. (2007) 'The selective nature of knowledge networks in clusters: Evidence from the wine industry', *Journal of Economic Geography*, 7(2), pp. 139–168.
Glynn, M. A. (2017) 'Theorizing the Identity-Institution Relationship: Considering Identity as Antecedent to, Consequence of, and Mechanism for, Processes of Institutional Change', in Greenwood, R., Oliver, C., Lawrence, T. B., and Meyer, R. E. (eds) *The SAGE Handbook of Organizational Institutionalism*. 2nd edn. London: SAGE Publications Ltd, pp. 243–257.
Godwyn, M. and Gittell, J. H. (2012) *Sociology of organizations : structures and relationships*. Pine Forge Press.
Goldberg, A., Srivastava, S. B. S., Manian, V. G., Monroe, W. and Potts, C. (2016) 'Fitting In or Standing Out? The Tradeoffs of Structural and Cultural Embeddedness', *American Sociological Review*, 81(6), pp. 1190–1222.
Goodridge, D., Rana, M., Harrison, E. L., Rotter, T., Dobson, R., Groot, G., Udod, S. and Lloyd, J. (2018) 'Assessing the implementation processes of a large-scale, multi-year quality improvement initiative: Survey of health care providers', *BMC Health Services Research*. BMC Health Services Research, 18(1), pp. 1–22.
Gould, R. V. and Fernandez, R. M. (1989) 'Structures of Mediation: A Formal Approach to Brokerage in Transaction Networks', *Sociological Methodology*, 19(May), p. 89.
Gould, R. V, Fernandez, R. M., Gould, R. V and Roberto, M. (2018) 'Structures of Mediation : A Formal Approach to Brokerage in Transaction Networks Published by : American Sociological Association Stable URL : http://www.jstor.org/stable/270949 Structures of Mediation : A Formal Approach to Brokerage in Transaction Netwo', 19(1989), pp. 89–126.
Gozzo, S. and Tomaselli, V. (2017) 'Network Analysis Methods to Measure Sociometric Status', 4(October), pp. 81–94.
Graham, I. D. and Tetroe, J. (2007) 'Some Theoretical Underpinnings of Knowledge Translation', *Academic Emergency Medicine*, 14(11), pp. 936–941.
Granovetter, M. (1983) 'The Strength of Weak Ties: A Network Theory Revisited', *Sociological Theory*, 1, pp. 201–233.
Granovetter, M. (1985) 'Economic Action and Social Structure: The Problem of Embeddedness', *The American Journal of Sociology*, 91(3), pp. 481–510.
Gray, B., Purdy, J. M. and Ansari, S. (2015) 'From Interactions to Institutions: Microprocesses of framing and mechanisms for the structuring of institutional fields', *Academy of Management Review*, 40(1), pp. 115–143.
Greenwood, R., Oliver, C., Sahlin, K. and Suddaby, R. (2008) *The SAGE Handbook of Organizational Institutionalism*. 1st edn, *The SAGE Handbook of Organizational Institutionalism*. 1st edn. Edited by R. Greenwood, C. Oliver, R. Suddaby, and K. Sahlin. London: SAGE Publications Ltd.
Greenwood, R. and Suddaby, R. (2006) 'Institutional entrepreneurship in mature fields: The big five accounting firms', *Academy of Management Journal*, 49(1), pp. 27–48.
Greenwood, R., Suddaby, R. and Hinings, C. R. (2002) 'Theorizing Change : The Role of Professional Associations in the Transformation of Institutionalized Fields Author (s): Royston Greenwood , Roy Suddaby and C . R . Hinings Source : The Academy of Management Journal , Vol . 45 , No . 1 (Feb ., 2002), p', *The Academy of Management Journal*, 45(1), pp. 58–80.
Groves, R. M., Floyd J. Fowler, J., Couper, M. P., Lepkowski, J. M., Singer, E. and Tourangeau, R. (2009) *Survey Methodology*. 2nd edn. New Jersey: John Wiley & Sons Inc.
Gulati, R. and Gargiulo, M. (1999) 'Where Do Interorganizational Networks Come From?', *American Journal of Sociology*. The University of Chicago Press, 104(5), pp. 1439–1493.
Gunn, J. M., Palmer, V. J., Dowrick, C. F., Herrman, H. E., Griffiths, F. E., Kokanovic, R., Blashki, G. A., Hegarty, K. L., Johnson, C. L., Potiriadis, M. and May, C. R. (2010) 'Embedding effective depression care: Using theory for primary care organisational and systems change', *Implementation Science*, 5(1), pp. 1–15.

Haack, P., Sieweke, J. and Wessel, L. (2019) 'Microfoundations & Multi-level Research on Institutions', in *Microfoundations of Institutions*. Emerald Publishing Limited, pp. 11–40.
Hallebone, E. and Priest, J. (2008) *Business and Management Research: Paradigms and Practices*. Hampshire: Palgrave Macmillan.
Hallett, T. and Hawbaker, A. (2019) 'Bringing Society Back in Again: The Importance of Social Interaction in an Inhabited Institutionalism', 65, pp. 317–336.
Hanneman, R. a and Riddle, M. (2005) 'Introduction to Social Network Methods', *Riverside, CA: University of California, Riverside. On-line textbook*, 46(7), pp. 5128–30.
Hansen, M. T. (1999) 'The Search-Transfer Problem: The Role of Weak Ties in Sharing Knowledge across Organization Subunits', *Administrative Science Quarterly*, 44(1), p. 82.
Hardy, C. and Maguire, S. (2008) 'Institutional Entrepreneurship', in Greenwood, R., Oliver, C., Suddaby, R., and Sahlin, K. (eds) *The SAGE Handbook of Organizational Institutionalism*. 1st edn. London: SAGE Publications Ltd, pp. 198–217.
Hardy, C. and Maguire, S. (2017) 'Institutional Entrepreneurship and Change in Fields', in *The SAGE Handbook of Organizational Institutionalism*, pp. 198–218.
Hargrave, T. J. and Van De Ven, A. H. (2006) 'A Collective Action Model of Institutional Innovation', *Academy of Management Review*, 31(4), pp. 864–888.
Harmon, D. J., Haack, P. and Roulet, T. J. (2019) 'Microfoundations of institutions: A matter of structure versus agency or level of analysis?', *Academy of Management Review*, 44(2), pp. 464–467.
Health Foundation (2018) *Evaluation of NHS partnership with Virginia Mason Institute*.
Hiatt, S. R., Sine, W. D. and Tolbert, P. S. (2009) 'From Pabst to Pepsi: The Deinstitutionalization of Social Practices and the Creation of Entrepreneurial Opportunities', *Administrative Science Quarterly*, 54(4), pp. 635–667.
Hibbert, P., Huxham, C. and Ring, P. S. (2009) 'Managing Collaborative Inter-organizational Relations', *The Oxford Handbook of Inter-Organizational Relations*, (March 2019), pp. 1–30.
Hinings, C. R. and Tolbert, P. S. (2008) 'Organizational Institutionalism and Sociology: A Reflection', in *The SAGE Handbook of Organizational Institutionalism*, pp. 473–490.
Hollway, J. and Koskinen, J. (2016) 'Multilevel embeddedness: The case of the global fisheries governance complex', *Social Networks*. Elsevier B.V., 44, pp. 281–294.
Hsu, D. H. (2006) 'Venture Capitalists and Cooperative Start-up Commercialization Strategy', *Management Science*, 52(2), pp. 204–219.
Hunter, D. R., Goodreau, S. M. and Handcock, M. S. (2008) 'Goodness of fit of social network models', *Journal of the American Statistical Association*, 103(481), pp. 248–258.
Hunter, D. R. and Handcock, M. S. (2006) 'Inference in curved exponential family models for networks', *Journal of Computational and Graphical Statistics*, 15(3), pp. 565–583.
Hwang, H. and Colyvas, J. (2019) 'What Do We Talk about When We Talk about Microfoundations? Conceptualizations of Actor and Multi-Level Accounts of the Micro in Institutional Processes', *Microfoundations of Institutions*. Emerald Publishing Limited, 65, pp. 337–352.
Ibarra, H. (1992) 'Homophily and Differential Returns: Sex Differences in Network Structure and Access in an Advertising Firm', *Administrative Science Quarterly*, 37(3), p. 422.
Ibarra, H. and Andrews, S. B. (1993) 'Power, Social Influence, and Sense Making: Effects of Network Centrality and Proximity on Employee Perceptions', *Administrative Science Quarterly*, 38(2), p. 277.
Ibarra, H., Kilduff, M. and Tsai, W. (2005) 'Zooming In and Out: Connecting Individuals and Collectivities at the Frontiers of Organizational Network Research', *Organization Science*, 16(4), pp. 359–371.
Ibert, O. and Müller, F. (2015) 'Network dynamics in constellations of cultural differences: Relational distance in innovation processes in legal services and biotechnology', *Research Policy*, 44, pp. 181–194.
Ireri, S. K., Walshe, K., Benson, L. and Mwanthi, M. (2017) 'A comparison of experiences, competencies and development needs of doctor managers in Kenya and the United Kingdom (UK)', *International Journal of Health Planning and Management*, 32(4), pp. 509–539.
Janhonen, M. and Johanson, J. E. (2011) 'Role of knowledge conversion and social networks in team performance', *International Journal of Information Management*. Elsevier Ltd, 31(3), pp. 217–225.
Jupp, V. (ed.) (2006) *The Sage Dictionary of Social Research Methods*. London: Sage Publications.

Kaltenbrunner, M., Bengtsson, L., Mathiassen, S. E. and Engström, M. (2017) 'A questionnaire measuring staff perceptions of Lean adoption in healthcare: Development and psychometric testing', *BMC Health Services Research*. BMC Health Services Research, 17(1), pp. 1–11.
Kelley, S., Goldberg, M. K., Mertsalov, K., Ismail, M. M. and Wallace, W. (2011) 'Overlapping communities in social networks', *International Journal of Social Computing and Cyber-Physical Systems*, 1(2), p. 135.
Kenis, P. and Oerlemans, L. (2009) 'The Social Network Perspective: Understanding the Structure of Cooperation', *The Oxford Handbook of Inter-Organizational Relations*, (March 2019), pp. 1–26.
Kennedy, M. and Fiss, P. (2009) 'Institutionalization, framing, and diffusion: The logic of TQM adoption and implementation decisions among U.S. Hospitals', *Academy of Management Journal*, 52(5), pp. 897–918.
Kilduff, M. (1990) 'The Interpersonal Structure of Decision Making: A Social Comparison Approach to Organizational', *Organizational Behavior and Human Decision Processes*, 47(2), pp. 270–288.
Kilduff, M. and Brass, D. J. (2010) 'Organizational Social Network Research: Core Ideas and Key Debates', *The Academy of Management Annals*, 4(1), pp. 317–357.
Kilduff, M. and Krackhardt, D. (2008) *Interpersonal Networks in Organizations*, *Cambridge, New York*.
Kilduff, M. and Tsai, W. (2003) *Social Networks and Organizations*. 1st edn. London: Sage Publications.
Kincaid, H. (ed.) (2012) *The Oxford Handbook of Philosophy of Social Science*. Oxford University Press.
Kippist, L. and Fitzgerald, A. (2009) 'Organisational professional conflict and hybrid clinician managers', *Journal of Health Organization and Management*. Edited by P. Hyde. Emerald Group Publishing Limited, 23(6), pp. 642–655.
Kleinbaum, A. M., Jordan, A. H. and Audia, P. G. (2012) 'Do You Read Me? How Perceptions of Empathy Shape Self-Monitors' Brokerage in Social Networks'.
Kleinbaum, A. M., Jordan, A. H. and Audia, P. G. (2015) 'An Altercentric Perspective on the Origins of Brokerage in Social Networks: How Perceived Empathy Moderates the Self-Monitoring Effect', *Organization Science*, 26(4), pp. 1226–1242.
Koene, B. and Ansari, S. (2013) 'Entrepreneurs, institutional entrepreneurship and institutional change: Contextualizing the changing role of actors in the institutionalization of temporary work in the Netherlands from 1960 to 2008', *ERIM Report Series Research in Management*, ERS–2013–0, p. 58.
Kogut, B. and Zander, U. (1996) 'What Firms Do? Coordination, Identity, and Learning', *Organization Science*. INFORMS, 7(5), pp. 502–518.
Kraatz, M. S. and Block, E. S. (2008) 'Organizational Implications of Institutional Pluralism', in Greenwood, R., Oliver, C., Suddaby, R., and Sahlin, K. (eds) *The SAGE Handbook of Organizational Institutionalism*. SAGE Publications Ltd, pp. 243–275.
Krackhardt, D. and Kilduff, M. (2002) 'Structure, culture and simmelian ties in entrepreneurial firms', *Social Networks*, 24(3), pp. 279–290.
Kramer, R. M. (1999) 'Trust and Distrust in Organizations: Emerging Perspectives, Enduring Questions', *Annual Review of Psychology*, 50(1), pp. 569–598.
Kraut, A. (1996) *Organizational Surveys: Tools for Assessment & Change*. First. Jossey-Bass, A Wiley Company.
Kravitz, R. L., Krackhardt, D., Melnikow, J., Franz, C. E., Gilbert, W. M., Zach, A., Paterniti, D. A. and Romano, P. S. (2003) 'Networked for change? Identifying obstetric opinion leaders and assessing their opinions on caesarean delivery', *Social Science and Medicine*, 57(12), pp. 2423–2434.
Kumar, R. (2011) *Research Methodology: A Step-by-Step Guide for Beginners*. Third. London: Sage Publications.
Laumann, E., Marsden, P. V. and Prensky, D. (1983) 'The Boundary Specification Problem in Network Analysis', in Burt, R. and Minor, M. (eds) *Applied Network Analysis*. Beverly Hills: SAGE Publications Ltd, pp. 18–34.
Lawrence, T. B. and Buchanan, S. (2018) 'Power, Institutions and Organizations', in *The SAGE Handbook of Organizational Institutionalism*.
Lazega, E., Snijders, T. A. B. and Editors, T. A. B. S. (2016) *Multilevel Network Analysis for the Social Sciences*, *Multilevel Network Analysis for the Social Sciences*. Springer International Publishing.
Lee, J. "Jay" (2010) 'Heterogeneity, Brokerage, and Innovative Performance: Endogenous Formation of Collaborative Inventor Networks', *Organization Science*, 21(4), pp. 804–822.
Leicht, K. T. and Fennell, M. L. (2008) 'Institutionalism and the Professions', in Greenwood, R., Oliver,

C., Suddaby, R., and Sahlin, K. (eds) *The SAGE Handbook of Organizational Institutionalism*. 1st edn. London: SAGE Publications Ltd, pp. 431–448.
Levay, C. (2010) 'Charismatic leadership in resistance to change', *Leadership Quarterly*. Elsevier Inc., 21(1), pp. 127–143.
Levin, D. Z. and Cross, R. (2014) 'The Strength of Weak Ties you can Trust: The Mediating Role of Trust in Effective Knowledge Transfer.', *Management Science*, 50(11), pp. 1477–1490.
Levin, D. Z., Walter, J., Appleyard, M. M. and Cross, R. (2016) 'Relational Enhancement How the Relational Dimension of Social Capital Unlocks the Value of Network-Bridging Ties', *Group & Organization Management*, 41(4), pp. 415–457.
Li, M. (2013) 'Social network and social capital in leadership and management research: A review of causal methods', *Leadership Quarterly*. Elsevier Inc., 24(5), pp. 638–665.
Lindkvist, L. (2005) 'Knowledge Communities and Knowledege Collectivities: A Typology of Knowledge Work in Groups', *The Journal of Management Studies*, 42(6), pp. 1189–1210.
Lockett, A., Currie, G., Finn, R., Martin, G. and Waring, J. (2014) 'The influence of social position on sensemaking about organizational change', *Academy of Management Journal*, 57(4), pp. 1102–1129.
Lockett, A., Currie, G., Waring, J., Finn, R. and Martin, G. (2012) 'The role of institutional entrepreneurs in reforming healthcare', *Social Science and Medicine*. Elsevier Ltd, 74(3), pp. 356–363.
Lomi, A., Conaldi, G., Tonellato, M. and Pallotti, F. (2014) 'Participation motifs and the emergence of organization in open productions', *Structural Change and Economic Dynamics*, 29, pp. 40–57.
Long, J. J. C., Cunningham, F. C. F. and Braithwaite, J. (2013) 'Bridges, brokers and boundary spanners in collaborative networks: a systematic review', *BMC Health Services Research*, 13(1), p. 158.
Lounsbury, M. and Crumley, E. T. (2007) 'New Practice Creation: An Institutional Perspective on Innovation', *Organization Studies*, 28(7), pp. 993–1012.
LTHT (2019) *Leeds Teaching Hospitals NHS Trust*, *Overview, Hospitals, Clinics & Departments*.
LTHT (2020) *Leeds Teaching Hospitals NHS Trust*, *About Us*.
Lumineau, F. and Schilke, O. (2018) 'Trust development across levels of analysis: An embedded-agency perspective', *Journal of Trust Research*, 8(2), pp. 238–248.
Lusher, D., Johan, K. and Robins, G. (2013) *Exponential Random Graph Models for Social Networks: Theory, Methods, and Applications*. 1st edn. Cambridge, UK: Cambridge University Press.
Lusher, D., Koskinen, J. and Robins, G. (2013) *Exponential Random Graph Models for Social Networks*. Structural. Edited by M. Granovetter. Cambridge: Cambridge University Press.
MacCallum, R. C., Zhang, S., Preacher, K. J. and Rucker, D. D. (2002) 'On the practice of dichotomization of quantitative variables', *Psychological Methods*, 7(1), pp. 19–40.
Majchrzak, A., Jarvenpaa, S. L. and Bagherzadeh, M. (2015) 'A Review of Interorganizational Collaboration Dynamics', *Journal of Management*, 41(5), pp. 1338–1360.
Mallidou, A. A., Atherton, P., Chan, L., Frisch, N., Glegg, S. and Scarrow, G. (2017) 'Protocol of a scoping review on knowledge translation competencies.', *Systematic reviews*. BioMed Central, 6(1), p. 93.
Marczyk, G., DeMatteo, D. and Festinger, D. (2005) *Essentials of Research Design and Methodology*. New Jersey: John Wiley & Sons Inc.
van Marrewijk, A., Ybema, S., Smits, K., Clegg, S. and Pitsis, T. (2016) 'Clash of the Titans: Temporal Organizing and Collaborative Dynamics in the Panama Canal Megaproject', *Organization Studies*, 37(12), pp. 1745–1769.
Marsden, P. V., Campbell, K. E., Strength, M. T. and Campbell, K. E. (1984) 'Measuring Tie Strength', *Social Forces*, 63(2), pp. 482–501.
Martins, R. S., Duarte, A. L. C. M., Martins, G. S. and Rossoni, L. (2017) 'Supply chain relationships: exploring the effects of both relational and structural embeddedness on operational performance', *International Journal of Procurement Management*, 10(5), p. 639.
May, C. and Finch, T. (2009) 'Implementing, Embedding, and Integrating Practices: An Outline of Normalization Process Theory', *Sociology*, 43(3), pp. 535–554.
May, C. R., Mair, F., Finch, T., MacFarlane, A., Dowrick, C., Treweek, S., Rapley, T., Ballini, L., Ong, B. N., Rogers, A., Murray, E., Elwyn, G., Légaré, F., Gunn, J. and Montori, V. M. (2009) 'Development of a theory of implementation and integration: Normalization Process Theory', *Implementation Science*, 4(29), p. 10.
McEvily, B., Soda, G. and Tortoriello, M. (2014) 'More Formally: Rediscovering the Missing Link between Formal Organization and Informal Social Structure', *The Academy of Management*

Annals, 8(1), pp. 299–345.
McFadyen, M. A., Semadeni, M. and Cannella, A. A. (2009) 'Value of Strong Ties to Disconnected Others: Examining Knowledge Creation in Biomedicine', *Organization Science*, 20(3), pp. 552–564.
McIntyre, L. and Rosenberg, A. (2017) *The Routledge Companion to Philosophy of Social Science*. First. New York: Taylor & Francis Group.
McWilliam, C. L., Kothari, A., Ward-Griffin, C., Forbes, D. and Leipert, B. (2009) 'Evolving the theory and praxis of knowledge translation through social interaction: a social phenomenological study', *Implementation Science*, 4(1), p. 26.
Mehra, A., Kilduff, M. and Brass, D. J. (2001) 'The Social Networks of High and Low Self-Monitors: Implications for Workplace Performance', *Administrative Science Quarterly*. SAGE Publications, 46(1), p. 121.
Meyer, R. E. (2006) 'Visiting Relatives: Current Developments in the New Sociology of Knowledge', *Organization*, 13(5), pp. 725–738.
Meyer, R. E. and Vaara, E. (2020) 'Institutions and Actorhood as Co-Constitutive and Co-Constructed: The Argument and Areas for Future Research', *Journal of Management Studies*, 57(4), pp. 898–910.
Micelotta, E., Lounsbury, M. and Greenwood, R. (2017) 'Pathways of Institutional Change: An Integrative Review and Research Agenda', *Journal of Management*, 43(6), pp. 1885–1910.
Miller, K. (2002) *Communication Theories : Perspectives, Processes, and Contexts*. McGraw-Hill.
Möllering, G. (2007) 'Collective institutional entrepreneurship? The recursive interplay of action, networks, and institutions in market constitution', *Institutional Embeddedness of Markets …*, (December 2006), pp. 1–23.
Möllering, G. (2014) 'Trust, calculativeness, and relationships: A special issue 20 years after Williamson's warning', *Journal of Trust Research*, 4(1), pp. 1–21.
Molm, L. D. (1997) *Coercive power in social exchange*. Cambridge University Press.
Moody, J. and White, D. R. (2003) 'Structural cohesion and embeddedness: A hierarchical concept of social groups', *American Sociological Review*, 68(1), pp. 103–127.
Moran, P. (2005) 'Structural vs. relational embeddedness: social capital and managerial performance', *Strategic Management Journal*. John Wiley & Sons, Ltd., 26(12), pp. 1129–1151.
Morris, M., Handcock, M. S. and Hunter, D. R. (2008) 'Specification of Exponential-Family Random Graph Models', *Journal of Statistical Software*, 24(4), pp. 1548–7660.
Morrison, D. and Mair, F. S. (2011) 'Telehealth in practice: using Normalisation Process Theory to bridge the translational gap', *Primary Care Respiratory Journal*. Primary Care Respiratory Society UK, 20(4), pp. 351–352.
Morrison, E. W. (2002) 'Newcomers' relationships: The role of social network ties during socialization', *Academy of Management Journal*, 45(6), pp. 1149–1160.
Müller, F. C. and Ibert, O. (2015) '(Re-)sources of innovation: Understanding and comparing time-spatial innovation dynamics through the lens of communities of practice', *Geoforum*, 65, pp. 338–350.
Nahapiet, J. and Ghoshal, S. (1998) 'Social Capital , Intellectual Capital , and the Organizational Advantage', *Academy of Management Review*, 23(2), pp. 242–266.
Nakauchi, M., Washburn, M. and Klein, K. (2017) 'Differences between inter- and intra-group dynamics in knowledge transfer processes', *Management Decision*, 55(4), pp. 766–782.
Nasir, L., Robert, G., Fischer, M., Norman, I., Murrells, T. and Schofield, P. (2013) 'Facilitating knowledge exchange between health-care sectors, organisations and professions: a longitudinal mixed-methods study of boundary-spanning processes and their impact on health-care quality', *Health Services and Delivery Research*, 1(7), pp. 1–170.
NHS (2019a) *Barking, Havering and Redbridge University Hospitals NHS Trust*, *Overview, Hospitals, Clinics & Departments*.
NHS (2019b) *University Hospitals Coventry and Warwickshire NHS Trust*, *Overview, Hospitals, Clinics & Departments*.
NHS Survey Coordination Centre (2018) *Technical Guide to the 2018 Staff Survey*. Oxford.
Novikov, A. M. and Novikov, D. A. (2013) *Research Methodology: From Philosophy of Science to Research Design*. Taylor & Francis Group.
Obstfeld, D. (2005) 'Social Networks, the *Tertius Iungens* Orientation, and Involvement in Innovation', *Administrative Science Quarterly*, 50(1), pp. 100–130.

Ocasio, C. W., Thornton, P. H. and Lounsbury, M. (2018) 'Advances to the Institutional Logics Perspective', in *The SAGE Handbook of Organizational Institutionalism*, pp. 509–531.
Oh, H. and Kilduff, M. (2008) 'The Ripple Effect of Personality on Social Structure: Self-Monitoring Origins of Network Brokerage', *Journal of Applied Psychology*, 93(5), pp. 1155–1164.
Oliver, C. (1992) 'The Antecedents of Deinstitutionalization', *Organization Studies*, 13(4), pp. 563–588.
Orlikowski, W. J. (1996) 'Improvising Organizational Transformation over Time: A Situated Change Perspective', *Information Systems Research*, 7(1), pp. 63–92.
Owen-smith, J. and Powell, W. W. (2008) 'Networks and Institutions', in *The SAGE Handbook of Organizational Institutionalism*. 1st edn. SAGE Publications Ltd, pp. 596–624.
Pacheco, D. F., York, J. G., Dean, T. J. and Sarasvathy, S. D. (2010) 'The coevolution of institutional entrepreneurship: A tale of two theories', *Journal of Management*, 36(4), pp. 974–1010.
Padula, G. (2008) 'Enhancing the Innovation Performance of Firms by Balancing Cohesiveness and Bridging Ties', *Long Range Planning*, 41(4), pp. 395–419.
Pappi, F. U. and Scott, J. (1993) 'Social Network Analysis: A Handbook.', *Contemporary Sociology*, p. 128.
Patriotta, G. (2020) 'Actors and Actorhood in Institutional Theory', *Journal of Management Studies*, 57(4), pp. 867–872.
Phelps, C., Heidl, R. and Wadhwa, A. (2012) *Knowledge, Networks, and Knowledge Networks: A Review and Research Agenda*, *Journal of Management*.
Podolny, J. M. and Baron, J. N. (1997) 'Resources and Relationships: Social Networks and Mobility in the Workplace', *American Sociological Review*. American Sociological Association, 62(5), p. 673.
Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y. and Podsakoff, N. P. (2003) 'Common Method Biases in Behavioral Research: A Critical Review of the Literature and Recommended Remedies', *Journal of Applied Psychology*, 88(5), pp. 879–903.
van der Pol, J. (2019) *Introduction to Network Modeling Using Exponential Random Graph Models (ERGM): Theory and an Application Using R-Project*, *Computational Economics*. Springer US.
Polit, D. F. and Beck, C. T. (2010) 'Generalization in quantitative and qualitative research: Myths and strategies', *International Journal of Nursing Studies*. Elsevier Ltd, 47(11), pp. 1451–1458.
Portela, M. C., Pronovost, P. J., Woodcock, T., Carter, P. and Dixon-Woods, M. (2015) 'How to study improvement interventions: A brief overview of possible study types', *Postgraduate Medical Journal*, 91(1076), pp. 343–354.
Powell, C. W. W. and Rerup, C. (2018) 'Opening the Black Box : The Microfoundations of Institutions', in *The SAGE Handbook of Organizational Institutionalism*, pp. 311–335.
Powell, W. W. (2019) 'Institutions on the ground', *Research in the Sociology of Organizations*, 65B, pp. 419–428.
Powell, W. W. and Colyvas, J. A. (2008) 'Microfoundations of Institutional Theory', in *The SAGE Handbook of Organizational Discourse*, pp. 276–298.
Powell, W. W. and DiMaggio, P. J. (1991) *The New Institutionalism in Organizational Analysis*. 1st edn. University of Chicago Press.
Powell, W. W. and Oberg, A. (2018) 'Networks and Institutions', in *The SAGE Handbook of Organizational Institutionalism*, pp. 446–476.
Provan, K. G., Fish, A. and Sydow, J. (2007) 'Interorganizational Networks at the Network Level: A Review of the Empirical Literature on Whole Networks', *Journal of Management*, 33(3), pp. 479–516.
Provan, K. G. and Kenis, P. (2008) 'Modes of network governance: Structure, management, and effectiveness', *Journal of Public Administration Research and Theory*, 18(2), pp. 229–252.
Pruzan, P. (2016) *Research methodology: The Aims, Practices and Ethics of Science*. Switzerland: Springer International Publishing.
Quintane, E. and Carnabuci, G. (2016) 'How Do Brokers Broker? Tertius Gaudens, Tertius Iungens, and the Temporality of Structural Holes', *Organization Science*, 27(6), pp. 1343–1360.
Raffaelli, R. and Glynn, M. A. (2014) 'Turnkey or Tailored? Relational Pluralism, Institutional Complexity, and the Organizational Adoption of More or Less Customized Practices', *Academy of Management Journal*, 57(2), pp. 541–562.
Rao, H., Morrill, C. and Zald, M. N. (2004) 'Power Plays: How Social Movements and Collective Action Create New Organizational Forms', *Research in Organizational Behavior*, 22, pp. 237–281.
Rathi, D., M. Given, L. and Forcier, E. (2014) 'Interorganisational partnerships and knowledge sharing:

the perspective of non-profit organisations (NPOs)', *Journal of Knowledge Management*, 18(5), pp. 867–885.
Rea, L. M. and Parker, R. A. (2014) *Designing & Conducting Survey Research: A Comprehensive Guide*. 4th edn. San Francisco, CA: John Wiley & Sons Inc.
Reagans, R. E. and McEvily, B. (2003) 'Network Structure and Knowledge Transfer: The Effects of Cohesion and Range', *Administrative Science Quarterly*, 48(2), pp. 240–267.
Reagans, R. and McEvily, B. (2008) 'Contradictory or compatible? reconsidering the "trade-off" between brokerage and closure on knowledge sharing', *Advances in Strategic Management*, 25, pp. 275–313.
Reagans, R. and Zuckerman, E. W. (2001) 'Networks, Diversity, and Productivity: The Social Capital of Corporate R&D Teams', *Organization Science*, 12(4), pp. 502–517.
Reay, T., Golden-Biddle, K. and Germann, K. (2006) 'Legitimizing a new role: Small wins and microprocesses of change', *Academy of Management Journal*, 49(5), pp. 977–998.
Van De Rijt, A. (2011) 'The Micro-Macro Link for the Theory of Structural Balance', *The Journal of Mathematical Sociology*, 35(March), pp. 94–113.
Risjord, M. (2014) *Philosophy of Social Science: A Contemporary Introduction*. First. New York: Routledge, Taylor and Francis Group.
Rivera, M. T., Soderstrom, S. B. and Uzzi, B. (2010) 'Dynamics of Dyads in Social Networks: Assortative, Relational, and Proximity Mechanisms', *Annual Review of Sociology*, 36(1), pp. 91–115.
Robins, G. (2011) 'Exponential Random Graph Models (ERGM/p*)', in Barnett, G. A. (ed.) *Encyclopedia of Social Networks*. Thousand Oaks: Sage Publications, pp. 281–282.
Robins, G. (2013) 'A tutorial on methods for the modeling and analysis of social network data', *Journal of Mathematical Psychology*. Elsevier Inc., 57(6), pp. 261–274.
Robins, G., Pattison, P., Kalish, Y. and Lusher, D. (2007) 'An introduction to exponential random graph (p *) models for social networks', 29, pp. 173–191.
Robins, G., Pattison, P. and Wang, P. (2009) 'Closure, connectivity and degree distributions: Exponential random graph (p*) models for directed social networks', *Social Networks*, 31(2), pp. 105–117.
Robins, G., Snijders, T., Wang, P., Handcock, M. and Pattison, P. (2007) 'Recent developments in exponential random graph (p*) models for social networks', *Social Networks*, 29(2), pp. 192–215.
Rodan, S. (2010) 'Structural holes and managerial performance: Identifying the underlying mechanisms', *Social Networks*. Elsevier B.V., 32(3), pp. 168–179.
Romzek, B. S., Leroux, K. and Blackmar, J. M. (2012) 'A Preliminary Theory of Informal Accountability among Network Organizational Actors', *Public Administration Review*, 72(3), pp. 442–453.
Rosenberg, A. (2016) *Philosophy of Social Science*. Fifth. Boulder, CO: Westview Press.
Roulet, T. J., Paolella, L., Gabbioneta, C. and Muzio, D. (2019) 'Microfoundations of Institutional Change in the Career Structure of UK Elite Law Firms', in *Microfoundations of Institutions*, pp. 251–268.
Sahlin, K. and Wedlin, L. (2008) 'Circulating Ideas: Imitation, Translation and Editing', in *The SAGE Handbook of Organizational Institutionalism*, pp. 218–242.
SASH (2019a) *SASH Annual Report 2018-19*. Surrey.
SASH (2019b) *Surrey and Sussex Healthcare NHS Trust*, *Overview, Hospitals, Clinics & Departments*.
SATH (2019) *Shrewsbury and Telford Hospital NHS Trust*, *Overview, Hospitals, Clinics & Departments*.
SATH (2020) *Shrewsbury and Telford Hospital NHS Trust*, *Trust Information*.
Schilke, O. (2018) 'A micro-institutional inquiry into resistance to environmental pressures', *Academy of Management Journal*, 61(4), pp. 1431–1466.
Schneiberg, M. and Lounsbury, M. (2008) 'Social Movements and Institutional Analysis', in *The SAGE Handbook of Organizational Institutionalism*, pp. 650–672.
Scott, J. (2012) *Social Network Analysis*. 3rd edn. Sage Publications.
Scott, J. (2017) 'Basics of Social Network Analysis', in *Social Network Analysis*. 4th edn. Sage Publications, Inc, pp. 2–24.
Scott, W. R. (2003) 'Institutional carriers: reviewing modes of transporting ideas over time and space and considering their consequences', *Industrial and Corporate Change*, 12(4), pp. 879–894.
Scott, W. R. (2010) 'Reflections: The past and future of research on institutions and institutional change', *Journal of Change Management*, 10(1), pp. 5–21.
Scott, W. R. (2014) *Institutions and Organizations: Ideas, Interests and Identities*. 4th Editio. SAGE Publications.

Scott, W. R., Ruef, M., Mendel, P. J. and Caronna, C. A. (2000) *Institutional Change and Healthcare Organizations: From Professional Dominance to Managed Care*. Edited by W. R. Scott. University of Chicago Press.
Seo, M.-G. and Creed, W. E. D. (2002) 'Institutional Contradictions, Praxis and Institutional Change: A Dialectical Perspective', *Academy of Management Review*, 27(2), pp. 222–247.
Seto, W. H., Cowling, B. J., Lam, H. S., Ching, P. T. Y., To, M. L. and Pittet, D. (2011) 'Clinical and nonclinical health care workers faced a similar risk of acquiring 2009 pandemic H1N1 infection', *Clinical Infectious Diseases*, 53(3), pp. 280–283.
Shumate, M. and Palazzolo, E. T. (2010) 'Exponential random graph (p*) models as a method for social network analysis in communication research', *Communication Methods and Measures*, 4(4), pp. 341–371.
Siciliano, M. D., Wang, W. and Medina, A. (2020) 'Mechanisms of Network Formation in the Public Sector: A Systematic Review of the Literature', *Perspectives on Public Management and Governance*, pp. 1–19.
Simmel, G. (1955) *Conflict and the Web of Group Affiliations*. Reprint. Free Press.
Simmel, G. (2011) *Georg Simmel on Individuality and Social Forms - Georg Simmel - Google Books*. Edited by Donald N. Levine. University of Chicago Press.
Smets, M., Aristidou, A. and Whittington, R. (2018) 'Towards a Practice-Driven Institutionalism', in *The SAGE Handbook of Organizational Institutionalism*, pp. 365–389.
Smets, M., Morris, T. and Greenwood, R. (2012) 'From Practice to Field: A Multi-level Model of Practice Driven Institutional Change', *Academy of Management Journal*, 55(4), pp. 877–904.
Smets, M. and Reihlen, M. (2013) 'Institutional Entrepreneurship: A Literature Review and Analysis of the Maturing Consulting Field', in Reihlen, M. and Werr, A. (eds) *Handbook of Research on Entrepreneurship in Professional Services*. Edward Elgar Publishing, pp. 297–317.
Smith, B. (2018) 'Generalizability in qualitative research: misunderstandings, opportunities and recommendations for the sport and exercise sciences', *Qualitative Research in Sport, Exercise and Health*. Routledge, 10(1), pp. 137–149.
Snijders, T. A. B. (2017) 'Stochastic Actor-Oriented Models for Network Dynamics', *Annual Review of Statistics and Its Application*, 4(1), pp. 343–363.
Snijders, T. A. B., Pattison, P. E., Robins, G. L. and Handcock, M. S. (2006) 'NEW SPECIFICATIONS FOR EXPONENTIAL RANDOM GRAPH MODELS', *Sociological Methodology*, 36(1), pp. 99–153.
Stoop, I., Billiet, J., Koch, A. and Fitzgerald, R. (2010) *Improving Survey Response: Lessons Learned from the European Social Survey*, *Improving Survey Response: Lessons Learned from the European Social Survey*.
Suddaby, R., Bitektine, A. and Haack, P. (2017) 'Legitimacy', *Academy of Management Annals*, 11(1), pp. 451–478.
Sytch, M. and Tatarynowicz, A. (2014) 'Friends and Foes : The Dynamics of Dual Social Structures', *Academy of Management Journal*, 57(2), pp. 585–613.
Tasselli, S. (2014) 'Social networks of professionals in health care organizations: A review', *Medical Care Research and Review*, 71(6), pp. 619–660.
Tasselli, S. (2015) 'Social Networks and Inter-professional Knowledge Transfer: The Case of Healthcare Professionals', *Organization Studies*, 36(7), pp. 841–872.
Tasselli, S., Kilduff, M. and Menges, J. I. (2015) 'The Microfoundations of Organizational Social Networks: A Review and an Agenda for Research', *Journal of Management*, 41(5), pp. 1361–1387.
Thornton, P. H. and Ocasio, W. (2008) 'Institutional Logics', in Greenwood, R., Oliver, C., Suddaby, R., and Sahlin, K. (eds) *The SAGE Handbook of Organizational Institutionalism*. 1st edn. London: SAGE Publications Ltd, pp. 99–129.
Tolbert, P. S. and Barley, S. R. (1997) 'the Links between Action and Institution', *Organization Studies*, 18(1), pp. 93–117.
Tolbert, P. S., David, R. J. and Sine, W. D. (2011) 'Studying Choice and Change: The Intersection of Institutional Theory and Entrepreneurship Research', *Organization Science*, 22(5), pp. 1332–1344.
Tolbert, P. S. and Zucker, L. G. (2019) 'What Are Microfoundations ? Why and How To Study Them ?', *Research in the Sociology of Organizations*. Emerald Publishing Limited, 65, pp. 3–8.
Tortoriello, M. and Krackhardt, D. (2010) 'Activating Cross-boundary Knowledge: The Role of Simmelian Ties in the Generation of Innovations', *Academy of Management Journal*, 53(1), pp.

167–181.
Tortoriello, M., Reagans, R. and McEvily, B. (2012) 'Bridging the Knowledge Gap: The Influence of Strong Ties, Network Cohesion, and Network Range on the Transfer of Knowledge Between Organizational Units', *Organization Science*, 23(4), pp. 1024–1039.
Tortoriello, M., Taube, F. and Moebus, S. (2014) 'Lost in Transition: Knowledge Acquisition and Knowledge Loss in Interpersonal Exchanges.', *Academy of Management Annual Meeting Proceedings*, 2015, pp. 855–860.
Tracey, P., Phillips, N. and Jarvis, O. (2010) 'Bridging Institutional Entrepreneurship and the Creation of New Organizational Forms: A Multilevel Model', *Organization Science*, 22(1), pp. 60–80.
Tsoukas, H. and Chia, R. (2002) 'On organizational becoming: Rethinking organizational change', *Organization Science*, 13(5), pp. 567–582.
Tucker, A. L., Nembhard, I. M. and Edmondson, A. C. (2007) 'Implementing New Practices: An Empirical Study of Organizational Learning in Hospital Intensive Care Units', *Management Science*, 53(6), pp. 894–907.
Udehn, L. (2002) 'The Changing Face of Methodological Individualism', *Annual Review of Sociology*, 28(1), pp. 479–507.
Uzzi, B. (1996) 'The sources and consequences of embeddedness for the economic performance of organizations: The network effect', *American Sociological Review*, 61(4), pp. 674–698.
Uzzi, B. (1997) 'Social Structure and Competition in Interfirm Networks: The Paradox of Embeddedness', *Administrative Science Quarterly*. Sage Publications, Inc.Johnson Graduate School of Management, Cornell University, 42(1), p. 35.
Uzzi, B. and Lancaster, R. (2003) 'Relational embeddedness and learning: The case of bank loan managers and their clients', *Management Science*, 49(4), pp. 383–399.
Uzzi, B. and Spiro, J. (2005) 'Collaboration and Creativity: The Small World Problem', *American Journal of Sociology*, 111(2), pp. 447–504.
Vaan, M., Vedres, B., Stark, D., De Vaan, M., Vedres, B. and Stark, D. (2015) 'Game Changer: The Topology of Creativity', *American Journal of Sociology*, 120(4), pp. 1144–1194.
Valente, T. W. (1996) 'Social network thresholds in the diffusion of innovations', *Social Networks*, 18(1), pp. 69–89.
Vasudeva, G., Zaheer, A. and Hernandez, E. (2012) 'The Embeddedness of Networks: Institutions, Structural Holes, and Innovativeness in the Fuel Cell Industry', *Organization Science*, 24(3), pp. 645–663.
Vedres, B. and Stark, D. (2010) 'Structural Folds: Generative Disruption in Overlapping Groups', *American Journal of Sociology*, 115(4), pp. 1150–1190.
VMI, V. M. I. (2019) *Virginia Mason Production System*.
Voronov, M. and Weber, K. (2020) 'People, Actors, and the Humanizing of Institutional Theory', *Journal of Management Studies*, 57(4), pp. 873–884.
Wang, C., Rodan, S., Fruin, M. and Xu, X. (2014) 'Knowledge Networks, Collaboration Networks & Exploratory Innovation', *Academy of Management Journal*, 57(2), pp. 484–514.
Wang, P., Robins, G., Pattison, P. E. and Koskinen, J. H. (2009) *PNet: Program for the Simulation and Estimation of Exponential Random Graph Models*. Melbourne School of Psychological Sciences: The University of Melbourne.
Wang, P., Robins, G., Pattison, P. and Lazega, E. (2016) 'Social selection models for multilevel networks', *Social Networks*. Elsevier B.V., 44, pp. 346–362.
Wang, P., Sharpe, K., Robins, G. L. and Pattison, P. E. (2009) 'Exponential random graph () models for affiliation networks', *Social Networks*, 31(1), pp. 12–25.
Ward, V., Smith, S., House, A. and Hamer, S. (2012) 'Exploring knowledge exchange: A useful framework for practice and policy', *Social Science & Medicine*, 74(3), pp. 297–304.
Wasserman, S. and Faust, K. (1994) *Social network analysis : methods and applications*. Cambridge University Press.
Wasserman, S. and Pattison, P. E. (1996) 'Logit Models and Logistic Regressions for Social Networks: An Introduction to Markov Graphs and p *', *Psychometrika*, 61(3), pp. 401–425.
Wenger, E. (1998) *Communities of practice: Learning, Meaning and Identity*. Cambridge, UK: Cambridge University Press.
West, E., Barron, D. N., Dowsett, J. and Newton, J. N. (1999) 'Hierarchies and cliques in the social networks of health care professionals: Implications for the design of dissemination strategies',

Social Science and Medicine, 48(5), pp. 633–646.
West, M., Dawson, J., Admasachew, L. and Topakas, A. (2011) *NHS Staff Management and Health Service Quality*, *Results from the NHS Staff Survey and Related Data*.
White, H. C. and Mohr, J. W. (2008) 'How to model an institution', *Theory and Society*, 37(5), pp. 485–512.
White, L., Currie, G. and Lockett, A. (2014) 'The enactment of plural leadership in a health and social care network: The influence of institutional context', *Leadership Quarterly*. Elsevier Inc., 25(4), pp. 730–745.
White, L., Currie, G. and Lockett, A. (2016) 'Pluralized leadership in complex organizations: Exploring the cross network effects between formal and informal leadership relations', *Leadership Quarterly*. Elsevier Inc., 27(2), pp. 280–297.
Wijen, F. and Ansari, S. (2007) 'Overcoming inaction through collective institutional entrepreneurship: Insights from regime theory', *Organization Studies*, 28(7), pp. 1079–1100.
Zaheer, A. and Soda, G. (2009) 'Network Evolution : The Origin of Structural Holes', *Administrative Science Quarterly*, 54, pp. 1–31.
Zappa, P. and Robins, G. (2016) 'Organizational learning across multi-level networks', *Social Networks*. Elsevier B.V., 44, pp. 295–306.
Zhelyazkov, P. I. (2018) 'Interactions and Interests: Collaboration Outcomes, Competitive Concerns, and the Limits to Triadic Closure', *Administrative Science Quarterly*, 63(1), pp. 210–247.
Zhong, W., Su, C., Peng, J. and Yang, Z. (2017) 'Trust in Interorganizational Relationships', *Journal of Management*, 43(4), pp. 1050–1075.
Zilber, T. B. (2006) 'The Work of the Symbolic in Institutional Processes: Translations of Rational Myths in Israeli High Tech', *Academy of Management Journal*, 49(2), pp. 281–303.
Zucker, L. (1987) 'Institutional Theories Of Organization', *Annual Review of Sociology*, 13(1), pp. 443–464.
Zucker, L. G. and Schilke, O. (2019) 'Towards a Theory of Micro-Institutional Processes: Forgotten Roots, Links to Social-Psychological Research, and New Ideas', in *Microfoundations of Institutions*, pp. 371–389.

Appendix

Appendix A: Research Context

A1 Organisational Characteristics

In terms of organisational characteristics, the five trusts vary considerably in size and resources (Table 24). NHS-D has the most employees and most resources, with approximately 17,000 persons, 2,500 beds and 68 operating theatres (NHS-D, 2019, 2020). The second-largest trust in the partnership is NHS-C, which has 8,700 approximately employees, 1,250 beds and 26 operating theatres (NHS, 2019b). Next is NHS-K, which has approximately 6,500 employees and 940 beds; however, they have limited operating theatres compared to the other trusts, with only seven operating theatres (NHS, 2019a). NHS-E and NHS-A are similar in terms of size and resources, where the former has 5,000 employees, 700 beds and 19 operating theatres (NHS-E, 2019, 2020), and the latter has approximately 4,450 employees, 735 beds and 14 operating theatres (NHS-A, 2019b, 2019a).

Table 24: Organisational Characteristics Summary

	NHS-A	NHS-D	NHS-C	NHS-K	NHS-E
Number of Employees	4450	17000	8700	6500	5000
Number of Beds	735	2500	1250	940	700
Operating Theatres	14	68	26	7	19

A2 Organisational Culture

In terms of organisational culture, the NHS staff survey captures the organisational climate, staff attitudes and behaviours, such as employee motivation and job satisfaction (NHS Survey Coordination Centre, 2018). These areas are associated with different forms of engagement, organisational effectiveness, quality of care and other organisational outcomes (West et al., 2011). The NHS staff survey is aggregated at the organisational level and scored out of 5. In this case, the values are averaged from 2015, the year that the partnership commenced in 2018, which is the most recent data available (Table 25). Among the five trusts, NHS-A has the highest average staff survey score with 3.99, followed by NHS-C with a score of 3.81, NHS-D with a score of 3.75, NHS-K with a score of 3.65 and NHS-E with a score of 3.56.

Table 25: Organisational Culture – NHS Staff Survey Average (2015–2018)

	2015	2016	2017	2018	Average
NHS-A	3.92	3.98	4.05	4.02	**3.99**
NHS-D	3.59	3.72	3.84	3.86	**3.75**
NHS-C	3.76	3.9	3.81	3.75	**3.81**
NHS-K	3.55	3.65	3.73	3.66	**3.65**
NHS-E	3.45	3.62	3.62	3.55	**3.56**

Appendix B: Research Methodology – Data Collection

B1 Paper -Based Sociometric Survey Instrument

For each person listed, please rate each of the following statements relating to improvement work relationships

NAME	ROLE	ORGANISATION	I am aware of this person's areas of expertise, and so understand which aspects of improvement work they can help me with	This person provides me with information or advice with regards to improvement work	I feel personally comfortable asking this person for information or advice	This person is influential with regards to improvement work issues	I trust this person enough to talk freely to them about improvement work matters
			1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5
			1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5
			1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5
			1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5
			1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5
			1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5
			1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5
			1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5
			1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5
			1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5	1 – 2 – 3 – 4 – 5

(Please circle your answer: 1= **Strongly disagree** 2= **Disagree** 3= **Neither agree nor disagree**, 4= **Agree**, 5= **Strongly agree**

B2 Survey Invitation

Dear *(L4L's Name)*,

You have been selected to participate in a survey to gather opinions about the impact of the Pride Way for Leaders training. Your feedback is valuable for understanding the impact of the training in terms of improvements in quality, efficiency and cost. We also seek to collect data about who you work with and talk to about improvement in a bid to consider how improvement knowledge is spread within the organisation.

The survey will take a ***maximum of 20 minutes*** and your responses will be held anonymously. The evaluation has been commissioned by The Health Foundation and approved by Health Research Authority (HRA), study number: 240305.

If you have any questions about the evaluation or the survey, please contact Nicola.burgess@wbs.ac.uk.

Follow this link to the Survey or copy and paste the URL below into your internet browser:
(*Survey Link)*

Please complete the survey by the ***7th December 2018***.

Thank you in advance for your time and feedback.

Nicola Burgess

Warwick Business School

B3 Survey Reminder Notice

Dear,

This is your chance to give feedback on the impact of Lean for Leader (L4L) training. We have extended the deadline to the ***14th December 2018****.*

Your feedback is valuable for understanding the impact of the training in terms of improvements in quality, efficiency and cost. We also seek to collect data about who you work with and talk to about improvement in a bid to consider how improvement knowledge is spread within the organisation.

The survey will take a ***maximum*** ***of 20 minutes*** and your responses will be held anonymously.

Follow this link to the Survey or copy and paste the URL below into your internet browser:

If you have any questions about the evaluation or the survey, please contact Nicola.burgess@wbs.ac.uk.

Thank you in advance for your time and feedback.

Nicola Burgess

Warwick Business School

B4 Online Survey Instrument

The following displays the survey instrument used to collect data from the Lean for Leaders.

English (UK)

Informed Consent

Q1. This survey is designed as part of national evaluation of the partnership between the NHS and the Virginia Mason Institute led by Dr Nicola Burgess at Warwick Business School (University of Warwick), commissioned by The Health Foundation (IRAS Project ID: 240305).

The survey aims to examine the impact of the Lean for Leaders (L4L) or a variant of L4L (e.g. Pride Way for Leaders) training upon the trained individual, the impact upon those that L4L interact with, and the impact of the training in terms of improvements in quality, efficiency and cost.

We also welcome your views on the partnership and how the organisation and/or the NHS can better support you to apply knowledge and skills of improvement in your daily work. If you would like to elaborate further on your answers please feel free to contact us directly: Nicola.burgess@wbs.ac.uk

In providing a response to our survey we are assuming consent for your data to be used as part of the evaluation. All data is anonymised and held in accordance with GDPR guidelines. If you have any questions about the evaluation or the survey please contact Nicola.burgess@wbs.ac.uk

○ I consent, begin the study

Personal Details

Q2. Please select your age.

16 - 20	21 - 30	31 - 40	41 - 50	51 - 65	66+
○	○	○	○	○	○

Q3. Please select your gender.

Male	Female
○	○

Q4. Please select your ethnic background.

Trust, Role & Professional Details

Q5. Please identify the trust in which you work:

- ○ Barking, Havering and Redbridge University Hospitals NHS Trust
- ○ University Hospitals Coventry and Warwickshire NHS Trust
- ○ Shrewsbury and Telford Hospital NHS Trust
- ○ Surrey and Sussex Healthcare NHS Trust
- ○ The Leeds Teaching Hospitals NHS Trust
- ○ Other:

Q6. How long have you worked for the organisation?

Less than one year	1-2 years	3-5 years	6-10 years	11-15 years	More than 15 years
○	○	○	○	○	○

Q7. Please select the **occupational group** that best describes your **professional role.**

Q8. Please specify, as you have selected "Other Occupational Group".

Q9. How many years of experience do you have in your professional role?

Less than one year	1-2 years	3-5 years	6-10 years	11-15 years	More than 15 years
○	○	○	○	○	○

Q10. Do you hold a leadership role, in addition to your occupational role ?

- ○ No
- ○ Yes. Please specify:

L4L Training Details & Previous Training

Q11. Are you currently undertaking or have you completed the Lean for Leaders training program?

- ○ I am a Lean for Leader Graduate – I have **completed all** of the coursework, modules and assignments.
- ○ I am a Lean Leader in Training – I am **still working on** the modules and assignments.
- ○ I have **completed** Advanced Lean Training (ALT).
- ○ I am **undertaking** Advanced Lean Training (ALT).
- ○ _____ Other:

Q12. When did you complete your training i.e. all of the coursework, modules and assignments?

Year ▾

Month ▾

Q13. How many core modules have you completed?

1	2	3	4	5	6	Other:
○	○	○	○	○	○	_____ ○

Q14. Do you have any previous experience with Lean or any other improvement method prior to your engagement with the Lean for Leaders program?

- ○ No
- ○ Yes. Briefly comment on this experience and how it was gained.

_____

Q15. Why did you sign up for L4L? (Please select all that apply.)

- ☐ I was interested in improvement and wanted to further my professional development in this area
- ☐ I wanted to contribute to the organisation's mission to adopt the lean methodology from Virginia Mason
- ☐ I was told I had to sign up by a senior member of staff
- ☐ I know of colleagues who signed up and I have seen and/or heard about the impact of the training through their work
- ☐ _____ Other

Post Training & Change in Daily Practice

Q16. For each statement please select an answer that best suits your experience.

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
Involvement in the L4L training programme has allowed me to **acquire new knowledge and skills for improvement**.	O	O	O	O	O
In my view, the L4L training has **improved my daily leadership**.	O	O	O	O	O
I see Lean as a **temporary project** and am only **willing to devote limited time** and commitment to improvement work.	O	O	O	O	O
In my view, the **Lean methodology was not effective** and did not improve the standard practice of my trust/department.	O	O	O	O	O

Q17. To what extent do you **apply the knowledge and skills** gained through the L4L programme to continuously improve the quality and efficiency of your work and that of your wider work environment?

	Daily	Weekly	Monthly	Ad Hoc	Never
My Work	O	O	O	O	O
My Work Environment	O	O	O	O	O

Q18. When you use the L4L knowledge and skills in your daily practice, how **familiar** does it feel?

Not at all Familiar	Slightly Familiar	Moderately Familiar	Very Familiar	Extremely Familiar
O	O	O	O	O

Q19. For each statement please select an answer that best suits your experience.

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
I can see how Lean differs from **usual ways of working**.	O	O	O	O	O
I can see the **potential value** of Lean for my work.	O	O	O	O	O
I understand how Lean affects **the nature of my own work**.	O	O	O	O	O
The people I work with have a **shared understanding of the purpose** of Lean in healthcare.	O	O	O	O	O

Q20. How **impactful** has the L4L methodology been upon your approach to your daily work?

- O No Impact, I continue to work in the same way.
- O Low Impact, Minor aspects of my daily work have changed.
- O Moderate impact, I am confident I have the skills to conduct improvement work and look for opportunities to improve my efficiency whilst improving care for the patient.
- O High Impact, The L4L methodology has changed the way I think about the importance of efficiency and I take the initiative to involve others in improvement work, teaching them skills and coaching them in behaviours to bring about change.

Q21. Do you feel the L4L methodology **will become a normal** part of your work?

Extremely unlikely	Somewhat unlikely	Neither likely nor unlikely	Somewhat likely	Extremely likely
O	O	O	O	O

Integration & Barriers to Implementation

Q22. For each statement please select an answer that best suits your experience.

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somew disagr
I can **easily integrate Lean** practices into my existing work.	O	O	O	O
Following L4L training, it is now **more difficult to work with others** than before.	O	O	O	O
I have confidence in **other people's ability to use or apply** Lean in my trust.	O	O	O	O
Improvement work is **assigned to those with appropriate skills** to use Lean in my trust.	O	O	O	O
Sufficient training is provided to enable health care providers to implement Lean in my trust.	O	O	O	O
Sufficient resources are available to support the implementation of Lean in health care in my trust.	O	O	O	O
Management adequately **supports** the use of Lean practices in my trust.	O	O	O	O

Q23. What **barriers** have you experienced in **implementing the knowledge and skills** gained through L4L? (Please select all that apply.)

- ☐ Lack of engagement from **senior** management
- ☐ Lack of engagement from **middle** management
- ☐ Lack of engagement from **lower** management
- ☐ Lack of engagement from **doctors** in improvement work
- ☐ Lack of engagement from **nurses** in improvement work
- ☐ Lack of engagement from **allied health professionals** in improvement work (e.g. Radiographer, mental health etc)
- ☐ Lack of engagement from **support functions** (e.g. IT, estates etc)
- ☐ Lack of engagement from **inter-connected external services** (e.g. Social services, community nursing team, GP etc.)
- ☐ Lack of staff with **appropriate** improvement **skills**
- ☐ Lack of **money** in the organisation
- ☐ Lack of **money in the NHS**
- ☐ Lack of **time**
- ☐ Pressure to **save money**
- ☐ Pressure to **meet targets**
- ☐ Own **lack of skills and know-how**
- ☐ Lack of **support** from the **organisation's improving care team**

☐ Other (Please speak freely about what prevents you from utilizing your knowledge and skills from L4L training)

Q24. What in your opinion can your organisation do to **better support you to use the knowledge and skills gained through L4L** within the organisation?

Impact & Outputs

Q25. For each statement please select an answer that best suits your experience.

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewl disagr
I am aware of **reports** about the **outcomes** of Lean implementation **in my trust**.	○	○	○	○
I am aware of **reports** about the **outcomes** of Lean implementation **outside of my trust**.	○	○	○	○
The people I work with believe that **Lean is worthwhile**.	○	○	○	○
I value the **effects** that Lean has had **on my work**.	○	○	○	○
Feedback about Lean can be **used to improve its implementation** in health care in the future.	○	○	○	○
I can **modify how** I **use Lean** in my work.	○	○	○	○

Q26. To what extent does improvement work incorporate the **notion of 'value'** from the perspective of the patient/customer.

Always	Most of the time	Sometimes	Never	I don't know
○	○	○	○	○

Q27. How would you describe the impact of the improvement work that you have undertaken as a result of the L4L training in terms of **quality, efficiency and financial savings**?

	High Impact	Moderate Impact	Low Impact
Impact in terms of **Quality**	○	○	○
Impact in terms of **Efficiency and Flow**	○	○	○
Impact in terms of **Financial Savings**	○	○	○

Q28. In your view, has the impact identified above been **effectively communicated** to the organisation?

Yes	No	I don't know
○	○	○

SN Section & Colleagues Interest

Q29. To what extent are staff within your immediate working environment **interested to learn** about your work through the L4L program?

	No Interest	Some curiosity in tools and methods of improvement	Keen to support and learn about tools and methods of improvement	I
Staff who report to me	O	O	O	
Staff I report to	O	O	O	
People I work with (Similar Level)	O	O	O	

Q30. For each statement please select an answer that best suits your experience.

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somew disagr
Involvement in Lean for Leaders has allowed me to **strengthen existing relationships** that improve the work that I do.	O	O	O	O
Involvement in Lean for Leaders has allowed me to **build new relationships** which improves the work that I do.	O	O	O	O
Involvement in Lean for Leaders has allowed me to **build on my understanding of lean in healthcare with persons** in other trusts who are also involved in improvement work.	O	O	O	O

Q31. For each statement please select an answer that best suits your experience.

	Strongly agree	Somewhat agree	Neither agree nor disagree	Some disag
There are **key people who drive Lean** forward and get others involved.	O	O	O	C
One of my **professional roles** is participating in Lean improvement activities.	O	O	O	C
I am open to **working with colleagues in new ways** to use Lean improvement methods in my trust.	O	O	O	C
I **support** the use of Lean in health care.	O	O	O	C

. In this section, we will ask you to name some of the persons you work with and talk to about improvement work, in a bid to consider how improvement knowledge is spread within the organisation. We understand that you may have concerns, but ***we would like to assure you that this information is solely for the purpose of analysis and all identifiable data will be anonymised and held under strict confidentiality, in accordance with GDPR regulations.***

Q32. Please list the names or initials of up to five people who are involved in some way in your improvement work on a regular basis. We are interested in the knowledge sharing activities between yourself and the members you list and would like to know the extent to which you are involved with, or linked to, these members of your network. **This information will be anonymized.**

Person 1	
Person 2	
Person 3	
Person 4	
Person 5	

Q33. For the same individuals, please state their role and organization, indicate whether you have worked together before and your primary mode of communication.

	Role	Organisation	We have worked together prior to L4L		We mainly c		
	Enter Role Title or Abbreviation	Enter Organisation Name or Abbreviation	Yes	No	In person	By Email	Via Me
» Person 1							
» Person 2							
» Person 3							
» Person 4							
» Person 5							

Q34. For each person listed, please rate each of the following statements relating to improvement work relationships.

	I am aware of this person's areas of **expertise**, and so understand which aspects of Lean they can help me with.			This person **provides me with information or advice** with regards to L4L.			I feel personally comfortable **asking this person for information or advice** regarding the L4L method.		
	Disagree	Neither Agree or Disagree	Agree	Disagree	Neither Agree or Disagree	Agree	Disagree	Neither Agree or Disagree	Agree
» Person 1									
» Person 2									
» Person 3									
» Person 4									

	I am aware of this person's areas of **expertise**, and so understand which aspects of Lean they can help me with.			This person **provides me with information or advice** with regards to L4L.			I feel personally comfortable **asking this person for information or advice** regarding the L4L method.		
	Disagree	Neither Agree or Disagree	Agree	Disagree	Neither Agree or Disagree	Agree	Disagree	Neither Agree or Disagree	Agree
» Person 5	○	○	○	○	○	○	○	○	○

Q35. For each person listed, please rate each of the following statements relating to improvement work relationships.

	This person is **influential** with regards to Lean training and implementation matters.			I **trust** this person enough to **talk freely** to them about Lean training and implementation matters.			This person and I have have **similar ideas, goals and objectives** regarding the implementation of Lean principles.		
	Disagree	Neither Agree or Disagree	Agree	Disagree	Neither Agree or Disagree	Agree	Disagree	Neither Agree or Disagree	Agree
» Person 1	○	○	○	○	○	○	○	○	○
» Person 2	○	○	○	○	○	○	○	○	○
» Person 3	○	○	○	○	○	○	○	○	○
» Person 4	○	○	○	○	○	○	○	○	○
» Person 5	○	○	○	○	○	○	○	○	○

Appendix C: Research Methodology – Data Analysis

C1 Section 1 Structure & Design

As measurement and testing of tools that are designed to evaluate improvement work and other complex processes such as the application of new knowledge and changes in practice in healthcare is still an emerging area in research (Portela et al., 2015), the L4L survey was developed and adapted based on the NoMAD survey. The NoMAD survey, a 23-item instrument developed to assess healthcare professionals' views on the processes related to implementing complex interventions in practice (Finch et al., 2013; Goodridge et al., 2018). This instrument emerged from Normalization Process Theory (NPT) and was developed by a group of social and healthcare scientists to understand how new practices become routinely embedded within the individual and collective levels of social contexts (May & Finch, 2009; May et al., 2009; Finch et al., 2012). It also helps us to understand "*the ways in which large-scale transformations are embedded and integrated into evolving and diverse practice settings*" (Goodridge et al., 2018, p. 2) and is therefore able to capture and explain the processes underlying the application of new practices, implementation and change in healthcare settings (Gask et al., 2008; Gunn et al., 2010; Forster et al., 2011; Morrison & Mair, 2011). The NoMAD tool was divided into twenty-three (23) items that captured six dimensions that influence implementation and change processes: **familiarity, normality, coherence, cognitive participation, collective action and reflexivity** (May & Finch, 2009; May et al., 2009). The first dimension, *familiarity,* is associated with the application and understanding of new practices within the context of daily practice (Q.18). The second dimension, *normality,* is associated with the potential acceptance of new practice as part of their daily work (Q.21). The third dimension, *coherence,* is associated with making sense of new practices and identifying the meaningful aspects of the new practices that change their daily work and environment (Q.19). The fourth dimension, *cognitive participation,* is associated with the relational aspects of embedding and integrating new practices within a work environment, specifically building and sustaining a community of practice around new practices and complex interventions. (Q.31). The fifth dimension, *collective action,* captures the operational aspects of aligning and enacting new practices within daily work activities and the general work environment (Q.22). The sixth dimension, *reflexive monitoring,* is associated with assessing how new practices affect them and those around them. (Q.25)

As such, the NoMAD tool sheds light on the individual and collective views of the Lean methodology among the healthcare professionals in each trust; since the Lean methodology seeks to improve healthcare quality by integrating and embedding new practices at individual and collective levels of these organisations (May & Finch, 2009; Finch et al., 2012, 2013). Based on these points, the NoMAD tool is an appropriate instrument to gather data regarding the

institutionalisation of new practices, due to its conceptual fit and alignment with the overall goals and objectives of this study.

The NOMAD measures measured on a 5-point Likert scale were transformed by first combining individual items to create one measure and then dichotomizing the variable, which comes with a cost of losing detailed information due to the aggregation of data (MacCallum et al., 2002). There is no definitive approach in this process as there is no exact cut-off point used as a rule; however, one approach is determined by choosing a parametric or non-parametric cut-off. For the non-parametric approach, the median value is used to determine the cut-off point. In this case, for a five-point Likert scale, the median value is 3. In the parametric approach, the mean of the responses is used as the cut-off to aggregate the responses' general sentiment. The parametric approach used cut-off points derived at three different levels. The first cut-off was labelled High, where responses measured 4 and above included Strongly Agree were recorded as 1, and all other responses were recorded as 0. The second cut-off labelled was Moderate, where responses measured 3.8 and above included responses such as Somewhat & Strongly Agree were recorded as 1, and all other responses were recorded as 0. The third and final cut-off labelled was Low, where responses measured 3.5 and above included responses such as Mostly Agree were recorded as 1, and all other responses were recorded as 0.

Table 26: Data Transformation for NoMAD measures

Format	If Response is valued at:		
High	Strongly Agree	4 thru 5=1	0 thru 3.99=0
Moderate	Somewhat & Strongly Agree	3.8 thru 5=1	0 thru 3.79=0
Low	Mostly Agree	3.5 thru 5 = 1	0-3.49 = 0

According to the method suggested by Lusher, Johan et al. (2013), each of these cut-off points was tested in the ERGM models, and the results were compared. The cut-off decision is then validated through the comparison of results, including and excluding extreme values. Afterwards, the most consistent results were determined at the Low tier, where responses 3.35-5 were coded as 1. Similarly, the cut-off rule for Impact which was the combination of questions 20 and 27, measured as No-Low-Moderate-High Impact was dichotomized at 2.49, where responses under this value were coded at 0 to indicate No or Low Impact, and responses between 2.5-4 were coded at 1 to indicate Moderate/High Impact.

Due to data collection, the NoMAD data is limited to the directly surveyed persons in the study. Therefore, actors mentioned as collaborators would have missing data in the ERGM model based on this Actor-Relation measure. However, according to Lusher et al. (2013) and Kossinets (2006), this is not a problem for two key reasons. First, network data and analysis do not give primacy to actor-attributes; this information is supplementary rather than primary data. Second, this

research focuses not on the NoMAD responses' sentiment, but the network's structural and relational mechanisms. Therefore, although the NoMAD responses do not capture the entire network's sentiment, they lend some explanatory power regarding the context and institutionalisation of practices in each organisational network.

C2 Quadratic Assignment Procedure (QAP)

Since data from five networks, expertise, advice provision, advice seeking, influence and trust, were measured, bivariate analysis is used to determine whether the pattern of ties for one network aligns with the pattern of ties for another network that contains the same actors. A Quadratic Assignment Procedure (QAP) was performed to test the correlations and statistically significant association between two network matrices. A QAP is a nonparametric technique used for network analysis to conduct both correlation and multiple regression analysis. It can account for the relationality among variables because it does not require independence assumptions than traditional methods such as __ and Generalized Least Squares (GLS). For correlation analysis of network matrices, the QAP tests whether the association between two networks is statistically significant by testing differences in the 5-point Likert scale ratings while controlling for underlying matrix structure. In this case, the ties between actors remain constant, but the ties' ratings are used to examine the structural influence of the network and the ratings attributed to an actor. The results are displayed in a correlation matrix format to indicate the degree of similarity between each question's ratings, as the structure of the network does not change.

This method is used to detect and test for differences in question responses to the ratings while controlling for underlying matrix structure. In this case, the ties between actors remain constant, but the ties' ratings are re-evaluated to examine the structural influence of network and the ratings attributed to an actor. The results are displayed in a correlation matrix format to indicate the degree of similarity between each question's ratings, as the structure of the network does not change. Table 1 displays the QAP results for the valued data structure, including ratings from 1 to 5 (Strongly Disagree to Strongly Disagree) for each of the five questions in the social network survey. Table 2 displays the results for a binary data structure that recodes all responses to a 0 and 1 representation, where only the ties rated as a 5 (Strongly Agree) are retained. The differences in the valued summary data ranging from 1-5 and the binary data of 5 only indicate a moderate level of variability in the similarity of questions 1 (Knowledge of Expertise), 2 (Provides Information or Advice), 3 (Seeks Information or Advice), and 5 (Trust); and a high level of variability or a low level of similarity in the ratings for question 4 (Influence). This result means that many of the persons surveyed did not strongly agree that their collaborators were influential regarding improvement work.

C4 ERGM Analytical Procedure

Open PNet - Initial Estimation Set-Up:

Step 1. Create Session Name -> **Step 2.** Load Session Folder.

Step 3. Select the Estimation Tab -> **Step 4.** Input Number of Actors and Load Session File

Step 5. Select Directed Network

Step 6. Selection of Structural Parameters

Step 7. Selection of Actor Attributes

Step 8. Estimation Options

Step 9. Start Estimation

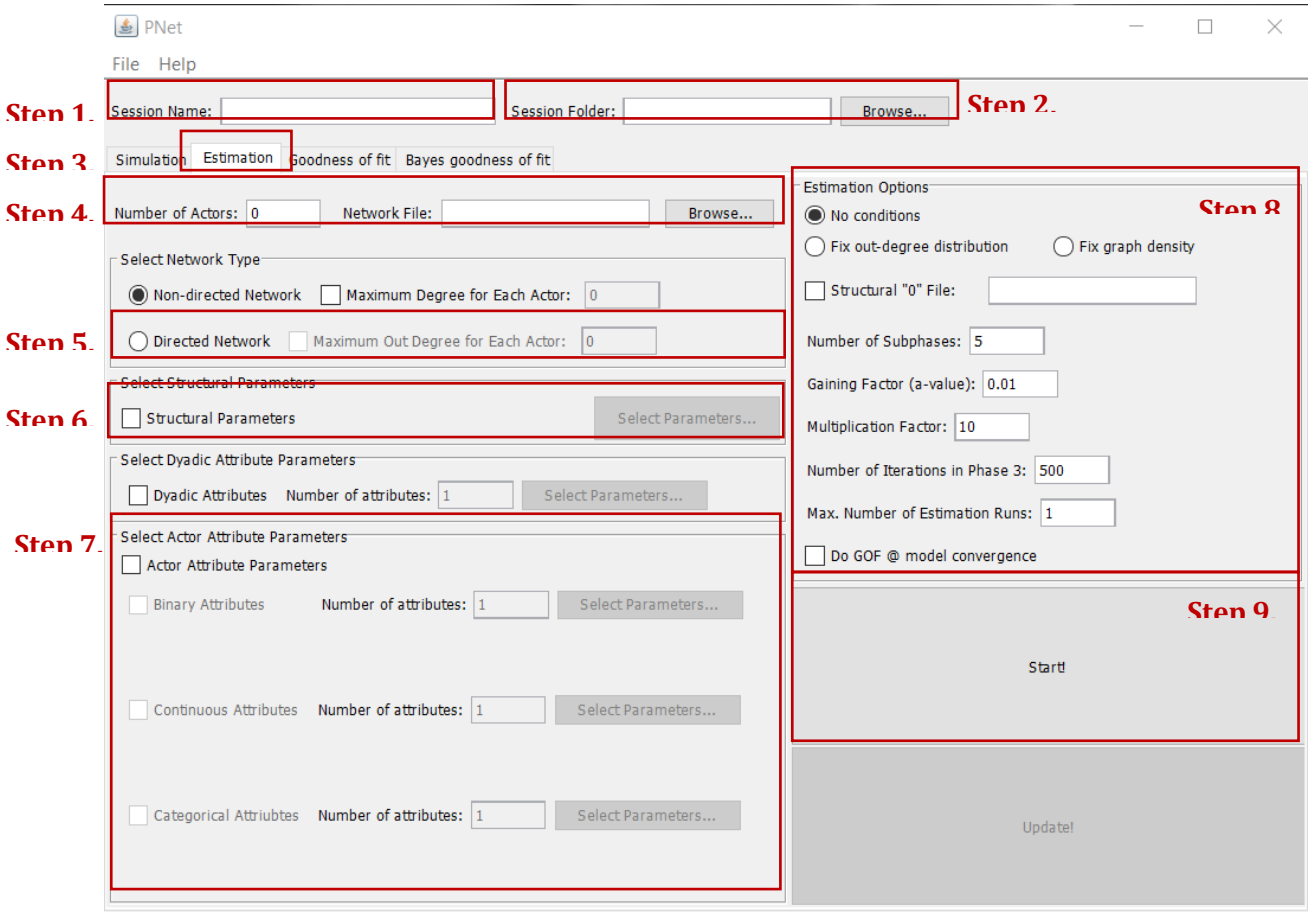
Step 10. Examine Output

Step 11. Rename Session name (Step 1), adjust parameters (Step 6 & 7), estimation settings (Step 8), then Start New Estimation (Step 9).

Step 12. Repeat Step 11 until the model converges.

Step 13. Conduct Goodness of Fit

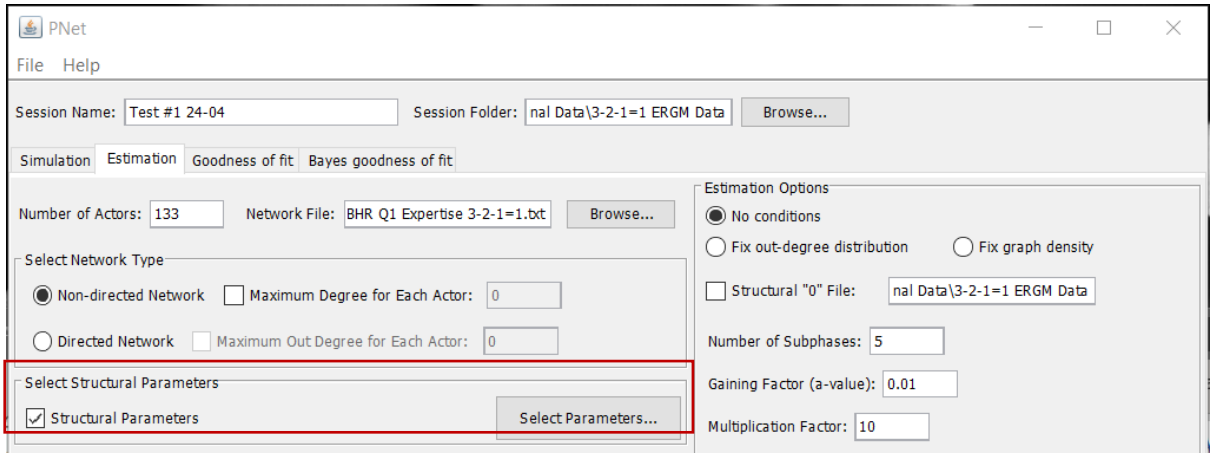
The selection of structural parameters, actor attributes and estimation settings vary. For further details, for steps 6-8 and 13, please see the specific estimation routines.



Specific Estimation Routines for Steps 6-8

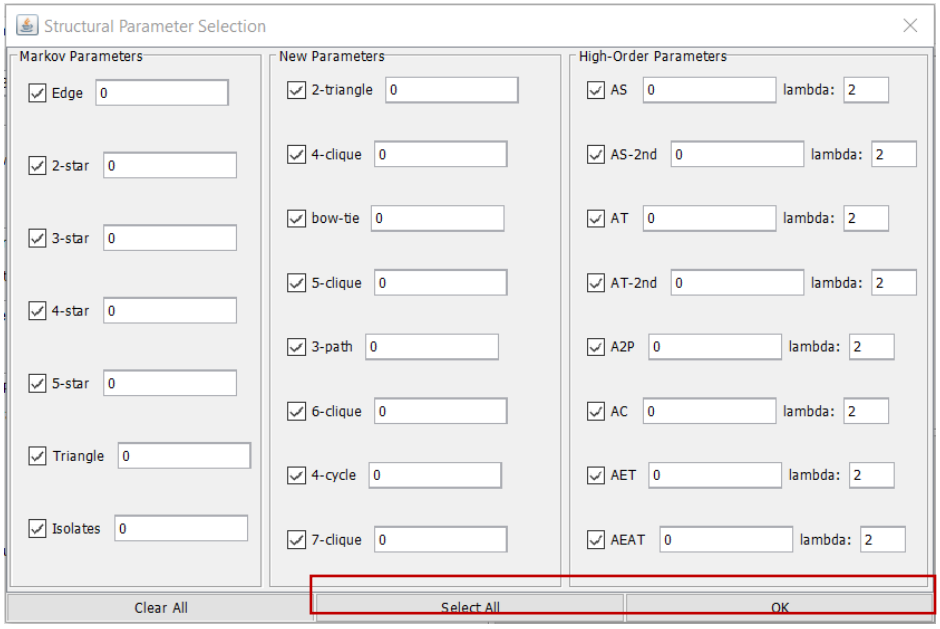
Estimation 1 – Model Degeneracy Test - Check All Structural Parameters

Step 6. Selection of Structural Parameters

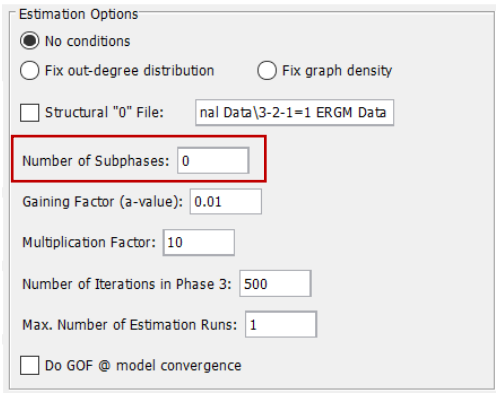


Step 6.

For the first estimation, select all structural parameters and OK.



Step 8: Change the number of subphases to zero (0) and start estimation (Step 9). This process should last a few seconds.



Step 10: Examine Output

Expect a Degenerate Model – This step is to examine the parameters that are present in the network.

Examine the Start Statistics File and make a note of all the parameters that are between 0 and 30.

Parameters of zero will be excluded from future estimations, as these will degenerate the model.

Parameters less than 30 will be included but should be carefully examined, as these are likely to either degenerate the model or produce poor estimates.

*start_statistics_Test #1 24-04 - Notepad

File Edit Format View Help

```
***This graph contains:****
vertices        133
edges   122
2-star  313
3-star  417
4-star  424
5-star  330
Triangle        13
4-clique        1
5-clique        0
6-clique        0
7-clique        0
Isolates        10
Triangle2       16
Bow_tie 2
3Path   624
cycle4  15
AS(2.00)        179.04688
AS2(2.00)       179.04688
AT(2.00)        32.12500
AT2(2.00)       32.12500
A2P(2.00)       299.12500
AC(2.00)        1.00000
AET(2.00)       57.76563
AEAT(2.00)      50.57813
```

Figure 25: Example of Statistics Output

Estimation 2 – Check Pre-determined/Theoretical Model Parameters

Rename Session.

In step 6. Select the pre-determined theoretical model parameters.

In step 8. Change the number of subphases to 5, then Start the Estimation.

Step 10. Check Estimates, Statistics and/or Model Degeneracy.

Unlikely to be a good fit, if there are sensible estimates, keep the parameters and increase the multiple factors to 20, 50, 75 or 100 and set the maximum number of estimation runs to 5 or 10 in varying trials. The higher the multiplication factor and the number of estimation runs, the longer the estimation time.

With a multiplication factor of either 50 or 75 and a maximum estimation of 5, the model may converge. If it does not, continue to increase these parameters. If there are still poor estimates, begin estimation 3.

Estimation 3 – Basic Lower Level Structural Parameters Only

Rename Session.

In step 6. Select Markov Parameters only (these are lower-level parameters) but exclude parameters less than 30.

In step 8. Keep the number of subphases to 5, then Start the Estimation (Step 9).

Step 10. Check Estimates, Statistics and/or Model Degeneracy.

Unlikely to be a good fit, if there are sensible estimates, keep the structural parameters and increase the multiplication factor to 20, 50, 75 or 100 and set the maximum number of estimation runs to 5 or 10 in varying trials. With a multiplication factor of either 50 or 75 and a maximum estimation of 5, the model may converge. If it does not, continue to increase these parameters.

If there are poor estimates, begin estimation 4.

Estimation 4 – Include New & Higher-Level Model Parameters

Rename Session.

In step 6. Keep the basic Markov Parameters with reasonable or significant estimates and include the new and higher-level model parameters, one or two at a time.

In step 8. Keep the number of subphases to 5, then Start the Estimation (Step 9).

Step 10. Check Estimates, Statistics and/or Model Degeneracy.

Subsequent Estimations

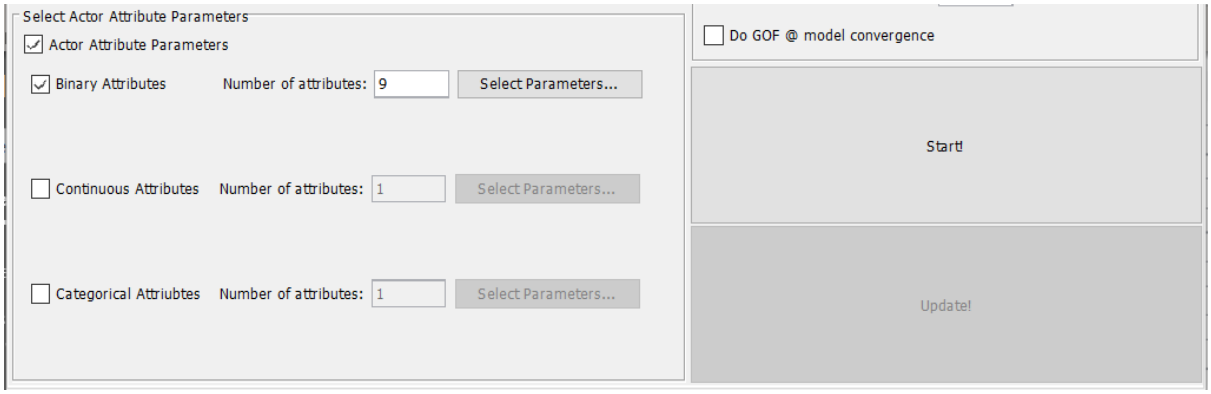
Repeat the selection and omission of parameters based on the estimation result and model degeneracy. Eventually, a set of parameters will be excluded as they are not present in the observed model, and the remaining parameters can be varied until model convergence is achieved.

Converged Model = the t-statistic for all the configurations in the model are less than 0.1.

Attribute Model Estimation

After identifying a suitable and converged model, include actor attributes in that model.

Step 7. Selection of Actor Attribute Parameters.



Step 7.1. Begin with Binary Attributes only, enter the raw file's number of attributes, and select the model parameters. Keep the Structural Parameters and Estimation settings of the converged model and Start the new estimation. Check the Results.

Step 7.2. Next, include the Continuous Attributes only, enter the raw file's number of attributes, and select the model parameters. Keep the Estimation settings of the converged model and Start the new estimation. Check the Results.

Step 7.3. Next, include the Categorial Attributes only, enter the raw file's number of attributes, and select the model parameters. Keep the Estimation settings of the converged model and Start the new estimation. Check the Results.

Step 7.4. - Finally, include the **Binary, Continuous and Categorial Attributes** in the same estimation. Keep the Estimation settings of the converged model and Start the new estimation. Check the Results, estimates and level of significance. If the model estimates become unreasonable, exclude the model's suspected parameters and Estimate the model until acceptable parameters have been derived, and the model has converged.

Appendix D: Results & Output

D1 Univariate Output

Table 27: NHS-A Univariate Statistics

	NHS-A Networks	Expertise	Provide Advice	Seek Advice	Influence	Trust
1	Observations	60762	60762	60762	60762	60762
2	Missing	0	0	0	0	0
3	Minimum	0	0	0	0	0
4	Maximum	3	3	3	3	3
5	Sum	1141	972	1060	987	1135
6	Average	0.019	0.016	0.017	0.016	0.019
7	SSQ	3379	2632	3004	2681	3347
8	Standard Deviation	0.235	0.208	0.222	0.209	0.234
9	Variance	0.055	0.043	0.049	0.044	0.055
10	MCSSQ	3357.574	2616.451	2985.508	2664.968	3325.799
11	Euclidean Norm	58.129	51.303	54.809	51.778	57.853
12	Positives	389	389	389	389	389
13	Average Positive Value	2.933	2.499	2.725	2.537	2.918
	Frequencies					
1	0	60373	60373	60373	60373	60373
2	3	367	247	301	249	360
3	2	18	89	69	100	26
4	1	4	53	19	40	3

Table 28: NHS-A Density Statistics

		Average Value	Total	Std Dev	Average Weighted Degree
1	Expertise	0.019	1141	0.235	4.619
2	Provide Advice	0.016	972	0.208	3.935
3	Seek Advice	0.017	1060	0.222	4.291
4	Influence	0.016	987	0.209	3.996
5	Trust	0.019	1135	0.234	4.595

Table 29: NHS-D Univariate Statistics

	NHS-D Networks	Expertise	Provide Advice	Seek Advice	Influence	Trust
1	Observations	32580	32580	32580	32580	32580
2	Missing	0	0	0	0	0
3	Minimum	0	0	0	0	0
4	Maximum	3	3	3	3	3
5	Sum	789	676	754	713	795
6	Average	0.024	0.021	0.023	0.022	0.024
7	SSQ	2313	1814	2158	1977	2343
8	Standard Deviation	0.265	0.235	0.256	0.245	0.267
9	Variance	0.07	0.055	0.066	0.06	0.071
10	MCSSQ	2293.893	1799.974	2140.55	1961.396	2323.601
11	Euclidean Norm	48.094	42.591	46.454	44.463	48.405
12	Positives	273	273	273	273	273
13	Avg Positive Value	2.89	2.476	2.762	2.612	2.912
	Frequencies					
1	0	32307	32307	32307	32307	32307
2	3	246	166	221	192	252
3	2	24	71	39	56	18
4	1	3	36	13	25	3
		32580	32580	32580	32580	32580

Table 30: NHS-D Density Statistics

		Avg Value	Total	Std Dev	Avg Wtd Degree
1	Expertise	0.024	789	0.265	4.359
2	Provide Advice	0.021	676	0.235	3.735
3	Seek Advice	0.023	754	0.256	4.166
4	Influence	0.022	713	0.245	3.939
5	Trust	0.024	795	0.267	4.392

Table 31: NHS-C Univariate Statistics

	NHS-C Networks	Expertise	Provide Advice	Seek Advice	Influence	Trust
1	Observations	27722	27722	27722	27722	27722
2	Missing	0	0	0	0	0
3	Minimum	0	0	0	0	0
4	Maximum	3	3	3	3	3
5	Sum	776	712	749	731	773
6	Average	0.028	0.026	0.027	0.026	0.028
7	SSQ	2270	1980	2147	2059	2265
8	Standard Deviation	0.285	0.266	0.277	0.271	0.284
9	Variance	0.081	0.071	0.077	0.074	0.081
10	MCSSQ	2248.278	1961.713	2126.763	2039.724	2243.446
11	Euclidean Norm	47.645	44.497	46.336	45.376	47.592
12	Positives	269	269	269	269	269
13	Avg Positive Value	2.885	2.647	2.784	2.717	2.874
	Frequencies					
1	0	27453	27453	27453	27453	27453
2	3	240	191	219	202	242
3	2	27	61	42	58	20
4	1	2	17	8	9	7

Table 32: NHS-C Density Statistics

		Average Value	Total	Std Dev	Avg Wtd Degree
1	Expertise	0.028	776	0.285	4.647
2	Provide Advice	0.026	712	0.266	4.263
3	Seek Advice	0.027	749	0.277	4.485
4	Influence	0.026	731	0.271	4.377
5	Trust	0.028	773	0.284	4.629

Table 33: NHS-K Univariate Statistics

	NHS-K Networks	Expertise	Provide Advice	Seek Advice	Influence	Trust
1	Observations	17556	17556	17556	17556	17556
2	Missing	0	0	0	0	0
3	Minimum	0	0	0	0	0
4	Maximum	3	3	3	3	3
5	Sum	561	511	546	518	567
6	Average	0.032	0.029	0.031	0.03	0.032
7	SSQ	1643	1427	1586	1450	1675
8	Standard Deviation	0.304	0.284	0.299	0.286	0.307
9	Variance	0.093	0.08	0.089	0.082	0.094
10	MCSSQ	1625.073	1412.126	1569.019	1434.716	1656.688
11	Euclidean Norm	40.534	37.776	39.825	38.079	40.927
12	Positives	194	194	194	194	194
13	Avg Positive Value	2.892	2.634	2.814	2.67	2.923
	Frequencies					
1	0	17362	17362	17362	17362	17362
2	3	174	141	168	142	181
3	2	19	35	16	40	11
4	1	1	18	10	12	2
		17556	17556	17556	17556	17556

Table 34: NHS-K Density Statistics

		Average Value	Total	Std Dev	Avg Wtd Degree
1	Expertise	0.032	561	0.304	4.218
2	Provide Advice	0.029	511	0.284	3.842
3	Seek Advice	0.031	546	0.299	4.105
4	Influence	0.03	518	0.286	3.895
5	Trust	0.032	567	0.307	4.263

Table 35: NHS-E Univariate Statistics

	NHS-E Networks	Expertise	Provide Advice	Seek Advice	Influence	Trust
1	Observations	34782	34782	34782	34782	34782
2	Missing	0	0	0	0	0
3	Minimum	0	0	0	0	0
4	Maximum	3	3	3	3	3
5	Sum	803	690	779	728	814
6	Average	0.023	0.02	0.022	0.021	0.023
7	SSQ	2349	1838	2235	2006	2402
8	Standard Deviation	0.259	0.229	0.252	0.239	0.262
9	Variance	0.067	0.052	0.064	0.057	0.069
10	MCSSQ	2330.461	1824.312	2217.553	1990.763	2382.95
11	Euclidean Norm	48.466	42.872	47.276	44.788	49.01
12	Positives	279	279	279	279	279
13	Avg Positive Value	2.878	2.473	2.792	2.609	2.918
	Frequencies					
1	0	34503	34503	34503	34503	34503
2	3	249	163	228	190	259
3	2	26	85	44	69	17
4	1	4	31	7	20	3

Table 36: NHS- E Density Statistics

		Average Value	Total	Std Dev	Avg Wtd Degree
1	Expertise	0.023	803	0.259	4.294
2	Provide Advice	0.02	690	0.229	3.69
3	Seek Advice	0.022	779	0.252	4.166
4	Influence	0.021	728	0.239	3.893
5	Trust	0.023	814	0.262	4.353

D2 Centrality Measures

Next, centrality measures are actor level measures that reflect an actor's activity or involvement within the network (Fang et al., 2015). The ***in-degree centrality*** reports the number of inward-directed ties to an actor and indicates their prominence. In this case, a high in-degree centrality indicates the importance of an actor in being a source of information or advice as other actors refer to them regarding improvement knowledge and the lean methodology. The ***out-degree centrality*** reports the number of outward-directed ties to an actor and indicates their activity in seeking information and advice from actors to exchange knowledge or coordinate with them regarding improvement work. Therefore, high out-degree centrality indicates that an actor is active in reaching out to and seeking knowledge from a high number of actors within the network. As such, network centrality measures provide insight into the network's social fabric and power structure by focusing on the number of important actors, their roles, and an indication of their prominence and influence in the overall network. ***Betweenness centrality*** is a traditional brokering measure that reports the proportion of times an actor is part of the shortest path between two other actors; thus, this actor becomes a mediator for these two actors. A high betweenness centrality indicates that an actor has a higher-than-average capacity to broker relationships among several other actors. More activity and knowledge are shared regarding improvement work knowledge and practices between actors who have a high betweenness centrality score and those connected to them. This network centrality measure identifies important actors and provides a relative indication of their brokering status in the overall network.

D3 Centrality Results

Centrality measures reflect an actor's activity or involvement within the network. It is an actor-level construct that looks at each actor's centrality measures through the number of incoming to or outgoing from an actor. Due to the size of the organisational networks, this information will be aggregated to examine prominence, influence, and brokerage within the network, rather than specifying each actor separately. Table 37 first summarises the non-zero results in each network, accounting for the minimum, maximum, range, and percentage of actors as this provides a relative basis to examine the extent of centrality within the whole network for each organisation.

The ***in-degree centrality*** reports the proportion of inward-directed ties to an actor and indicates their prominence. In this case, a high in-degree centrality indicates the importance of an actor in being a source of information or advice as other actors refer to them regarding improvement work knowledge and the lean methodology. The minimum in-degree centrality for each organisation is 1, which means that at least one person is a source of information and advice regarding improvement work. However, the maximum in-degree varies. NHS-A has an actor with

an in-degree centrality of 27, NHS-C has an actor with an in-degree centrality of 22, and NHS-D & NHS-K have actors with a maximum in-degree of 20. However, NHS-E has an actor with a maximum in-degree of 14, this nearly half as much as NHS-A. The NHS-C, NHS-D and NHS-K results represent 85% of their network, whereas NHS-E and NHS-A have higher results with 91% and 90%, respectively. Overall, these results show that NHS-A's network has a popular actor who is a key source of information or advice; however, when we compare NHS-D and NHS-E, which are similar in size, actors in NHS-E are not as popular sources of information and advice regarding improvement work.

The ***out-degree centrality*** reports the number of outward-directed ties to an actor and indicates their activity in seeking information and advice from actors to exchange knowledge or coordinate with them regarding improvement work. In this case, the minimum out-degree centrality for NHS-A, NHS-D and NHS-C is 1, whereas NHS-K and NHS-E have an out-degree of 2. When examining the maximum outdegree, NHS-E and NHS-C have the highest with 13 and 11, respectively. NHS-K has an actor with a maximum outdegree of 9, whereas NHS-A and NHS-D both have a maximum out-degree of 8. Although NHS-E and NHS-K have relatively higher values, only 33% of their networks are engaged in information-seeking activities, whereas for NHS-A, NHS-D and NHS-C, between 36-38% of their actors are seeking information from other network actors. This result is also aligned with the out-degree, and in-degree centralisation as NHS-E has the highest out-degree and lowest in-degree centralisation. Also, since a high out-degree centrality indicates that an actor is actively seeking information and advice from many actors within the network, NHS-E and NHS-C have some actors who are more active in this regard when compared to NHS-A, NHS-D and NHS-K.

The ***betweenness centrality*** measure identifies important actors and provides a relative indication of their brokering status in the overall network. The result is provided as a score where a high betweenness centrality indicates that an actor has a higher-than-average capacity to broker relationships among several other actors. In this case, NHS-E and NHS-A have the highest score, 1418.1 and 1177.3, respectively. NHS-C and NHS-D have a betweenness result of 972.63 and 937.6, respectively, and NHS-K has the lowest result, 532.8. These results indicate that actors have varying opportunities to broker information from a network perspective and provide insight into the percentage of network actors who can do so. NHS-A and NHS-E have the highest percentage of actors, with 25% and 24%, respectively. NHS-C and NHS-D have slightly lower results, with 23% and 22%, and NHS-K has the lowest result, 16%. From a centrality perspective, there is less brokering activity in NHS-K than the other organisations, which has relatively similar percentages.

Network centrality measures provide insight into the network's social fabric and power structure by focusing on the number of important actors, their roles, and an indication of their prominence and influence in the overall network. Overall, NHS-A, NHS-D, NHS-C and NHS-K have similar centrality measures, as some actors in these networks have higher levels of prominence than NHS-E. This result indicates very popular collaborators within these networks and fewer popular actors in NHS-E. The NHS-A, NHS-D, NHS-C, and NHS-K actors engage in less information-seeking activities than the NHS-E actors. This result indicates that in NHS-A, NHS-D, NHS-C, and NHS-K, most actors are not seeking information from many collaborators but have a smaller group of persons they engage with regarding improvement work. In contrast, in NHS-E, most actors seek information from several collaborators resulting in a broader range of persons collaborating and the decentralised network structure observed from the centralisation measures. Similarly, NHS-E has actors with higher brokering scores than the other trusts, which indicates more opportunities to broker information within the network than the organisations, especially NHS-K, which has the fewest opportunities to do so.

Table 37: Summary of Top 10 Centrality Measures

Top 10 Actors	NHS-A			NHS-D			NHS-C			NHS-K			NHS-E		
Centrality	Min	Max	Range	Min	Max	Range	Min	Max	Range	Min	Max	Range	Min	Max	Range
Indegree	4	27	23	4	20	16	4	22	18	3	20	17	4	14	10
Outdeg	5	8	3	5	8	3	5	11	6	5	9	4	5	13	8
Betweenness	310.3	1177.3	867	206	937.6	731.6	161.57	972.63	811.06	102.2	532.8	430.6	346.9	1418.1	1071.2

Table 38: Detailed Centralisation Results Summary

	NHS-A	NHS-D	NHS-C	NHS-K	NHS-E
Network Outdegree Centralisation	0.026 (2.6%)	0.036 (3.6%)	0.057 (5.7%)	0.058 (5.8%)	0.062 (6.2 %)
Nurses	0.235 (23.5%)	0.105 (10.5%)	0.202 (20.2%)	0.108 (10.8%)	0.161 (16.1%)
Drs & Consultants	0.185 (18.5%)	0.191 (19.1%)	0.077 (7.7%)	0.127 (12.7%)	0.132 (13.2%)
Allied healthcare Professionals	0.143 (14.3%)	0.143 (14.3%)	0.165 (16.5%)	0.101 (10.1%)	0.124 (12.4%)
Non-Clinical & Management	0.221 (22.1%)	0.266 (26.6%)	0.313 (31.3%)	0.314 (31.4%)	0.281 (28.1%)
Network Indegree Centralisation	0.104 (10.4%)	0.103 (10.3%)	0.124 (12.4%)	0.142 (14.2%)	0.068 (6.8%)
Nurses	0.163 (16.3%)	0.140 (14.0%)	0.167 (16.7%)	0.147 (14.7%)	0.095 (9.5%)
Drs & Consultants	0.134 (13.4%)	0.132 (13.2%)	0.039 (3.9%)	0.051 (5.1%)	0.132 (13.2%)
Allied healthcare Professionals	0.062 (6.2%)	0.045 (4.5%)	0.128 (12.8%)	0.064 (6.4%)	0.052 (5.2%)
Non-Clinical & Management	0.262 (26.2%)	0.234 (23.4%)	0.253 (25.3%)	0.186 (18.6%)	0.247 (24.7%)

Table 39: NHS-K Top 10 Centrality Measures in Detail

	NHS-K		Professional Role		Partnership			
		Indegree	**Professional Role**	**Occu Role Class**	**TGT**	**KPO**	**RPIW**	**L4L**
1	***NHSK04***	20	KPO Lead	Non-Clinical MGMT	Yes	Yes	Yes	No
2	***NHSK01***	13	KPO Specialist	Non-Clinical MGMT	Yes	Yes	Yes	No
3	***NHSK03***	10	KPO Specialist	Non-Clinical MGMT	No	Yes	Yes	No
4	***NHSK02***	6	KPO Specialist	Non-Clinical MGMT	No	Yes	Yes	No
5	***NHSK18***	5	Chief Nurse	Nurse	Yes	No	Yes	No
6	***NHSK20***	5	Director of Strategy and Infrastructure	Non-Clinical MGMT	Yes	No	Yes	No
7	NHSK19	4	Change Advisor	Non-Clinical MGMT	No	No	No	Yes
8	NHSK11A05	4	KPO Specialist	Non-Clinical MGMT	No	Yes	Yes	No
9	NHSKL4L018	3	Quality Improvement Fellow	Non-Clinical MGMT	No	No	Yes	Yes
10	NHSK04A03	3	Director of Productivity	Non-Clinical MGMT	No	No	Yes	No
		Betweenness	**Professional Role**	**Occu Role Class**	**TGT**	**KPO**	**RPIW**	**L4L**
1	***NHSK01***	532.8	KPO Specialist	Non-Clinical MGMT	Yes	Yes	Yes	No
2	***NHSK02***	328.1	KPO Specialist	Non-Clinical MGMT	No	Yes	Yes	No
3	***NHSK18***	272.5	Chief Nurse	Nurse	Yes	No	Yes	No
4	***NHSK04***	262.6	KPO Lead	Non-Clinical MGMT	Yes	Yes	Yes	No
5	NHSK15	218.3	Director of IM&T	Non-Clinical MGMT	No	No	Yes	No
6	***NHSK02A02***	150.0	Quality and Safety Lead Nurse	Other Health Pro.	No	No	Yes	Yes
7	***NHSK03***	137.5	KPO Specialist	Non-Clinical MGMT	No	Yes	Yes	No
8	***NHSK14***	122.8	Director of Operations	Non-Clinical MGMT	Yes	No	Yes	No
9	***NHSK09***	116.0	IT Service Delivery	Non-Clinical MGMT	No	No	Yes	Yes
10	***NHSK20***	102.2	Director of Strategy and Infrastructure	Non-Clinical MGMT	Yes	No	Yes	No
		Outdegree	**Professional Role**	**Occu Role Class**	**TGT**	**KPO**	**RPIW**	**L4L**
1	NHSK05a	9	Ex-CEO	Non-Clinical MGMT	Yes	No	No	No
2	NHSK08	8	PMO Manager	Non-Clinical MGMT	No	No	Yes	Yes
3	***NHSK18***	7	Chief Nurse	Nurse	Yes	No	Yes	No
4	NHSK07	7	Service Improvement Facilitator	Non-Clinical MGMT	No	Yes	Yes	Yes
5	NHSK12	6	PMO Support - Programme Management Office	Non-Clinical MGMT	No	No	Yes	Yes
6	NHSK13	6	Associate Medical Director	Drs & Consultants	No	No	Yes	No
7	***NHSK02***	5	KPO Specialist	Non-Clinical MGMT	No	Yes	Yes	No
8	***NHSK02A02***	5	Quality and Safety Lead Nurse	Other Health Pro.	No	No	Yes	Yes
9	***NHSK14***	5	Director of Operations	Non-Clinical MGMT	Yes	No	Yes	No
10	***NHSK09***	5	IT Service Delivery	Non-Clinical MGMT	No	No	Yes	Yes

Table 40: NHS-D Top 10 Centrality Measures in Detail

	NHS-D		Professional Role		Partnership			
		Indegree	**Professional Role**	**Occu Role Class**	**TGT**	**KPO**	**RPIW**	**L4L**
1	***NHSD09***	20	KPO Lead	Non-Clinical MGMT	Yes	Yes	Yes	No
2	***NHSD07***	12	KPO Specialist	Non-Clinical MGMT	No	Yes	Yes	No
3	***NHSD10***	12	KPO Specialist	Non-Clinical MGMT	No	Yes	Yes	Yes
4	***NHSD02A01***	7	KPO Specialist	Non-Clinical MGMT	No	Yes	Yes	No
5	NHSD12	7	CEO	Non-Clinical MGMT	Yes	No	No	No
6	***NHSD05***	6	CMO - Chief Medical Officer	Drs & Consultant	Yes	No	No	No
7	NHSD10A06	5	Deputy Head of Nursing	Nurse	No	No	Yes	No
8	NHSD11A04	5	Clinical Director	Drs & Consultant	No	No	No	No
9	NHSD02	4	KPO Facilitator/Specialist	Non-Clinical MGMT	No	Yes	No	No
10	NHSD03	4	KPO Business Admin	Non-Clinical MGMT	No	No	No	No
		Betweenness	**Professional Role**	**Occu Role Class**	**TGT**	**KPO**	**RPIW**	**L4L**
1	***NHSD09***	937.6	KPO Lead	Non-Clinical MGMT	Yes	Yes	Yes	No
2	***NHSD10***	874.4	KPO Specialist	Non-Clinical MGMT	No	Yes	Yes	No
3	***NHSD05***	624.0	CMO - Chief Medical Officer	Drs & Consultant	Yes	No	No	Yes
4	***NHSD07***	437.4	KPO Specialist	Non-Clinical MGMT	No	Yes	Yes	No
5	***NHSDL4L007***	375.0	Director of Quality	Non-Clinical MGMT	No	No	No	Yes
6	***NHSD11***	270.5	Finance Director	Non-Clinical MGMT	Yes	No	No	No
7	***NHSD10A04***	266.0	Clinical Director (CSU)	Drs & Consultant	No	No	Yes	Yes
8	NHSDL4L028	248.0	Clinical Director	Drs & Consultant	No	No	No	Yes
9	***NHSD02A01***	222.9	KPO Specialist	Non-Clinical MGMT	No	Yes	Yes	Yes
10	***NHSD11A02***	206.0	General Manager	Non-Clinical MGMT	No	No	No	Yes
		Outdegree	**Professional Role**	**Occu Role Class**	**TGT**	**KPO**	**RPIW**	**L4L**
1	***NHSD09***	8	KPO Lead	Non-Clinical MGMT	Yes	Yes	Yes	No
2	NHSD14	7	KPO Specialist	Non-Clinical MGMT	No	Yes	Yes	Yes
3	***NHSD10***	6	KPO Specialist	Non-Clinical MGMT	No	Yes	Yes	No
4	***NHSD05***	6	CMO - Chief Medical Officer	Drs & Consultant	Yes	No	No	Yes
5	***NHSDL4L007***	5	Director of Quality	Non-Clinical MGMT	No	No	No	Yes
6	***NHSD11***	5	Finance Director	Non-Clinical MGMT	Yes	No	No	No
7	***NHSD10A04***	5	Clinical Director (CSU)	Drs & Consultant	No	No	Yes	Yes
8	***NHSD02A01***	5	KPO Specialist	Non-Clinical MGMT	No	Yes	Yes	Yes
9	***NHSD11A02***	5	General Manager	Non-Clinical MGMT	No	No	No	Yes
10	NHSD07A04	5	Senior Pharmacist	Other Health Pro.	No	No	Yes	Yes

Table 41: NHS-A Top 10 Centrality Measures in Detail

	NHS-A		Professional Role		Partnership			
		Indegree	**Professional Role**	**Occu Role Class**	**TGT**	**KPO**	**RPIW**	**L4L**
1	***NHSA08***	27	KPO Lead	Non-Clinical MGMT	Yes	No	Yes	Yes
2	NHSA02A6	12	Chief of Medicine	Drs & Consultants	No	No	No	Yes
3	***NHSA02***	10	KPO Specialist	Non-Clinical MGMT	No	No	No	No
4	***NHSA01***	8	Medical Director	Drs & Consultants	No	Yes	Yes	No
5	NHSA06	6	KPO Facilitator	Non-Clinical MGMT	No	No	Yes	No
6	NHSA07	5	KPO Facilitator/Surgery service delivery coordinator	Non-Clinical MGMT	No	Yes	Yes	Yes
7	***NHSA12***	5	HR Business Partner	Non-Clinical MGMT	No	No	No	Yes
8	NHSALA093	5	Physicians Associate (L4L graduate)	Drs & Consultants	No	No	No	No
9	***NHSA03***	4	KPO Specialist	Non-Clinical MGMT	No	Yes	Yes	Yes
10	NHSA05A2	4	COO	Non-Clinical MGMT	No	Yes	Yes	Yes
		Betweenness	**Professional Role**	**Occu Role Class**	**TGT**	**KPO**	**RPIW**	**L4L**
1	***NHSA08***	1177.3	KPO Lead	Non-Clinical MGMT	Yes	Yes	Yes	Yes
2	***NHSA02***	894.9	KPO Specialist	Non-Clinical MGMT	No	Yes	Yes	No
3	***NHSA03***	862.6	KPO Specialist	Non-Clinical MGMT	No	Yes	Yes	Yes
4	***NHSA01***	643.6	Medical Director	Drs & Consultants	Yes	No	Yes	Yes
5	NHSA03A4	502.0	Ophthalmology Service Manager	Non-Clinical MGMT	No	No	No	Yes
6	***NHSAL4L31***	472.2	Medical secretary to palliative care team	Non-Clinical MGMT	No	No	No	Yes
7	***NHSA12***	325.8	HR Business Partner	Non-Clinical MGMT	No	No	No	No
8	***NHSA05***	324.7	Chief Nurse	Nurse	Yes	No	No	No
9	***NHSAL4L41***	315.0	SDC	Other Health Pro.	No	No	No	Yes
10	***NHSA11A2***	310.3	Divisional Chief Nurse Medicine	Nurse	No	No	Yes	Yes
		Outdegree	**Professional Role**	**Occu Role Class**	**TGT**	**KPO**	**RPIW**	**L4L**
1	***NHSA03***	8	KPO Specialist	Non-Clinical MGMT	No	Yes	Yes	Yes
2	***NHSAL4L31***	8	Medical secretary to palliative care team	Non-Clinical MGMT	No	No	No	Yes
3	***NHSA01***	7	Medical Director	Drs & Consultants	Yes	No	Yes	Yes
4	NHSA13	7	Head of Library Services and Knowledge Management	Non-Clinical MGMT	No	No	No	Yes
5	***NHSA02***	6	KPO Specialist	Non-Clinical MGMT	No	Yes	Yes	No
6	NHSA10	6	Clinical Lead (stroke)	Drs & Consultants	No	No	No	Yes
7	***NHSA12***	5	HR Business Partner	Non-Clinical MGMT	No	No	No	No
8	***NHSA05***	5	Chief Nurse	Nurse	Yes	No	No	No
9	***NHSAL4L41***	5	SDC	Other Health Pro.	No	No	No	Yes
10	***NHSA11A2***	5	Divisional Chief Nurse Medicine	Nurse	No	No	Yes	Yes

Table 42: NHS-E Top 10 Centrality Measures in Detail

	NHS-E		Professional Role		Partnership			
		Indegree	**Professional Role**	**Occu Role Class**	**TGT**	**KPO**	**RPIW**	**L4L**
1	NHSE17	14	KPO Lead	Non-Clinical MGMT	Yes	Yes	Yes	No
2	***NHSE03***	10	KPO Specialist	Non-Clinical MGMT	No	Yes	Yes	Yes
3	***NHSE02***	8	KPO Specialist	Non-Clinical MGMT	No	Yes	Yes	Yes
4	***NHSE13***	8	Ass. Med Director/Consultant	Drs & Consultants	No	No	Yes	No
5	***NHSEL4L10A04***	7	Senior KPO Specialist	Non-Clinical MGMT	No	No	Yes	Yes
6	NHSE05	6	KPO	Non-Clinical MGMT	No	Yes	Yes	No
7	***NHSE11***	6	Head of Procurement	Non-Clinical MGMT	No	No	Yes	Yes
8	***NHSE12***	5	Deputy COO	Non-Clinical MGMT	No	No	Yes	No
9	***NHSE01***	4	KPO Specialist	Non-Clinical MGMT	No	Yes	Yes	No
10	NHSELA066	4	Centre Manager/CCH therapy manager	Non-Clinical MGMT	No	No	No	No
		Betweenness	**Professional Role**	**Occu Role Class**	**TGT**	**KPO**	**RPIW**	**L4L**
1	***NHSE03***	1418.1	KPO Specialist	Non-Clinical MGMT	No	Yes	Yes	Yes
2	***NHSEL4L10A04***	684.3	Senior KPO Specialist	Non-Clinical MGMT	No	No	Yes	Yes
3	NHSE10	620.0	Corporate Gov. Director	Non-Clinical MGMT	No	No	No	No
4	***NHSE14***	590.3	Clinical Director (ENT/maxillofacial/oral) - ENT Clinical Lead	Drs & Consultants	No	No	No	Yes
5	***NHSE13***	519.8	Ass. Med Director/Consultant	Drs & Consultants	No	No	Yes	No
6	***NHSE01***	483.9	KPO Specialist	Non-Clinical MGMT	No	Yes	Yes	No
7	***NHSE11***	456.8	Head of Procurement	Non-Clinical MGMT	No	No	Yes	Yes
8	***NHSE12***	389.3	Deputy COO	Non-Clinical MGMT	No	No	Yes	No
9	NHSE10A01	369.3	Head of Facilities - Facilities Directorate	Non-Clinical MGMT	No	No	No	Yes
10	***NHSE02***	346.9	KPO Specialist	Non-Clinical MGMT	No	Yes	Yes	Yes
		Outdegree	**Professional Role**	**Occu Role Class**	**TGT**	**KPO**	**RPIW**	**L4L**
1	***NHSE03***	13	KPO Specialist	Non-Clinical MGMT	No	Yes	Yes	Yes
2	***NHSE11***	8	Head of Procurement	Non-Clinical MGMT	No	No	Yes	Yes
3	NHSE16	8	Care Group Medical Director	Drs & Consultants	Yes	No	Yes	No
4	***NHSE12***	7	Deputy COO	Non-Clinical MGMT	No	No	Yes	No
5	NHSE09	7	CEO	Non-Clinical MGMT	No	No	No	Yes
6	***NHSE14***	6	Clinical Director (ENT/maxillofacial/oral) - ENT Clinical Lead	Drs & Consultants	No	No	No	Yes
7	***NHSE02***	6	KPO Specialist	Non-Clinical MGMT	No	Yes	Yes	Yes
8	NHSEL4L28	6	Senior Cleanliness Manager	Non-Clinical MGMT	No	No	Yes	Yes
9	***NHSEL4L10A04***	5	Senior KPO Specialist	Non-Clinical MGMT	No	No	Yes	Yes
10	***NHSE13***	5	Ass. Med Director/Consultant	Drs & Consultants	No	No	Yes	No

Table 43: NHS-C Top 10 Centrality Measures in Detail

	NHS-C		Professional Role		Partnership			
		Indegree	**Professional Role**	**Occu Role Class**	**TGT**	**KPO**	**RPIW**	**L4L**
1	***NHSC21***	22	KPO Lead Nurse	Non-Clinical MGMT	Yes	Yes	Yes	No
2	***NHSC20***	16	KPO Lead	Non-Clinical MGMT	Yes	Yes	Yes	No
3	***NHSC03***	9	KPO Specialist	Non-Clinical MGMT	No	Yes	Yes	No
4	NHSC10	9	KPO Specialist + OPS	Non-Clinical MGMT	No	Yes	Yes	No
5	***NHSC18***	9	KPO Specialist/Advanced Nurse Practitioner	Non-Clinical MGMT	No	Yes	Yes	No
6	***NHSC15***	7	Head of Patient Safety	Other Health Pro.	No	No	Yes	No
7	***NHSC07***	6	CMO	Non-Clinical MGMT	Yes	No	No	No
8	***NHSC14***	5	Associate Director of Quality & Safety	Non-Clinical MGMT	No	No	Yes	No
9	NHSC02A03	4	Modern Matron - Theatres	Nurse	No	No	Yes	Yes
10	NHSC08	4	CEO	Non-Clinical MGMT	Yes	No	No	No
		Betweenness	**Professional Role**	**Occu Role Class**	**TGT**	**KPO**	**RPIW**	**L4L**
1	***NHSC21***	972.63	KPO Lead Nurse	Non-Clinical MGMT	Yes	Yes	Yes	No
2	***NHSC15***	492.87	Head of Patient Safety	Other Health Pro.	No	No	Yes	No
3	NHSC11A05	346.00	Associate Director of Nursing Quality & Patient Safety	Nurse	No	No	Yes	Yes
4	***NHSC06A05***	321.33	Modern Matron - Clinical Support Group OPD	Nurse	No	No	Yes	Yes
5	***NHSC14***	315.48	Associate Director of Quality & Safety	Non-Clinical MGMT	No	No	Yes	No
6	***NHSC20***	289.48	KPO Lead	Non-Clinical MGMT	Yes	Yes	Yes	No
7	***NHSC11***	180.17	Exec CWIO	Non-Clinical MGMT	Yes	No	No	No
8	***NHSC18***	176.65	KPO Specialist/Advanced Nurse Practitioner	Non-Clinical MGMT	No	Yes	Yes	No
9	***NHSC07***	169.20	CMO	Non-Clinical MGMT	Yes	No	No	No
10	***NHSC03***	161.57	KPO Specialist	Non-Clinical MGMT	No	Yes	Yes	No
		Outdegree	**Professional Role**	**Occu Role Class**	**TGT**	**KPO**	**RPIW**	**L4L**
1	NHSC01	11	KPO Admin	Non-Clinical MGMT	No	Yes	No	Yes
2	***NHSC11***	8	Exec CWIO	Non-Clinical MGMT	Yes	No	No	No
3	NHSC02	8	Anaesthetist Consultant	Drs & Consultants	No	No	Yes	Yes
4	***NHSC21***	7	KPO Lead Nurse	Non-Clinical MGMT	Yes	Yes	Yes	No
5	NHSC19	7	KPO + CA - Consultant Anaesthetist	Non-Clinical MGMT	No	Yes	Yes	No
6	NHSC12	6	Chief Workforce and Information Officer, Deputy Chief Executive Officer	Non-Clinical MGMT	Yes	No	No	Yes
7	NHSC09	6	Chief Finance & Strategy Officer	Non-Clinical MGMT	Yes	No	No	No
8	***NHSC15***	5	Head of Patient Safety	Other Health Pro.	No	No	Yes	No
9	***NHSC06A05***	5	Modern Matron - Clinical Support Group OPD	Nurse	No	No	Yes	Yes
10	***NHSC14***	5	Associate Director of Quality & Safety	Non-Clinical MGMT	No	No	Yes	No

Bolded ID numbers indicate duplicated actors.

D4 Gould & Fernandez Brokering Roles in Detail

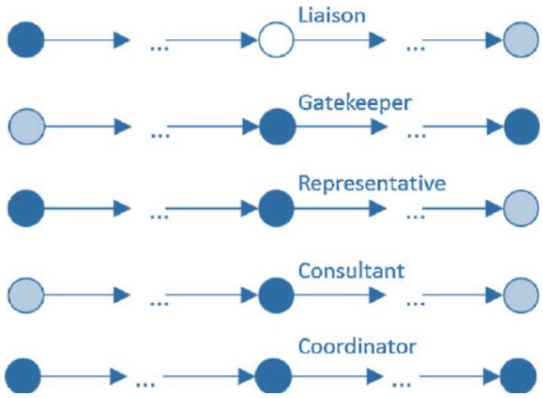


Figure 26: Graphical Representation of Gould & Fernandez Five Network Roles

Although useful, betweenness centrality does not distinguish actors' ties in the same or different groups. This distinction is crucial as it has varying implications regarding the nature and outcomes of improvement work and knowledge-sharing initiatives. Gould and Fernandez (1989) conceptualize five brokerage roles: *coordinator, gatekeeper, representative, consultant, and liaison* (See figure X), which examine group membership and tie direction in brokering relationships. This categorisation specifies the internal and external information flows and brokering activities within and outside professional groups and sheds light on relational mechanisms such as bridging and closure. The coordinator and gatekeeper have an internal orientation and can foster closure within professional groups, as they focus on information and advice flows to individuals within their professional group. In contrast, the representative, consultant and liaison roles are externally orientated as they share information and advice about improvement work outside of their professional group. This external orientation would be associated with sharing information and advice to introduce and embed new practices in other professional groups.

Since an actor can simultaneously fulfil more than one role, all brokering roles and scores are identified, and then all the unique actors performing multiple roles are extracted. The counts of these actors are aggregated so that the internal and external brokering roles are compared within the network (See Table 44-48). Second, by extracting the individual brokers, brokering behaviours within the organisations can be examined based on professional group membership (See Table 49-53). Of interest here are the professional groups engaged in these brokering roles and the extent to which they are present within each network.

Coordinators broker information and advice to individuals within their professional group, for example, a nurse sharing improvement work information with two other nurses. In this case, coordinator roles are commonly performed by non-clinical management professional, as this has the highest number among the networks. Among the clinical professionals, nurses perform this role more than doctors and allied healthcare professionals, especially in NHS-A and NHS-C. This

result indicates higher intra-group brokering and cohesion among non-clinical management professionals in NHS-D, NHS-K and NHS-E. Similarly, there is higher group brokering and cohesion among nurses in NHS-A and NHS-C. The coordinator role is not performed by any of the clinical professionals in NHS-K, by nurses in NHS-E or by doctors and allied healthcare professionals in NHS-C. Comparatively, this result indicates that there is no intra-group brokering among these clinical professionals in these NHS-C, NHS-K and NHS-E.

The gatekeeper, the second internally-oriented brokering role, acquires and screens knowledge from external sources and transfers this to an actor within their division. This role is performed more by non-clinical professionals in all the organisations except NHS-A, where most clinical professionals, particularly nurses, perform this role. This result indicates higher inter-group brokering among clinical professionals in NHS-A and higher inter-group brokering among non-clinical professionals in the other organisations.

Next are the representative, consultant, and liaison roles; these three roles have an external orientation as they share improvement work information with professionals outside of their group and expose themselves to other groups' knowledge. A representative provides information and advice regarding improvement work to an actor in another professional group. For example, a therapist represents their professional group by sharing information and advice about improvement work with doctors or nurses to collaborate better between these professional groups. In NHS-A, clinical professionals mostly perform this role, specifically nurses; and in NHS-D, this role is performed equally by clinical and non-clinical professionals. However, in NHS-C, NHS-K and NHS-E, it is mostly performed by non-clinical management professionals. Like the coordinator role, it is not performed by any clinical professionals in NHS-K. This result indicates high intergroup brokering levels among NHS-A nurses and both clinical and non-clinical professionals in NHS-D. In NHS-K and NHS-E, non-clinical management professionals are more active representatives. These actors actively represent their professional group and share information about improvement work with other professional groups.

The consultant transfers improvement work knowledge between actors who belong to the same group; however, they are not members of the group. For example, a non-clinical management professional may broker improvement work knowledge between two nurses instead of the nurses collaborating directly. Clinical professionals mostly perform the consultant role in the networks, except NHS-C, where non-clinical management professional mostly perform this brokering role. In NHS-A and NHS-E, it is mostly performed by doctors, and in NHS-K, it is performed by doctors and nurses. It is somewhat equally performed in NHS-D; however, it is mostly performed by doctors within the clinical group. Overall, the consultant role, which

facilitates inter-group brokering to actors in the same professional group, is common among clinical professionals, mostly doctors, than non-clinical professionals.

Finally, a liaison acts as a broker where none of the actors belongs to the same professional group; for example, a non-clinical management professional may broker improvement work knowledge between a nurse and a doctor. The liaison role supports collaboration among distinct professional groups and is performed somewhat equally by clinical and non-clinical professionals in NHS-D, NHS-C and NHS-K. However, in NHS-E, it is mostly performed by non-clinical management professionals, and in NHS-A, it is mostly performed by clinical professionals.

In summary, the coordinator role was the most common brokering role for NHS-A, NHS-D and NHS-C. The coordinator and gatekeeper roles were performed somewhat equally in NHS-E. These results indicate higher degrees of intra-group brokering within these networks and higher degrees of information coming within a professional group than being shared outside of it.

In NHS-A, NHS-D, NHS-C and NHS-E, the consultant role was the least observed brokering role, and this indicates a decreased tendency for a professional to share information with actors from the same professional group. NHS-K is different from the other networks in this regard as the coordinator, and representative roles were least observed, and the gatekeeper, consultant and liaison roles were equally observed. This result indicates a lower degree of intra-group brokering among clinical professionals and higher intergroup brokering degrees among non-clinical management professionals within this network.

At the network level, NHS-C has the highest percentage of actors performing a brokering role, 60%, where 37% are non-clinical management professionals. In NHS-E, 57% of the network performs a brokering role, and 36% are non-clinical management professionals. NHS-D and NHS-K have relatively fewer actors, 48% and 43%, respectively, and 29% of actors are non-clinical management professionals. Most brokering roles are performed by non-clinical management professionals in all the organisations except NHS-A, where clinicians perform 31% of brokering roles, accounting for 54% of the network. This result is unique, indicating that clinical actors are more active regarding brokering improvement information than other organisations.

When partnership roles are examined, the TGT and KPO actors make up 4-6% of brokering roles within the network. This small percentage is expected as these actors make up less than 10% of the overall network. However, this result varies at the L4L and RPIW level. In NHS-A and NHS-E, 23% of L4L and RPIW actors are in brokering roles, and NHS-C and NHS-D have 20% and 17%, respectively. NHS-K has only 7% in comparison, indicating that actors trained in the lean method are less likely to broker information about improvement work within this network.

Finally, when we compare betweenness centrality measures (See Appendix D3) and the brokering roles observed within the network, there are apparent differences, as the Gould &

Fernandez roles detect double and nearly triple the extent of brokering activities in the organisational networks. Centrality examining brokering based on actors' positions, whereas the Gould & Fernandez brokering roles examine intergroup and intragroup brokering behaviours. Therefore, this approach allows this research to analyse relational mechanisms, such as brokerage patterns and the direction of relationships between groups in networks, to generate additional insight into the processes underly the institutionalisation of new practices and micro-institutional change processes more broadly.

Table 44: NHS-K Relative Brokerage Scores

	ID	Professional Role	Coordinator	Gatekeeper	Representative	Consultant	Liaison	Total
1	NHSK02A02	Nurses	0	2.03	0	1.015	1.394	1
2	NHSK14	Nurses	0	0	0	3.947	0.774	1
3	NHSKL4L022	Nurses	0	1.015	0	2.03	1.394	1
4	NHSK10	Nurses	0	0	0	5.074	0	1
5	NHSKL4L018	Doctors	0	0	0	5.074	0	1
6	NHSK15	Doctors	0	1.691	0	1.691	1.161	1
7	NHSK19	Doctors	0	1.691	0	0.564	1.936	1
8	NHSK18A03	Allied healthcare Professionals	0	2.537	0	2.537	0	1
9	NHSK09	Allied healthcare Professionals	0	0	0	0	3.484	1
10	NHSK12	Non-Clinical MGMT	8.21	0	0	0	0	1
11	NHSK01	Non-Clinical MGMT	2.603	2.228	0.619	0.248	0.255	1
12	NHSK02	Non-Clinical MGMT	1.825	0.564	2.255	0.564	0.387	1
13	NHSK03	Non-Clinical MGMT	3.681	1.05	1.225	0	0.36	1
14	NHSK07	Non-Clinical MGMT	5.865	0	1.45	0	0	1
15	NHSK04	Non-Clinical MGMT	3.284	1.384	1.107	0.092	0.317	1
16	NHSKL4L011	Non-Clinical MGMT	4.105	0	2.537	0	0	1
17	NHSK08	Non-Clinical MGMT	4.561	0	2.255	0	0	1
18	NHSK17	Non-Clinical MGMT	0	3.045	0	0	1.394	1
19	NHSK18	Non-Clinical MGMT	3.284	1.353	1.015	0.338	0.232	1
20	NHSK20	Non-Clinical MGMT	1.729	0.267	2.938	0.534	0.183	1
21	NHSKL4L003	Non-Clinical MGMT	0	5.074	0	0	0	1
	Total Brokers		**10**	**13**	**9**	**13**	**13**	

(raw scores divided by randomization expected values given group sizes)

Table 45: NHS-D Relative Brokerage Scores

	ID	Professional Role	Coordinator	Gatekeeper	Representative	Consultant	Liaison	Total
1	NHSDL4L011	Nurses	8.032	0	0	0	0	1
2	NHSD10A06	Nurses	1.205	2.824	0.513	0.513	0.343	1
3	NHSDL4L013	Nurses	4.016	0	2.567	0	0	1
4	NHSDL4L042	Doctors	0	0	2.567	2.567	0	1
5	NHSD10A04	Doctors	0	4.107	0	0	0.687	1
6	NHSDL4L008	Doctors	0	0	0	0	3.434	1
7	NHSDL4L028	Doctors	1.147	1.467	0.733	0.733	0.981	1
8	NHSD05	Doctors	0	0	0.7	4.434	0	1
9	NHSDL4L036	Doctors	0	5.134	0	0	0	1
10	NHSDL4L051	Doctors	0	0	5.134	0	0	1
11	NHSD07A04	OHP	3.707	1.58	0.79	0	0.264	1
12	NHSDL4L023	OHP	0	0	5.134	0	0	1
13	NHSDL4L039	OHP	2.008	1.284	1.284	1.284	0	1
14	NHSDL4L003	OHP	0	0	5.134	0	0	1
15	NHSDL4L015	OHP	5.737	0	1.467	0	0	1
16	NHSD08	Non-Clinical MGMT	0	4.107	0	0	0.687	1
17	NHSD12	Non-Clinical MGMT	4.016	1.027	1.54	0	0	1
18	NHSD03	Non-Clinical MGMT	8.032	0	0	0	0	1
19	NHSD07	Non-Clinical MGMT	0.643	0.821	3.286	0	0.412	1
20	NHSD02A04	Non-Clinical MGMT	8.032	0	0	0	0	1
21	NHSDL4L024	Non-Clinical MGMT	0	5.134	0	0	0	1
22	NHSD02A01	Non-Clinical MGMT	8.032	0	0	0	0	1
23	NHSD11	Non-Clinical MGMT	4.381	0	2.334	0	0	1
24	NHSD06	Non-Clinical MGMT	5.355	0	1.711	0	0	1
25	NHSD11A02	Non-Clinical MGMT	1.606	1.027	2.054	0	0.687	1
26	NHSD02	Non-Clinical MGMT	8.032	0	0	0	0	1
27	NHSDL4L006	Non-Clinical MGMT	1.606	0	4.107	0	0	1
28	NHSD14	Non-Clinical MGMT	8.032	0	0	0	0	1
29	NHSDL4L038	Non-Clinical MGMT	1.606	4.107	0	0	0	1
30	NHSDL4L016	Non-Clinical MGMT	3.57	2.852	0	0	0	1
31	NHSD04	Non-Clinical MGMT	8.032	0	0	0	0	1
32	NHSDL4L029	Non-Clinical MGMT	8.032	0	0	0	0	1
33	NHSDL4L030	Non-Clinical MGMT	4.016	0	2.567	0	0	1
34	NHSD10	Non-Clinical MGMT	3.514	0.428	2.246	0.107	0.072	1
35	NHSDL4L040	Non-Clinical MGMT	2.677	0	3.423	0	0	1
36	NHSDL4L043	Non-Clinical MGMT	0	5.134	0	0	0	1
37	NHSDL4L044	Non-Clinical MGMT	0	0	0	5.134	0	1
38	NHSDL4L007	Non-Clinical MGMT	1.785	1.711	1.141	0.57	0.382	1
39	NHSD09	Non-Clinical MGMT	3.375	0.69	1.898	0.173	0.144	1
	Total Brokers		**27**	**17**	**22**	**9**	**11**	

(raw scores divided by randomization expected values given group sizes)

Table 46: NHS-A Relative Brokerage Scores

	ID	Professional Role	Coordinator	Gatekeeper	Representative	Consultant	Liaison	Total
1	NHSALA157	Nurses	9.937	0	0	0	0	1
2	NHSAL4L26	Nurses	4.969	0	2.504	0	0	1
3	NHSA05	Nurses	0	0	0	2.146	1.903	1
4	NHSAL4L15	Nurses	3.312	0	3.339	0	0	1
5	NHSA11	Nurses	0	2.003	0	1.002	1.332	1
6	NHSA11A2	Nurses	3.975	1.669	1.002	0	0.222	1
7	NHSAL4L56	Nurses	0	5.008	0	0	0	1
8	NHSAL4L02	Nurses	0	0	5.008	0	0	1
9	NHSAL4L07	Nurses	3.975	0	3.005	0	0	1
10	NHSAL4L50	Nurses	3.312	0	3.339	0	0	1
11	NHSAL4L21	Nurses	0	0	5.008	0	0	1
12	NHSAL4L59	Nurses	0	3.756	0	0	0.832	1
13	NHSAL4L22	Nurses	0	0	2.862	0	1.427	1
14	NHSAL4L23	Nurses	4.969	2.504	0	0	0	1
15	NHSALA153	Nurses	0	5.008	0	0	0	1
16	NHSAL4L66	Nurses	3.312	0	3.339	0	0	1
17	NHSALA040	Nurses	7.95	0	1.002	0	0	1
18	NHSA10	Doctors	0	0	0	1.669	2.22	1
19	NHSAL4L52	Doctors	0	0	5.008	0	0	1
20	NHSAL4L09	Doctors	0	0	0	5.008	0	1
21	NHSAL4L36	Doctors	0	3.005	0	2.003	0	1
22	NHSA01	Doctors	0	1.593	0.455	1.024	1.287	1
23	NHSAL4L57	Doctors	1.242	0.626	1.878	0.626	0.832	1
24	NHSA01A1	Doctors	0	1.002	2.003	2.003	0	1
25	NHSAL4L51	Doctors	0	1.431	0	1.431	1.427	1
26	NHSAL4L33	OHP	0	0	5.008	0	0	1
27	NHSA10A3	OHP	0	2.504	0	2.504	0	1
28	NHSAL4L04	OHP	8.281	0	0.835	0	0	1
29	NHSAL4L34	OHP	0	5.008	0	0	0	1
30	NHSAL4L47	OHP	5.962	0	2.003	0	0	1
31	NHSAL4L41	OHP	0	0	0	2.003	1.998	1
32	NHSAL4L35	OHP	0	0	5.008	0	0	1
33	NHSA10A2	OHP	2.484	1.252	1.252	1.252	0	1
34	NHSAL4L43	OHP	0	0	0	1.252	2.497	1
35	NHSA11A5	OHP	1.987	1.002	2.003	0	0.666	1
36	NHSA04	Non-Clinical	9.937	0	0	0	0	1
37	NHSA09	Non-Clinical	9.937	0	0	0	0	1
38	NHSAL4L14	Non-Clinical	7.453	0	1.252	0	0	1
39	NHSAL4L29	Non-Clinical	0	2.504	0	0	1.665	1
40	NHSAL4L39	Non-Clinical	0	0	0	5.008	0	1
41	NHSAL4L63	Non-Clinical	4.417	2.782	0	0	0	1
42	NHSAL4L17	Non-Clinical	0	5.008	0	0	0	1
43	NHSA03	Non-Clinical	1.987	0	4.006	0	0	1
44	NHSA13	Non-Clinical	6.625	0	1.669	0	0	1
45	NHSA14	Non-Clinical	9.937	0	0	0	0	1
46	NHSA12A3	Non-Clinical	3.312	0	3.339	0	0	1
47	NHSA08	Non-Clinical	2.599	2.003	0.77	0.308	0.41	1
48	NHSA06	Non-Clinical	1.046	1.581	1.581	0.264	0.701	1
49	NHSAL4L48	Non-Clinical	0	0	5.008	0	0	1
50	NHSA02	Non-Clinical	4.077	1.926	0.642	0.257	0.085	1
51	NHSAL4L27	Non-Clinical	9.937	0	0	0	0	1
52	NHSA03A4	Non-Clinical	2.484	0	3.756	0	0	1
53	NHSAL4L31	Non-Clinical	1.371	1.9	0.691	0.518	0.804	1
54	NHSAL4L32	Non-Clinical	1.656	4.173	0	0	0	1
55	NHSAL4L03	Non-Clinical	6.625	0	1.669	0	0	1
56	NHSA05A5	Non-Clinical	0	3.756	0	0	0.832	1
57	NHSA07	Non-Clinical	1.242	4.382	0	0	0	1
58	NHSAL4L11	Non-Clinical	4.969	0	2.504	0	0	1
59	NHSA12	Non-Clinical	3.478	1.502	1.252	0	0.333	1
60	NHSA12A4	Non-Clinical	9.937	0	0	0	0	1
61	NHSAL4L19	Non-Clinical	9.937	0	0	0	0	1
	Total Brokers		**35**	**26**	**33**	**18**	**19**	

(raw scores divided by randomization expected values given group sizes)

Table 47: NHS-E Relative Brokerage Scores

	ID	Professional Role	Coordinator	Gatekeeper	Representative	Consultant	Liaison	Total
1	NHSE01A04	Nurses	0	4.068	0	1.017	0	1
2	NHSEL4L14	Nurses	0	4.068	0	1.017	0	1
3	NHSE06	Nurses	0	3.39	0	0	1.307	1
4	NHSEL4L48	Nurses	0	0	0	5.085	0	1
5	NHSEL4L22	Nurses	0	3.814	0	0	0.98	1
6	NHSE03A02	Doctors	0	3.814	0	0	0.98	1
7	NHSE14	Doctors	0.645	1.017	2.034	1.017	0.392	1
8	NHSE13	Doctors	0.538	1.554	0.848	2.26	0	1
9	NHSEL4L26	Doctors	0	0	0	2.034	2.352	1
10	NHSE16	Doctors	0	0	0	4.359	0.56	1
11	NHSEL4L08	Doctors	0	0	0	2.543	1.96	1
12	NHSEL4L32	OHP	0	0	5.085	0	0	1
13	NHSEL4L34	OHP	3.872	2.034	0	0	0	1
14	NHSEL4L49	OHP	0	1.271	0	2.543	0.98	1
15	NHSEL4L50	OHP	3.227	2.543	0	0	0	1
16	NHSEL4L05	OHP	6.453	0	0	0	0	1
17	NHSEL4L30	OHP	3.227	0	2.543	0	0	1
18	NHSE12A01	OHP	0	0	0	3.39	1.307	1
19	NHSEL4L18	OHP	6.453	0	0	0	0	1
20	NHSE10A01	Non-Clinical	5.163	0	1.017	0	0	1
21	NHSE08A02	Non-Clinical	4.302	0	1.695	0	0	1
22	NHSEL4L13	Non-Clinical	6.453	0	0	0	0	1
23	NHSEL4L28	Non-Clinical	5.378	0	0.848	0	0	1
24	NHSE03	Non-Clinical	3.696	0.925	1.017	0.092	0.107	1
25	NHSE02	Non-Clinical	2.868	1.507	0.942	0.188	0.145	1
26	NHSE04A02	Non-Clinical	2.766	2.906	0	0	0	1
27	NHSE05	Non-Clinical	2.766	1.695	0.726	0	0.373	1
28	NHSEL4L43	Non-Clinical	0	0	5.085	0	0	1
29	NHSE08	Non-Clinical	3.227	2.543	0	0	0	1
30	NHSE09	Non-Clinical	3.442	0.678	1.017	0.339	0.261	1
31	NHSEL4L06	Non-Clinical	0	3.39	0	0	1.307	1
32	NHSE03A06	Non-Clinical	6.453	0	0	0	0	1
33	NHSE12	Non-Clinical	3.227	1.865	0.509	0	0.131	1
34	NHSEL4L45	Non-Clinical	0	2.543	0	1.271	0.98	1
35	NHSE10	Non-Clinical	5.531	0	0.726	0	0	1
36	NHSEL4L36	Non-Clinical	0	3.814	0	0	0.98	1
37	NHSE15	Non-Clinical	3.227	2.543	0	0	0	1
38	NHSE11	Non-Clinical	5.253	0.946	0	0	0	1
39	NHSE07	Non-Clinical	1.613	0.848	2.119	0.424	0.327	1
40	NHSEL4L03	Non-Clinical	0	0	5.085	0	0	1
41	NHSEL4L09	Non-Clinical	6.453	0	0	0	0	1
42	NHSEL4L10A04	Non-Clinical	4.163	0.984	0.492	0	0.253	1
43	NHSEL4L15	Non-Clinical	6.453	0	0	0	0	1
44	NHSE14A05	Non-Clinical	0	2.543	0	0	1.96	1
45	NHSE01	Non-Clinical	0.922	2.906	0.726	0.363	0.28	1
	Total Brokers		**27**	**26**	**18**	**16**	**21**	

(raw scores divided by randomization expected values given group sizes)

Table 48: NHS-C Relative Brokerage Scores

	ID	Professional Role	Coordinator	Gatekeeper	Representative	Consultant	Liaison	Total
1	NHSCL4L031	Nurses	9.56	0	0	0	0	1
2	NHSC02A03	Nurses	0.637	0.979	0.979	0.652	1.417	1
3	NHSC10A05	Nurses	2.39	1.223	2.446	0	0	1
4	NHSC05A02	Nurses	0	0	0	4.893	0	1
5	NHSC06A05	Nurses	0	3.669	0	0.612	0.443	1
6	NHSC11A05	Nurses	3.414	2.097	0.699	0	0.253	1
7	NHSCL4L021	Nurses	1.912	0.489	1.957	0	1.063	1
8	NHSCL4L023	Nurses	6.373	0	1.631	0	0	1
9	NHSCL4L006	Nurses	2.39	1.223	1.223	0	0.886	1
10	NHSCL4L029	Nurses	9.56	0	0	0	0	1
11	NHSC02	Doctors	0	0.815	0	0.815	2.362	1
12	NHSC07A05	Doctors	0	0	0	0	3.543	1
13	NHSCL4L071	OHP	0	2.936	0	0	1.417	1
14	NHSC15	OHP	0	0	0.753	0.753	2.453	1
15	NHSCL4L037	OHP	0	0	0	4.893	0	1
16	NHSC09	Non-Clinical	9.56	0	0	0	0	1
17	NHSCL4L034	Non-Clinical	9.56	0	0	0	0	1
18	NHSC05	Non-Clinical	7.17	0	1.223	0	0	1
19	NHSC06	Non-Clinical	2.049	0.699	2.097	0.699	0.253	1
20	NHSC10	Non-Clinical	2.294	1.957	0.783	0.783	0.142	1
21	NHSC07	Non-Clinical	1.593	0.408	2.446	0.612	0.443	1
22	NHSC04	Non-Clinical	9.56	0	0	0	0	1
23	NHSC17	Non-Clinical	7.17	0	1.223	0	0	1
24	NHSC18	Non-Clinical	3.741	1.064	1.489	0.213	0.154	1
25	NHSC03	Non-Clinical	6.784	1.42	0	0	0	1
26	NHSC19	Non-Clinical	0	2.446	0	1.223	0.886	1
27	NHSC20	Non-Clinical	5.463	0.932	0.932	0.155	0.056	1
28	NHSC14	Non-Clinical	6.748	0.576	0.863	0	0	1
29	NHSCL4L005	Non-Clinical	0	2.446	0	1.223	0.886	1
30	NHSC08	Non-Clinical	9.56	0	0	0	0	1
31	NHSCL4L013	Non-Clinical	6.373	0	1.631	0	0	1
32	NHSCL4L014	Non-Clinical	3.585	3.058	0	0	0	1
33	NHSCL4L015	Non-Clinical	9.56	0	0	0	0	1
34	NHSC11	Non-Clinical	6.692	0	1.468	0	0	1
35	NHSC21	Non-Clinical	2.425	1.489	1.099	0.496	0.411	1
36	NHSC12	Non-Clinical	5.975	1.835	0	0	0	1
37	NHSCL4L024	Non-Clinical	6.373	0	1.631	0	0	1
38	NHSC01	Non-Clinical	0	4.893	0	0	0	1
	Total Brokers		**28**	**21**	**19**	**14**	**17**	

Table 49: NHS-K Counts of Relative Brokerage Score by Brokering & Professional Roles

NHS-K	Brokering Roles								
Professional Roles	Coordinator	Gatekeeper	Representative	Consultant	Liaison	Total Brokers by Pro. Role	% of Brokers by Pro. Role	Total No. of Pro. Role in Network	% of Brokers in Network by Profession
Nurses	0	2	0	4	3	**9**	29%	**31**	7%
Doctors	0	2	0	3	2	**7**	47%	**15**	5%
Other Health. Pro.	0	1	0	1	1	**3**	13%	**24**	2%
Non-Clinical MGMT	10	8	9	5	7	**39**	62%	**63**	29%
Total Brokering Roles	**10**	**13**	**9**	**13**	**13**	**58**	44%	**133**	44%

Table 50: NHS-D Counts of Relative Brokerage Score by Brokering & Professional Roles

NHS-D	Brokering Roles								
Professional Roles	Coordinator	Gatekeeper	Representative	Consultant	Liaison	Total Brokers by Pro. Role	% of Brokers by Pro. Role	Total No. of Pro. Role in Network	% of Brokers in Network by Profession
Nurses	3	1	2	1	1	**8**	21%	**38**	4%
Doctors	1	3	4	3	3	**14**	48%	**29**	8%
Other Health. Pro.	3	2	5	1	1	**12**	44%	**27**	7%
Non-Clinical MGMT	20	11	11	4	6	**52**	60%	**87**	29%
Total Brokering Roles	**27**	**17**	**22**	**9**	**11**	**86**	48%	**181**	48%

Table 51: NHS-A Counts of Relative Brokerage Score by Brokering & Professional Roles

NHS-A	Brokering Roles								
Professional Roles	Coordinator	Gatekeeper	Representative	Consultant	Liaison	Total Brokers by Pro. Role	% of Brokers by Pro. Role	Total No. of Pro. Role in Network	% of Brokers in Network by Profession
Nurses	9	6	10	2	5	**32**	40%	**81**	13%
Doctors	1	5	4	7	4	**21**	68%	**31**	9%
Other Health. Pro.	4	4	6	4	3	**21**	57%	**37**	9%
Non-Clinical MGMT	21	11	13	5	7	**57**	58%	**98**	23%
Total Brokering Roles	**35**	**26**	**33**	**18**	**19**	**131**	53%	**247**	53%

Table 52: NHS-E Counts of Relative Brokerage Score by Brokering & Professional Roles

NHS-E	Brokering Roles								
Professional Roles	Coordinator	Gatekeeper	Representative	Consultant	Liaison	Total Brokers by Pro. Role	% of Brokers by Pro. Role	Total No. of Pro. Role in Network	% of Brokers in Network by Profession
Nurses	0	4	0	3	2	**9**	25%	**36**	5%
Doctors	2	3	2	5	5	**17**	89%	**19**	9%
Other Health. Pro.	5	3	2	2	2	**14**	41%	**34**	7%
Non-Clinical MGMT	20	16	14	6	12	**68**	69%	**98**	36%
Total Brokering Roles	**27**	**26**	**18**	**16**	**21**	**108**	58%	**187**	58%

Table 53: NHS-C Counts of Relative Brokerage Score by Brokering & Professional Roles

NHS-C	Brokering Roles								
Professional Roles	Coordinator	Gatekeeper	Representative	Consultant	Liaison	Total Brokers by Pro. Role	% of Brokers by Pro. Role	Total No. of Pro. Role in Network	% of Brokers in Network by Profession
Nurses	8	6	6	3	5	**28**	53%	**53**	17%
Doctors	0	1	0	1	2	**4**	33%	**12**	2%
Other Health. Pro.	0	1	1	2	2	**6**	18%	**34**	4%
Non-Clinical MGMT	20	13	12	8	8	**61**	90%	**68**	37%
Total Brokering Roles	**28**	**21**	**19**	**14**	**17**	**99**	59%	**167**	59%

D5 ERGM Results

D5.1 ERGM Univariate Statistics

Table 54: Q2 Provide Advice ERGM Univariate Statistics

Provide Advice Network	NHS-A	NHS-D	NHS-C	NHS-K	NHS-E
vertices	247	181	167	133	187
arc	388	273	269	194	279
reciprocity	29	21	18	10	13
in-2star	667	474	581	340	318
out-2star	729	485	531	383	586
in-3star	3416	1717	2446	1164	696
out-3star	766	486	686	460	847
mixed-2-star	656	582	659	332	611
T1	3	4	2	1	2
T2	31	38	15	8	12
T3	46	55	32	11	19
T4	30	56	20	9	9
T5	37	35	17	18	17
T6	33	38	18	8	7
T7	213	271	197	72	67
T8	213	172	152	81	126
T9(030T)	141	179	121	71	108
T10(030C)	21	25	23	5	14
Sink	157	114	103	77	125
Source	24	27	25	20	16
Isolates	1	0	0	12	0
AinS(2.00)	236.2	179.1	197.0	133.7	154.3
AoutS(2.00)	446.8	303.5	307.3	225.3	328.7
Ain1out-star(2.00)	367.1	233.5	250.8	154.0	298.0
1inAout-star(2.00)	286.8	233.2	263.0	0.0	208.7
AinAout-star(2.00)	160.1	103.1	104.3	65.6	115.5
AT-T(2.00)	122.6	125.5	93.4	66.5	86.9
AT-C(2.00)	56.4	55.9	52.8	14.5	38.3
AT-D(2.00)	107.0	100.7	80.2	0.0	80.0
AT-U(2.00)	116.0	128.8	101.4	51.3	80.1
AT-TD(2.00)	114.8	113.1	86.8	62.2	83.4
AT-TU(2.00)	119.3	127.1	97.4	58.9	83.5
AT-DU(2.00)	111.5	114.7	90.8	0.0	80.0
AT-TDU(2.00)	115.2	118.3	91.7	58.6	82.3
A2P-T(2.00)	620.4	501.4	597.6	318.0	564.1
A2P-D(2.00)	687.6	426.2	481.5	346.9	544.1
A2P-U(2.00)	608.8	389.1	505.1	288.1	267.8
A2P-TD(2.00)	654.0	463.8	539.5	332.5	554.1
A2P-TU(2.00)	614.6	445.2	551.3	303.1	415.9
A2P-DU(2.00)	648.2	407.6	493.3	317.5	405.9
A2P-TDU(2.00)	638.9	438.9	528.1	317.7	458.6

Table 55: Q5 Trust ERGM Univariate Statistics

Trust Network	NHS-K	NHS-D	NHS-A	NHS-E	NHS-C
vertices	133	181	247	187	167
arc	194	273	389	279	267
reciprocity	10	21	29	13	18
in-2star	384	474	668	318	580
out-2star	382	485	733	586	523
in-3star	1596	1717	3417	696	2446
out-3star	458	486	772	847	674
mixed-2-star	349	582	658	611	653
T1	1	4	3	2	2
T2	8	38	31	12	15
T3	11	55	46	19	32
T4	9	56	30	9	20
T5	18	35	37	17	17
T6	8	38	33	7	18
T7	79	271	214	67	197
T8	81	172	213	126	151
T9(030T)	74	179	141	108	119
T10(030C)	5	25	21	14	23
Sink	89	114	158	125	103
Source	20	27	24	16	26
Isolates	0	0	0	0	0
AinS(2.00)	125.8	179.1	236.7	154.3	196.0
AoutS(2.00)	225.1	303.5	448.7	328.7	303.6
Ain1out-star(2.00)	153.1	233.5	367.6	298.0	245.8
1inAout-star(2.00)	0.0	233.2	286.9	208.7	259.6
AinAout-star(2.00)	64.9	103.1	159.7	115.5	101.7
AT-T(2.00)	68.5	125.5	122.6	86.9	91.9
AT-C(2.00)	14.5	55.9	56.4	38.3	52.8
AT-D(2.00)	60.4	100.7	107.0	80.0	78.2
AT-U(2.00)	53.8	128.8	116.0	80.1	99.9
AT-TD(2.00)	64.5	113.1	114.8	83.4	85.1
AT-TU(2.00)	61.1	127.1	119.3	83.5	95.9
AT-DU(2.00)	57.1	114.7	111.5	80.0	89.1
AT-TDU(2.00)	60.9	118.3	115.2	82.3	90.0
A2P-T(2.00)	331.9	501.4	622.4	564.1	592.8
A2P-D(2.00)	343.4	426.2	691.6	544.1	473.5
A2P-U(2.00)	326.4	389.1	609.8	267.8	504.1
A2P-TD(2.00)	337.6	463.8	657.0	554.1	533.2
A2P-TU(2.00)	329.1	445.2	616.1	415.9	548.5
A2P-DU(2.00)	334.9	407.6	650.7	405.9	488.8
A2P-TDU(2.00)	333.9	438.9	641.2	458.6	523.5

Table 56: Model B ERGM Actor Attribute List & Counts

	NHS-K	NHS-D	NHS-A	NHS-E	NHS-C
Nodes/Actors	133	181	247	187	167
Gender (Female)	53	64	49	51	51
Clinical Role	70	94	149	89	99
Role (Nurse)	31	38	81	19	53
4Role (Drs)	15	29	31	36	12
5Role (OHCP)	24	27	37	34	34
6Role (Non Clinical MGMT)	63	87	98	98	68
7TGT 1Yes0No_Bin,	7	8	5	6	7
8KPO 1Yes0No_Bin,	6	9	8	7	8
9RPIW 1Yes0No_Bin,	31	38	79	90	54
10L4L 1Yes0No_Bin,	28	56	89	55	49
12Q10_LeadRole_Bin,	60	80	127	82	87
13SurveyRespon,	28	55	85	55	49
14Org Tenure Lessthan6,	10	12	35	19	12
15OrgTenMorethan6Yes,	18	5	50	36	37
16ProTenLessThan62,	11	43	12	40	42
17ProTenMoreThan6Yes,	17	49	73	15	6
18FamiliarYes,	11	26	52	32	18
19NormalYes,	24	48	78	44	40
20CognPartLowAgree,	27	52	80	49	47
21CoheLowAgree,	25	51	82	51	45
22CollectActionLowAgree,	9	25	68	27	25
23RefleMonitLowAgree,	20	44	76	42	34
24IndivEngageAgree,	24	41	79	46	34
25StaffEngageAgree,	24	48	67	46	42
26ImpactModHigh,	24	46	75	44	38
27FamiliarNo,	17	29	33	23	31
28NormalNo,	4	7	7	11	9
29CognPartBinLowDis,	1	3	2	3	2
30CoheLowDis,	3	4	3	4	4
31CollectActionLowDis,	19	30	17	28	24
32RefleMonitLowDis,	8	11	6	13	15
33IndivEngageDis,	4	14	6	9	15
34StaffEngageDis,	4	7	7	4	6
35ImpactBinLowNo	4	9	10	11	11

Table 57: Model Estimates for NHS-A Advice Provision Network

NHS A **Model A: Purely Structural Effects**			
Parameter [PNet Name]	**Estimates**	**Standard Error (SE)**	**Convergence Statistic (t-ratio)**
Arc	-6.657*	0.529	-0.065
3-out-star	-0.275*	0.040	-0.093
Multiple Connectivity [path2]	-0.192	0.108	-0.038
Popularity Spread [AinS(2.00)]	-1.479*	0.224	-0.046
Activity Spread [AoutS(2.00)]	3.336*	0.362	-0.076
Alternating-In-One-Out Star [Ain1out-star(2.00)]	-0.138	0.272	-0.055
One-In-Alternating Out Star [1inAout-star(2.00)]	0.862*	0.329	-0.025
Alternating-in-Alternating Out Star [AinAout-star(2.00)]	-1.135	0.757	-0.045
Transitive Path Closure [AT-T(2.00)]	2.107*	0.085	0.033
Model B: Structural & Actor-Relation Effects			
Arc	-7.210*	0.584	-0.050
3-out-star	-0.316*	0.043	0.065
Multiple Connectivity [path2]	-0.176	0.104	-0.042
Popularity Spread [AinS(2.00)]	-1.493*	0.236	-0.043
Activity Spread [AoutS(2.00)]	2.831*	0.398	-0.018
Alternating-In-One-Out Star [Ain1out-star(2.00)]	-0.152	0.279	-0.020
One-In-Alternating Out Star [1inAout-star(2.00)]	0.782*	0.315	-0.060
Alternating-in-Alternating Out Star [AinAout-star(2.00)]	-0.930	0.759	-0.051
Transitive Path Closure [AT-T(2.00)]	1.981*	0.093	-0.053
Model B: Actor Effects			
Homophily (Nurse)	0.726	0.138	0.205
Homophily (Drs)	0.814	0.144	-0.317
Homophily (Allied healthcare Professionals Role)	0.916*	0.155	0.041
Homophily (Non-Clinical Management Role)	0.760*	0.134	-0.015
Homophily (RPIW Participants)	0.622*	0.136	-0.084
Homophily (L4L Participants)	-0.208	0.138	0.104
Homophily (Leadership Role)	0.284*	0.114	-0.076

Estimation was conducted using the Pnet package (Wang, Robins, et al., 2009)

**** p<= 0.050***

Table 58: Model Estimates for NHS-A Trust Network

NHS A			
Model A: Purely Structural Effects			
Parameter [PNet Name]	**Estimates**	**Standard Error (SE)**	**Convergence Statistic (t-ratio)**
Arc	-6.634*	0.537	0.046
3-out-star	-0.278*	0.040	-0.006
Multiple Connectivity [path2]	-0.191	0.112	-0.001
Popularity Spread [AinS(2.00)]	-1.537*	0.226	0.028
Activity Spread [AoutS(2.00)]	3.364*	0.372	0.028
Alternating-In-One-Out Star [Ain1out-star(2.00)]	-0.140	0.282	0.021
One-In-Alternating Out Star [1inAout-star(2.00)]	0.895*	0.321	0.012
Alternating-in-Alternating Out Star [AinAout-star(2.00)]	-1.198	0.760	0.044
Transitive Path Closure [AT-T(2.00)]	2.101*	0.088	-0.014
Model B: Structural & Actor-Relation Effects			
Arc	-7.099*	0.601	-0.098
3-out-star	-0.313*	0.043	-0.036
Multiple Connectivity [path2]	-0.191	0.105	-0.048
Popularity Spread [AinS(2.00)]	-1.530*	0.237	-0.056
Activity Spread [AoutS(2.00)]	2.789*	0.400	-0.086
Alternating-In-One-Out Star [Ain1out-star(2.00)]	-0.096	0.272	-0.093
One-In-Alternating Out Star [1inAout-star(2.00)]	0.846*	0.310	-0.061
Alternating-in-Alternating Out Star [AinAout-star(2.00)]	-1.132	0.761	-0.112
Transitive Path Closure [AT-T(2.00)]	1.962*	0.095	0.002
Homophily (Nurse)	0.724	0.147	0.271
Homophily (Drs)	0.790*	0.172	0.044
Homophily (Allied healthcare Professionals Role)	0.917*	0.142	-0.035
Homophily (Non-Clinical Management Role)	0.771	0.135	-0.187
Homophily (RPIW Participants)	0.602*	0.130	0.020
Homophily (L4L Participants)	-0.212	0.139	-0.034
Homophily (Leadership Role)	0.308*	0.103	-0.059

Estimation was conducted using the Pnet package (Wang, Robins, et al., 2009)

**** p<= 0.050***

Table 59: NHS-A Model A Selected Goodness-of-Fit (GOF) Results

Selected Goodness-of-Fit (GOF) details for Model A Advice Provision Network						Selected Goodness-of-Fit (GOF) Details for Model B Trust Network			
Parameters	**Observed**	**Mean**	**Standard Dev.**	**GOF Ratio**		**Observed**	**Mean**	**Standard Dev.**	**GOF Ratio**
arc	388	411.77	35.75	-0.665		389	383.87	37.83	0.136
reciprocity	29	23.52	8.99	0.609		29	16.72	9.34	1.315
2-in-star	667	469.86	163.00	1.209		668	361.39	167.75	1.828
2-out-star	729	786.53	85.81	-0.67		733	723.20	90.33	0.109
3-in-star	3416	731.71	523.44	5.128		3417	481.02	493.18	5.953
3-out-star	766	833.93	113.53	-0.598		772	755.62	117.81	0.139
path2	656	784.14	199.00	-0.644		658	631.04	209.11	0.129
T1	3	11.41	5.89	-1.428		3	7.66	6.01	-0.775
T2	31	78.00	38.80	-1.211		31	52.06	40.14	-0.525
T3	46	90.35	43.77	-1.013		46	60.06	45.72	-0.307
T4	30	72.72	35.30	-1.21		30	48.82	37.84	-0.498
T5	37	53.98	23.72	-0.716		37	37.13	24.59	-0.005
T6	33	46.45	22.79	-0.59		33	30.73	23.50	0.097
T7	213	252.37	121.90	-0.323		214	168.33	129.29	0.353
T8	213	194.92	76.92	0.235		213	137.35	78.92	0.959
T9(030T)	141	208.68	83.72	-0.808		141	148.22	89.64	-0.081
T10(030C)	21	35.93	17.11	-0.873		21	23.87	17.88	-0.16
AinS(2.00)	236.21	275.06	59.03	-0.658		236.71	228.87	63.26	0.124
AoutS(2.00)	446.84	477.57	47.36	-0.649		448.72	441.90	50.01	0.136
Ain1out-star(2.00)	367.14	408.17	66.84	-0.614		367.64	357.08	68.17	0.155
1inAout-star(2.00)	286.80	338.09	79.08	-0.649		286.92	276.02	83.89	0.13
AinAout-star(2.00)	160.11	175.34	25.59	-0.595		159.73	155.89	26.05	0.148
AT-T(2.00)	122.63	158.53	56.94	-0.631		122.63	115.31	61.18	0.12
AT-C(2.00)	56.38	74.69	32.91	-0.556		56.38	50.35	34.40	0.175
AT-D(2.00)	107.02	125.16	41.07	-0.442		107.02	92.90	43.10	0.328
AT-U(2.00)	116.00	148.84	54.66	-0.601		116	107.80	58.90	0.139
AT-TD(2.00)	114.82	141.84	48.68	-0.555		114.82	104.10	51.93	0.206
AT-TU(2.00)	119.31	153.69	55.74	-0.617		119.31	111.55	60.01	0.129
AT-DU(2.00)	111.51	137.00	47.37	-0.538		111.51	100.35	50.68	0.22
AT-TDU(2.00)	115.21	144.18	50.52	-0.573		115.21	105.33	54.16	0.182
Std Dev in-degree dist	2.127	1.608	0.312	1.664		2.126	1.388	0.352	2.097
Skew in-degree dist	7.866	2.411	0.764	7.139		7.865	2.014	0.932	6.275
Std Dev out-degree dist	2.242	2.291	0.083	-0.593		2.247	2.232	0.094	0.161
Skew out-degree dist	0.925	0.835	0.129	0.69		0.922	0.932	0.141	-0.07

Table 60: NHS-A Model B Selected Goodness-of-Fit (GOF) Results

Selected Goodness-of-Fit (GOF) details for Model B Advice Provision Network						Selected Goodness-of-Fit (GOF) Details for Model B Trust Network			
Parameters	**Observed**	**Mean**	**Standard Dev.**	**GOF Ratio**		**Observed**	**Mean**	**Standard Dev.**	**GOF Ratio**
arc	388	390.80	19.92	-0.14		389	394.73	22.33	-0.257
reciprocity	29	19.15	5.91	1.667		29	19.67	6.80	1.372
2-in-star	667	419.06	138.13	1.795		668	443.90	158.13	1.417
2-out-star	729	740.59	53.61	-0.216		733	749.68	57.27	-0.291
3-in-star	3416	725.10	583.10	4.615		3417	813.81	674.37	3.86
3-out-star	766	777.68	79.76	-0.146		772	788.26	82.08	-0.198
path2	656	674.33	123.00	-0.149		658	695.69	139.90	-0.269
T1	3	9.80	4.86	-1.399		3	10.47	5.19	-1.439
T2	31	67.67	31.50	-1.164		31	71.80	33.79	-1.207
T3	46	79.27	35.29	-0.943		46	83.56	37.85	-0.993
T4	30	63.00	28.83	-1.144		30	67.78	32.40	-1.166
T5	37	45.37	17.71	-0.473		37	47.07	19.26	-0.523
T6	33	40.51	18.28	-0.411		33	42.70	19.58	-0.495
T7	213	215.06	96.87	-0.021		214	232.74	109.68	-0.171
T8	213	157.71	51.20	1.08		213	160.78	58.04	0.9
T9(030T)	141	178.85	64.74	-0.585		141	187.42	72.03	-0.644
T10(030C)	21	31.92	13.88	-0.787		21	33.42	14.82	-0.838
AinS(2.00)	236.21	241.92	37.34	-0.153		236.71	248.96	42.67	-0.287
AoutS(2.00)	446.84	451.08	27.79	-0.152		448.72	456.33	30.36	-0.251
Ain1out-star(2.00)	367.14	370.63	37.83	-0.092		367.64	374.71	42.33	-0.167
1inAout-star(2.00)	286.80	293.83	47.94	-0.147		286.92	302.69	56.05	-0.281
AinAout-star(2.00)	160.11	161.01	14.85	-0.061		159.73	162.21	16.46	-0.151
AT-T(2.00)	122.63	129.83	38.93	-0.185		122.63	135.18	44.46	-0.282
AT-C(2.00)	56.38	62.68	23.83	-0.265		56.38	65.47	26.63	-0.341
AT-D(2.00)	107.02	101.36	25.85	0.219		107.02	103.37	29.65	0.123
AT-U(2.00)	116.00	124.47	39.29	-0.216		116.00	130.21	44.59	-0.319
AT-TD(2.00)	114.82	115.59	31.86	-0.024		114.82	119.27	36.38	-0.122
AT-TU(2.00)	119.31	127.15	39.06	-0.201		119.31	132.69	44.47	-0.301
AT-DU(2.00)	111.51	112.91	31.86	-0.044		111.51	116.79	36.21	-0.146
AT-TDU(2.00)	115.21	118.55	34.15	-0.098		115.21	122.92	38.88	-0.198
1Gender_interaction	42	40.61	7.40	0.188		42	39.76	8.37	0.268
2ClinicalRoleID_Bin_interaction	162	170.01	14.18	-0.565		163	175.65	17.25	-0.733
3RoleNurse_interaction	63	61.20	7.67	0.235		63	61.13	8.85	0.211
4RoleDrs_interaction	17	23.37	11.36	-0.561		17	16.19	9.00	0.09
5RoleOHCP_interaction	24	22.99	8.46	0.119		25	34.32	13.83	-0.674
6RoleNCMGMT_interaction	104	105.81	14.40	-0.126		104	103.98	15.42	0.001
7TGT1Yes0No_Bin_interaction	10	0.13	0.37	26.99		10	0.13	0.35	28.085
8KPO1Yes0No_Bin_interaction	19	2.10	2.85	5.93		19	1.77	2.21	7.8
9RPIW1Yes0No_Bin_interaction	94	97.68	17.33	-0.212		94	95.68	17.82	-0.094
10L4L1Yes0No_Bin_interaction	122	123.72	13.11	-0.131		122	122.94	15.14	-0.062
12Q10_LeadRole_Bin_interaction	165	169.32	18.56	-0.233		166	173.36	20.70	-0.356
14OrgTenLessthan6_interaction	22	17.93	4.47	0.91		22	17.47	4.64	0.976
15OrgTenMorethan6Yes_interaction	29	40.93	6.98	-1.71		28	41.03	7.81	-1.669
16ProTenLessThan62_interaction	1	3.25	2.09	-1.075		1	2.46	1.78	-0.819

17ProTenMoreThan6Yes_interaction	87	81.21	10.30	0.562		87	83.74	11.94	0.273
18FamiliarYes_interaction	38	44.28	8.29	-0.758		38	44.57	8.64	-0.761
19NormalYes_interaction	92	96.11	10.87	-0.379		91	95.94	12.18	-0.406
20CognPartLowAgree_interaction	101	108.18	12.78	-0.562		101	106.76	14.38	-0.401
21CoheLowAgree_interaction	103	110.49	12.64	-0.593		103	108.16	13.94	-0.37
22CollectActionLowAgree_interaction	76	70.13	9.88	0.595		77	71.25	11.04	0.521
23RefleMonitLowAgree_interaction	91	93.63	10.93	-0.24		91	94.39	12.88	-0.263
1Gender_sender	198	208.05	10.99	-0.914		198	208.12	11.40	-0.888
2ClinicalRoleID_Bin_sender	237	235.73	14.02	0.091		238	241.50	16.06	-0.218
3RoleNurse_sender	111	117.12	8.83	-0.693		112	117.45	10.13	-0.539
4RoleDrs_sender	65	53.06	8.02	1.488		65	51.18	7.35	1.879
5RoleOHCP_sender	61	65.55	8.03	-0.566		61	72.86	10.68	-1.11
6RoleNCMGMT_sender	151	155.07	12.90	-0.315		151	153.23	14.07	-0.158
7TGT1Yes0No_Bin_sender	20	10.35	2.11	4.584		20	10.16	2.44	4.029
8KPO1Yes0No_Bin_sender	32	19.06	4.13	3.135		32	19.18	4.82	2.661
9RPIW1Yes0No_Bin_sender	150	167.15	14.15	-1.212		150	168.62	15.55	-1.198
10L4L1Yes0No_Bin_sender	357	351.85	15.18	0.339		358	353.38	16.05	0.288
11HybridvsPurePlay_Bin_sender	161	149.45	10.69	1.081		162	153.65	12.05	0.693
12Q10_LeadRole_Bin_sender	289	278.37	17.69	0.601		290	282.66	19.06	0.385
16ProTenLessThan62_sender	54	55.14	5.10	-0.224		54	54.11	5.18	-0.021
17ProTenMoreThan6Yes_sender	293	295.53	13.85	-0.183		294	297.38	14.39	-0.235
18FamiliarYes_sender	230	223.23	11.09	0.61		230	223.60	11.60	0.552
19NormalYes_sender	319	324.75	13.71	-0.419		319	325.10	14.21	-0.429
20CognPartLowAgree_sender	340	343.29	14.16	-0.233		341	343.40	15.08	-0.159
21CoheLowAgree_sender	343	345.75	14.56	-0.189		344	346.19	14.84	-0.148
22CollectActionLowAgree_sender	278	283.12	12.93	-0.396		279	284.45	13.50	-0.404
23RefleMonitLowAgree_sender	327	322.33	13.86	0.337		328	321.68	14.77	0.428
1Gender_receiver	90	78.74	11.60	0.971		89	78.68	13.53	0.763
2ClinicalRoleID_Bin_receiver	209	219.27	15.45	-0.664		210	224.90	19.56	-0.762
3RoleNurse_receiver	114	114.76	9.39	-0.081		114	115.23	10.65	-0.115
4RoleDrs_receiver	54	52.18	12.92	0.141		54	43.98	10.76	0.931
5RoleOHCP_receiver	41	52.32	10.49	-1.079		42	65.69	16.35	-1.449
6RoleNCMGMT_receiver	179	171.53	17.57	0.425		179	169.83	18.98	0.483
7TGT1Yes0No_Bin_receiver	41	9.68	3.84	8.149		41	7.83	3.09	10.723
8KPO1Yes0No_Bin_receiver	56	18.94	7.46	4.968		56	18.34	8.43	4.467
9RPIW1Yes0No_Bin_receiver	177	169.09	21.02	0.376		177	170.17	24.20	0.282
10L4L1Yes0No_Bin_receiver	140	139.11	14.35	0.062		140	140.32	16.49	-0.02
12Q10_LeadRole_Bin_receiver	202	225.72	21.38	-1.11		202	229.16	23.98	-1.132
18FamiliarYes_receiver	72	79.54	11.37	-0.663		73	80.33	12.90	-0.569
19NormalYes_receiver	125	118.97	12.82	0.47		125	120.48	14.45	0.313
20CognPartLowAgree_receiver	124	124.52	14.21	-0.036		124	125.46	15.81	-0.092
21CoheLowAgree_receiver	127	126.47	13.90	0.038		127	126.35	15.20	0.043
22CollectActionLowAgree_receiver	113	100.15	12.06	1.065		113	102.34	13.48	0.791
23RefleMonitLowAgree_receiver	118	116.66	12.83	0.105		118	119.18	14.93	-0.079
Std Dev in-degree dist	2.127	1.544	0.303	1.92		2.126	1.59	0.336	1.595
Skew in-degree dist	7.866	2.819	0.983	5.133		7.865	2.854	1.012	4.954
Std Dev out-degree dist	2.242	2.255	0.062	-0.211		2.247	2.263	0.063	-0.256
Skew out-degree dist	0.925	0.904	0.072	0.284		0.922	0.889	0.081	0.401

Table 61: Model Estimates for NHS-D Advice Provision Network

NHS D			
Model A: Purely Structural Effects			
Parameter [PNet Name]	**Estimates**	**Standard Error (SE)**	**Convergence Statistic (t-ratio)**
Arc	-6.943*	0.263	0.015
Reciprocity	0.702	0.480	-0.040
2-out-star	2.160*	0.212	0.013
3-out-star	-0.949*	0.109	0.001
Multiple Connectivity [path2]	0.198*	0.077	-0.001
One-In-Alternating Out Star [1inAout-star(2.00)]	-0.876*	0.207	-0.007
Generalized Transitivity [AT-TDU(2.00)]	2.012*	0.149	-0.021
Model B: Structural & Actor-Relation Effects			
Parameter [PNet Name]			
Arc	-7.549*	0.282	-0.005
Reciprocity	0.750	0.491	-0.053
2-out-star	1.699*	0.243	0.000
3-out-star	-0.831*	0.122	-0.007
Multiple Connectivity [path2]	-0.047	0.086	-0.013
One-In-Alternating Out Star [1inAout-star(2.00)]	-0.442*	0.211	-0.025
Generalized Transitivity [AT-TDU(2.00)]	1.816*	0.174	-0.074
Model B: Actor-Relation Effects			
Homophily (Nurse)	1.224*	0.322	0.040
Homophily (Drs)	0.868	0.244	0.318
Homophily (Allied healthcare Professionals Role)	1.341	0.201	-0.202
Homophily (Non-Clinical Management Role)	0.396*	0.138	0.029
Homophily (RPIW Participants)	0.630*	0.189	-0.037
Homophily (L4L Participants)	-0.128	0.220	-0.040
Homophily (Leadership Role)	0.036	0.150	0.075
Sender (TGT)	1.673*	0.339	-0.099
Sender (KPO)	2.224*	0.513	0.100
Receiver (TGT)	0.884*	0.215	0.007
Receiver (KPO)	0.671*	0.237	0.092

Estimation was conducted using the Pnet package (Wang, Robins, et al., 2009)

**** p<= 0.050***

Table 62: Model Estimates for NHS-D Trust Network

NHS D			
Model A: Purely Structural Effects			
Parameter [PNet Name]	**Estimates**	**Standard Error (SE)**	**Convergence Statistic (t-ratio)**
Arc	-6.977*	0.272	0.029
Reciprocity	0.737	0.498	0.047
2-out-star	2.193*	0.226	0.034
3-out-star	-0.964*	0.118	0.050
Multiple Connectivity [path2]	0.196*	0.076	0.076
One-In-Alternating Out Star [1inAout-star(2.00)]	-0.871*	0.213	0.060
Generalized Transitivity [AT-TDU(2.00)]	2.005*	0.155	0.082
Model B: Structural & Actor-Relation Effects			
Parameter [PNet Name]			
Arc	-7.548*	0.302	0.055
Reciprocity	0.745	0.482	-0.123
2-out-star	1.708*	0.241	0.048
3-out-star	-0.833*	0.114	0.029
Multiple Connectivity [path2]	-0.048	0.085	-0.038
One-In-Alternating Out Star [1inAout-star(2.00)]	-0.443*	0.216	-0.063
Generalized Transitivity [AT-TDU(2.00)]	1.820*	0.163	-0.100
Model B: Actor-Relation Effects			
Homophily (Nurse)	1.223*	0.298	0.047
Homophily (Drs)	0.889	0.224	0.129
Homophily (Allied healthcare Professionals Role)	1.344	0.204	-0.162
Homophily (Non-Clinical Management Role)	0.384*	0.147	0.093
Homophily (RPIW Participants)	0.611*	0.172	-0.003
Homophily (L4L Participants)	-0.130	0.202	-0.016
Homophily (Leadership Role)	0.046	0.153	0.048
Sender (TGT)	1.654*	0.339	0.034
Sender (KPO)	2.191*	0.571	-0.026
Receiver (TGT)	0.893*	0.200	-0.014
Receiver (KPO)	0.675*	0.224	-0.001

Estimation was conducted using the Pnet package (Wang, Robins, et al., 2009)

**** p<= 0.050***

Table 63: NHS-D Model A Selected Goodness-of-Fit (GOF) Results

Selected Goodness-of-Fit (GOF) details for Model A Advice Provision Network						Selected Goodness-of-Fit (GOF) Details for Model B Trust Network			
Parameters	Observed	Mean	Standard Dev.	GOF Ratio		Observed	Mean	Standard Dev.	GOF Ratio
arc	273	269.45	43.46	0.082		273	267.06	42.26	0.141
reciprocity	21	19.86	10.87	0.105		21	19.04	10.36	0.189
2-in-star	474	358.95	159.53	0.721		474	349.46	152.70	0.816
2-out-star	485	476.47	107.05	0.08		485	469.82	102.01	0.149
3-in-star	1717	544.03	447.96	2.619		1717	521.07	426.26	2.806
3-out-star	486	477.23	140.51	0.062		486	465.70	131.40	0.154
path2	582	565.90	250.99	0.064		582	546.72	236.69	0.149
T1	4	8.19	5.78	-0.725		4	7.89	5.55	-0.7
T2	38	63.64	43.37	-0.591		38	61.01	41.10	-0.56
T3	55	85.00	56.98	-0.526		55	81.15	53.33	-0.49
T4	56	51.18	33.74	0.143		56	48.83	31.64	0.227
T5	35	46.65	28.85	-0.404		35	44.48	27.06	-0.35
T6	38	45.67	31.52	-0.243		38	43.58	29.41	-0.19
T7	271	208.07	140.14	0.449		271	198.29	132.52	0.549
T8	172	182.59	105.28	-0.101		172	173.73	98.65	-0.018
T9(030T)	179	164.31	92.63	0.159		179	156.83	86.09	0.258
T10(030C)	25	39.27	26.31	-0.543		25	37.39	24.39	-0.508
AinS(2.00)	179.13	207.24	64.57	-0.435		179.13	203.17	61.85	-0.389
AoutS(2.00)	303.55	296.92	58.67	0.113		303.55	293.90	56.45	0.171
AinS(2.00)	179.13	207.24	64.57	-0.435		179.13	203.17	61.85	-0.389
AoutS(2.00)	303.55	296.92	58.67	0.113		303.55	293.90	56.45	0.171
Ain1out-star(2.00)	233.48	273.19	82.90	-0.479		233.48	267.62	78.98	-0.432
1inAout-star(2.00)	233.16	226.49	89.69	0.074		233.16	220.21	85.54	0.151
AinAout-star(2.00)	103.09	112.87	29.40	-0.333		103.09	111.14	28.41	-0.283
AT-T(2.00)	125.50	117.81	59.55	0.129		125.50	112.93	55.98	0.224
AT-C(2.00)	55.94	76.77	48.32	-0.431		55.94	73.02	44.91	-0.38
AT-D(2.00)	100.73	107.50	52.75	-0.128		100.73	103.12	49.32	-0.048
AT-U(2.00)	128.75	115.61	60.33	0.218		128.75	110.76	56.53	0.318
AT-TD(2.00)	113.12	112.66	56.10	0.008		113.12	108.03	52.59	0.097
AT-TU(2.00)	127.13	116.71	59.90	0.174		127.13	111.85	56.22	0.272
AT-DU(2.00)	114.74	111.55	56.43	0.056		114.74	106.94	52.80	0.148
AT-TDU(2.00)	118.33	113.64	57.46	0.082		118.33	108.94	53.85	0.174
Std Dev in-degree dist	2.12	1.751	0.367	1.008		2.12	1.73	0.36	1.084
Skew in-degree dist	5.295	1.893	0.57	5.966		5.295	1.882	0.589	5.795
Std Dev out-degree dist	2.149	2.116	0.17	0.196		2.149	2.105	0.166	0.263
Skew out-degree dist	0.956	0.979	0.205	-0.115		0.956	0.982	0.206	-0.126

Table 64: NHS-D Model B Selected Goodness-of-Fit (GOF) Results

Selected Goodness-of-Fit (GOF) details for Model A: Advice Provision Network						Selected Goodness-of-Fit (GOF) Details for Model B Trust Network			
Parameters	**Observed**	**Mean**	**Standard Dev.**	**GOF Ratio**		**Observed**	**Mean**	**Standard Dev.**	**GOF Ratio**
arc	273	273.036	14.479	-0.002		273	273.445	13.439	-0.033
reciprocity	21	21.716	6.121	-0.117		21	21.204	5.372	-0.038
2-in-star	474	443.019	83.786	0.37		474	452.553	86.037	0.249
2-out-star	485	485.276	38.107	-0.007		485	486.019	36.157	-0.028
3-in-star	1717	1012.97	504.401	1.396		1717	1065.67	494.107	1.318
3-out-star	486	486.654	54.357	-0.012		486	487.293	51.719	-0.025
path2	582	579.506	88.575	0.028		582	584.291	90.416	-0.025
T1	4	10.745	4.629	-1.457		4	10.288	4.202	-1.496
T2	38	81.03	29.686	-1.449		38	78.022	27.014	-1.482
T3	55	103.696	32.881	-1.481		55	100.729	30.559	-1.496
T4	56	64.746	17.638	-0.496		56	63.476	17.532	-0.426
T5	35	54.472	17.44	-1.117		35	52.722	15.352	-1.154
T6	38	58.455	18.406	-1.111		38	56.927	17.457	-1.084
T7	271	275.249	64.61	-0.066		271	276.547	69.084	-0.08
T8	172	197.693	53.343	-0.482		172	193.166	48.054	-0.44
T9(030T)	179	185.597	41.75	-0.158		179	183.855	41.312	-0.118
T10(030C)	25	45.226	12.85	-1.574		25	44.299	12.554	-1.537
AinS(2.00)	179.13	219.426	21.956	-1.835		179.127	220.845	21.22	-1.966
AoutS(2.00)	303.55	302.111	20.298	0.071		303.547	302.562	19.216	0.051
Ain1out-star(2.00)	233.48	252.499	32.447	-0.586		233.476	251.93	29.077	-0.635
1inAout-star(2.00)	233.16	233.01	32.777	0.004		233.156	234.412	32.506	-0.039
AinAout-star(2.00)	103.09	106.102	12.813	-0.235		103.092	105.916	11.425	-0.247
AT-T(2.00)	125.5	124.977	25.633	0.02		125.5	124.334	24.607	0.047
AT-C(2.00)	55.938	83.454	22.509	-1.222		55.938	82.075	21.791	-1.199
AT-D(2.00)	100.73	108.574	23.6	-0.332		100.73	107.369	21.304	-0.312
AT-U(2.00)	128.75	125.956	25.278	0.111		128.75	125.455	25.224	0.131
AT-TD(2.00)	113.12	116.776	24.403	-0.15		113.115	115.851	22.736	-0.12
AT-TU(2.00)	127.13	125.467	25.387	0.065		127.125	124.894	24.857	0.09
AT-DU(2.00)	114.74	117.265	24.066	-0.105		114.74	116.412	22.933	-0.073
AT-TDU(2.00)	118.33	119.836	24.549	-0.061		118.327	119.052	23.446	-0.031
1Gender_interaction	45	35.008	6.306	1.584		45	34.507	5.864	1.79
2ClinicalRoleID_Bin_interaction	79	74.341	12.104	0.385		79	73.685	10.028	0.53
3RoleNurse_interaction	14	13.989	3.591	0.003		14	14.056	3.763	-0.015
4RoleDrs_interaction	14	14.031	7.224	-0.004		14	14.602	6.217	-0.097
5RoleOHCP_interaction	20	20.551	8.542	-0.065		20	19.245	7.487	0.101
6RoleNCMGMT_interaction	114	113.84	9.852	0.016		114	113.857	10.424	0.014
7TGT1Yes0No_Bin_interaction	18	7.434	4.304	2.455		18	7.939	4.214	2.387
8KPO1Yes0No_Bin_interaction	32	26.984	5.018	1		32	25.293	5.866	1.143
9RPIW1Yes0No_Bin_interaction	41	42.263	7.551	-0.167		41	40.556	7.551	0.059
10L4L1Yes0No_Bin_interaction	48	47.361	10.318	0.062		48	47.962	9.269	0.004
11HybridvsPurePlay_Bin_interaction	31	30.62	7.936	0.048		31	31.252	7.31	-0.034
12Q10_LeadRole_Bin_interaction	81	79.536	10.312	0.142		81	81.14	10.333	-0.014
19NormalYes_interaction	37	36.434	8.264	0.068		37	36.599	7.205	0.056

20CognPartLowAgree_interaction	41	43.591	10.252	-0.253		41	44.094	9.225	-0.335
21CoheLowAgree_interaction	40	41.237	9.525	-0.13		40	41.667	8.391	-0.199
1Gender_sender	92	102.403	8.783	-1.184		92	101.133	8.531	-1.071
2ClinicalRoleID_Bin_sender	124	115.987	10.002	0.801		124	115.507	9.452	0.899
3RoleNurse_sender	32	29.744	4.583	0.492		32	29.583	4.749	0.509
4RoleDrs_sender	48	40.256	6.08	1.274		48	41.094	5.602	1.233
5RoleOHCP_sender	44	45.987	6.3	-0.315		44	44.83	6.112	-0.136
6RoleNCMGMT_sender	149	157.049	9.862	-0.816		149	157.938	9.563	-0.935
7TGT1Yes0No_Bin_sender	35	34.932	4.73	0.014		35	34.99	4.522	0.002
8KPO1Yes0No_Bin_sender	49	49.454	2.562	-0.177		49	49.012	2.594	-0.005
9RPIW1Yes0No_Bin_sender	78	80.416	5.857	-0.412		78	80.53	5.881	-0.43
10L4L1Yes0No_Bin_sender	210	200.778	12.136	0.76		210	201.775	11.633	0.707
18FamiliarYes_sender	104	100.231	8.255	0.457		104	101.174	7.591	0.372
19NormalYes_sender	186	184.784	11.346	0.107		186	185.45	11.035	0.05
20CognPartLowAgree_sender	201	200.144	12.087	0.071		201	201.084	11.486	-0.007
21CoheLowAgree_sender	196	196.115	11.873	-0.01		196	196.879	11.405	-0.077
2ClinicalRoleID_Bin_receiver	114	117.55	14.174	-0.25		114	117.766	12.404	-0.304
3RoleNurse_receiver	42	43.89	6.862	-0.275		42	43.732	7.025	-0.247
4RoleDrs_receiver	41	35.693	8.342	0.636		41	37.033	8.022	0.495
5RoleOHCP_receiver	31	37.967	9.529	-0.731		31	37.001	8.469	-0.709
6RoleNCMGMT_receiver	159	155.486	12.384	0.284		159	155.679	12.463	0.266
7TGT1Yes0No_Bin_receiver	40	39.113	9.388	0.094		40	41.446	9.357	-0.155
8KPO1Yes0No_Bin_receiver	58	58.132	8.168	-0.016		58	57.474	9.202	0.057
9RPIW1Yes0No_Bin_receiver	95	93.547	10.709	0.136		95	92.873	10.848	0.196
10L4L1Yes0No_Bin_receiver	72	68.093	11.997	0.326		72	68.969	11.023	0.275
18FamiliarYes_receiver	39	32.82	7.273	0.85		39	33.513	6.798	0.807
19NormalYes_receiver	62	59.117	10.901	0.264		62	59.69	9.621	0.24
20CognPartLowAgree_receiver	64	63.449	11.887	0.046		64	64.132	10.882	-0.012
Std Dev in-degree dist	2.12	2.025	0.206	0.461		2.12	2.05	0.212	0.333
Skew in-degree dist	5.295	3.047	0.75	2.997		5.295	3.119	0.712	3.055
Std Dev out-degree dist	2.149	2.147	0.066	0.029		2.149	2.148	0.064	0.012
Skew out-degree dist	0.956	0.955	0.082	0.005		0.956	0.953	0.077	0.039

Table 65: Model Estimates for NHS-K Advice Provision Network

NHS K **Model A: Purely Structural Effects**			
Parameter [PNet Name]	**Estimates**	**Standard Error (SE)**	**Convergence Statistic (t-ratio)**
Arc	-6.787*	0.279	0.060
Reciprocity	0.569	0.549	0.070
2-out-star	1.752*	0.200	0.051
3-out-star	-0.539*	0.083	0.042
Multiple Connectivity [path2]	-0.135*	0.038	0.059
Popularity Spread [AinS(2.00)]	0.041	0.147	0.056
Generalized Transitivity [AT-TDU(2.00)]	1.686*	0.196	0.056
Model B: Structural & Actor-Relation Effects			
Arc	-6.705*	0.296	0.023
Reciprocity	0.482	0.594	0.062
2-out-star	1.585*	0.205	0.021
3-out-star	-0.543*	0.084	0.011
Multiple Connectivity [path2]	-0.114*	0.044	0.055
Popularity Spread [AinS(2.00)]	-0.106	0.177	0.067
Generalized Transitivity [AT-TDU(2.00)]	1.452*	0.205	0.070
Model B: Actor Effects			
Homophily (Allied healthcare Professionals Role)	0.938*	0.275	0.027
Homophily (TGT Role)	0.440	0.304	0.002
Homophily (KPO Role)	0.698*	0.320	0.048
Homophily (RPIW Participants)	0.915*	0.194	0.007
Homophily (L4L Participants)	0.468	0.368	0.033
Homophily (Leadership Role)	0.003	0.176	0.051
Sender (TGT Role)	0.973*	0.283	0.049
Sender (Cohesion)	0.997*	0.175	-0.047
Sender (Low No Impact)	0.066	0.302	-0.077

Estimation was conducted using the Pnet package (Wang, Robins, et al., 2009)

**** p<= 0.050***

Table 66: Model Estimates for NHS-C Trust Network

NHS C - Trust Network			
Model A: Purely Structural Effects			
Parameter [PNet Name]	**Estimates**	**Standard Error (SE)**	**Convergence Statistic (t-ratio)**
Arc	-2.594*	0.289	-0.026
Reciprocity	1.518*	0.392	-0.018
3-out-star	-0.059*	0.016	-0.025
Popularity Spread [AinS(2.00)]	-1.026*	0.173	-0.021
Alternating-in-One-Out Star [Ain1out-star(2.00)]	0.518*	0.134	-0.030
Alternating-in-Alternating -Out Star [AinAout-star(2.00)]	-2.498*	0.261	-0.041
Transitive Path Closure [AT-T(2.00)]	1.435*	0.128	-0.030
Model B: Structural & Actor-Relation Effects			
Arc	-2.952*	0.293	-0.080
Reciprocity	1.606*	0.421	-0.091
3-out-star	-0.065*	0.015	-0.062
Popularity Spread [AinS(2.00)]	-0.933*	0.171	-0.098
Alternating-in-One-Out Star [Ain1out-star(2.00)]	0.512*	0.129	-0.074
Alternating-in-Alternating -Out Star [AinAout-star(2.00)]	-2.391*	0.266	-0.082
Transitive Path Closure [AT-T(2.00)]	1.402	0.137	-0.083
Sender (Clinical Role)	0.127	0.089	-0.052
Sender (L4L)	0.498*	0.100	0.059
Receiver (Nurse)	-0.316*	0.151	0.043
Receiver (L4L)	0.043	0.166	0.055

Estimation was conducted using the Pnet package (Wang, Robins, et al., 2009)

**** p<= 0.050***

Table 67: NHS-C Model A Selected Goodness-of-Fit (GOF) Results

Selected Goodness-of-Fit (GOF) details for Model A: Advice Provision Network						Selected Goodness-of-Fit (GOF) Details for Model B Trust Network			
Parameters	**Observed**	**Mean**	**Standard Dev.**	**GOF Ratio**		**Observed**	**Mean**	**Standard Dev.**	**GOF Ratio**
arc	269	278.82	68.82	-0.143		267	239.97	42.45	0.637
reciprocity	18	20.90	18.29	-0.159		18	10.43	11.12	0.681
2-in-star	581	377.56	284.65	0.715		580	225.94	155.96	2.27
2-out-star	531	513.44	285.82	0.061		523	350.01	169.52	1.02
3-in-star	2446	629.47	786.61	2.309		2446	244.10	392.60	5.609
3-out-star	686	784.28	645.81	-0.152		674	418.85	368.32	0.693
path2	659	662.44	553.90	-0.006		653	352.83	311.14	0.965
T1	2	9.34	9.82	-0.747		2	3.99	6.04	-0.329
T2	15	70.50	74.10	-0.749		15	29.45	44.78	-0.323
T3	32	90.05	95.61	-0.607		32	36.78	56.60	-0.085
T4	20	52.08	55.46	-0.578		20	21.29	32.75	-0.039
T5	17	52.58	53.39	-0.666		17	22.40	32.32	-0.167
T6	18	61.85	69.19	-0.634		18	23.91	38.53	-0.153
T7	197	247.78	277.44	-0.183		197	96.69	151.62	0.662
T8	152	268.97	272.93	-0.429		151	114.07	157.66	0.234
T9(030T)	121	159.25	159.00	-0.241		119	69.74	93.28	0.528
T10(030C)	23	39.28	42.44	-0.384		23	15.71	24.43	0.298
AinS(2.00)	196.99	213.40	109.82	-0.149		195.99	152.95	65.26	0.66
AoutS(2.00)	307.35	279.88	115.06	0.239		303.60	214.04	70.28	1.274
Ain1out-star(2.00)	250.83	272.16	149.73	-0.142		245.83	185.53	91.83	0.657
1inAout-star(2.00)	262.98	221.74	139.28	0.296		259.60	143.22	81.70	1.425
AinAout-star(2.00)	104.32	109.00	36.78	-0.127		101.69	88.14	24.42	0.555
AT-T(2.00)	93.44	109.41	103.39	-0.154		91.94	50.41	61.42	0.676
AT-C(2.00)	52.75	73.97	77.73	-0.273		52.75	30.09	44.66	0.507
AT-D(2.00)	80.25	99.60	92.57	-0.209		78.25	46.36	55.03	0.579
AT-U(2.00)	101.38	99.59	95.66	0.019		99.88	45.30	55.64	0.981
AT-TD(2.00)	86.84	104.50	97.95	-0.18		85.09	48.39	58.21	0.631
AT-TU(2.00)	97.41	104.50	99.49	-0.071		95.91	47.86	58.51	0.821
AT-DU(2.00)	90.81	99.59	94.03	-0.093		89.06	45.83	55.28	0.782
AT-TDU(2.00)	91.69	102.87	97.14	-0.115		90.02	47.36	57.32	0.744
Std Dev in-degree dist	2.452	1.698	0.609	1.237		2.455	1.369	0.391	2.778
Skew in-degree dist	5.247	1.428	0.691	5.524		5.241	1.128	0.628	6.548
Std Dev out-degree dist	2.325	2.149	0.522	0.338		2.31	1.841	0.363	1.295
Skew out-degree dist	1.207	1.329	0.23	-0.53		1.222	1.304	0.227	-0.364

Table 68: NHS-C Model B Selected Goodness-of-Fit (GOF) Results

Selected Goodness-of-Fit(GOF) details for Model A Advice Provision Network						Selected Goodness-of-Fit(GOF) Details for Model B Trust Network			
Parameters	**Observed**	**Mean**	**Standard Dev.**	**GOF Ratio**		**Observed**	**Mean**	**Standard Dev.**	**GOF Ratio**
arc	269	323.934	29.446	-1.866		267	245.905	38.392	0.549
reciprocity	18	33.295	8.09	-1.891		18	12.399	10.335	0.542
2-in-star	581	577.097	154.401	0.025		580	251.709	139.16	2.359
2-out-star	531	706.214	123.521	-1.418		523	383.42	155.061	0.9
3-in-star	2446	1185.94	589.187	2.139		2446	295.323	338.581	6.352
3-out-star	686	1209.51	302.003	-1.733		674	491.828	337.486	0.54
path2	659	1033.62	256.799	-1.459		653	401.441	281.152	0.895
T1	2	16.423	5.915	-2.439		2	5.075	5.908	-0.52
T2	15	124.709	40.587	-2.703		15	37.576	43.007	-0.525
T3	32	159.878	49.531	-2.582		32	47.051	53.674	-0.28
T4	20	93.397	28.876	-2.542		20	26.938	30.478	-0.228
T5	17	91.066	26.019	-2.847		17	28.221	30.32	-0.37
T6	18	110.647	38.335	-2.417		18	31.021	36.502	-0.357
T7	197	444.425	148.563	-1.665		197	122.232	138.983	0.538
T8	152	453.523	126.127	-2.391		151	143.462	146.495	0.051
T9(030T)	121	274.936	76.855	-2.003		119	85.992	86.111	0.383
T10(030C)	23	69.696	21.82	-2.14		23	20.107	23.062	0.125
AinS(2.00)	196.992	287.815	48.441	-1.875		195.992	164.357	58.817	0.538
AoutS(2.00)	307.346	357.31	48.503	-1.03		303.596	227.053	64.142	1.193
Ain1out-star(2.00)	250.828	370.261	62.406	-1.914		245.828	199.402	84.295	0.551
1inAout-star(2.00)	262.975	315.181	61.404	-0.85		259.6	154.338	73.896	1.424
AinAout-star(2.00)	104.319	131.863	17.117	-1.609		101.694	89.986	22.316	0.525
AT-T(2.00)	93.438	182.017	45.261	-1.957		91.938	61.16	56.293	0.547
AT-C(2.00)	52.75	127.247	35.943	-2.073		52.75	38.288	41.762	0.346
AT-D(2.00)	80.249	162.829	39.58	-2.086		78.249	56.396	50.841	0.43
AT-U(2.00)	101.375	167.348	43.637	-1.512		99.875	55.16	51.186	0.874
AT-TD(2.00)	86.843	172.423	42.26	-2.025		85.093	58.778	53.543	0.491
AT-TU(2.00)	97.406	174.682	44.336	-1.743		95.906	58.16	53.708	0.703
AT-DU(2.00)	90.812	165.089	41.285	-1.799		89.062	55.778	50.949	0.653
AT-TDU(2.00)	91.687	170.731	42.563	-1.857		90.021	57.572	52.72	0.615
1Gender_interaction	26	30.67	8.337	-0.56		26	21.291	6.808	0.692
2ClinicalRoleID_Bin_interaction	73	81.114	14.337	-0.566		72	59.464	14.887	0.842
3RoleDrs_interaction	4	4.142	2.349	-0.06		4	3.024	2.18	0.448
4RoleNurse_interaction	9	7.736	2.796	0.452		8	7.122	2.698	0.325
5RoleOHCP_interaction	11	18.092	6.448	-1.1		11	10.944	5.427	0.01
6RoleNCMGMT_interaction	62	77.253	13.24	-1.152		62	60.896	10.281	0.107
7TGT1Yes0No_Bin_interaction	0	0.187	0.42	-0.445		0	0.151	0.383	-0.395
8KPO1Yes0No_Bin_interaction	1	0.35	0.585	1.112		1	0.426	0.679	0.845
9RPIW1Yes0No_Bin_interaction	71	87.425	15.647	-1.05		69	62.93	16.794	0.361
10L4L1Yes0No_Bin_interaction	58	95.787	21.716	-1.74		57	48.69	21.637	0.384
12Q10_LeadRole_Bin_interaction	64	87.64	16.268	-1.453		63	58.869	15.224	0.271
14OrgTenLessthan6_interaction	8	10.126	5.582	-0.381		8	4.811	3.683	0.866
28NormalNo_interaction	2	11.006	6.834	-1.318		2	3.274	3.772	-0.338

29CognPartBinLowDis_interaction	0	0.118	0.377	-0.313		0	0.141	0.497	-0.283
30CoheLowDis_interaction	0	0.267	0.58	-0.461		0	0.267	0.59	-0.453
31CollectActionLowDis_interaction	14	33.503	10.791	-1.807		13	14.505	10.186	-0.148
32RefleMonitLowDis_interaction	3	9.479	5.603	-1.156		2	2.754	2.475	-0.305
33IndivEngageDis_interaction	1	4.035	3.211	-0.945		1	1.374	1.455	-0.257
34StaffEngageDis_interaction	0	0.289	0.588	-0.491		0	0.172	0.476	-0.361
35ImpactBinLowNo_interaction	3	7.568	5.131	-0.89		2	2.222	2.603	-0.085
1Gender_sender	89	98.549	16.099	-0.593		89	69.91	15.885	1.202
2ClinicalRoleID_Bin_sender	147	178.31	19.986	-1.567		146	135.11	25.044	0.435
3RoleDrs_sender	33	40.106	9.562	-0.743		33	28.202	8.797	0.545
4RoleNurse_sender	57	58.616	10.106	-0.16		56	51.421	9.876	0.464
5RoleOHCP_sender	57	79.588	13.662	-1.653		57	55.487	15.417	0.098
6RoleNCMGMT_sender	122	145.624	19.637	-1.203		121	110.795	18.807	0.543
7TGT1Yes0No_Bin_sender	6	6.244	3.682	-0.066		6	5.124	3.237	0.271
8KPO1Yes0No_Bin_sender	19	14.052	5.703	0.868		19	11.485	5.113	1.47
9RPIW1Yes0No_Bin_sender	140	171.781	19.418	-1.637		138	128.09	25.233	0.393
10L4L1Yes0No_Bin_sender	165	207.806	24.751	-1.729		163	145.049	31.457	0.571
12Q10_LeadRole_Bin_sender	135	185.257	20.985	-2.395		134	136.061	25.684	-0.08
18FamiliarYes_sender	105	117.3	17.187	-0.716		104	85.67	21.043	0.871
19NormalYes_sender	137	154.09	21.672	-0.789		136	114.614	23.087	0.926
20CognPartLowAgree_sender	149	187.833	23.721	-1.637		148	129.352	27.35	0.682
3RoleDrs_receiver	52	36.25	10.265	1.534		52	27.156	7.953	3.124
4RoleNurse_receiver	37	40.573	7.87	-0.454		35	34.206	6.968	0.114
5RoleOHCP_receiver	44	72.662	13.823	-2.074		44	48.001	15.15	-0.264
6RoleNCMGMT_receiver	136	174.449	18.363	-2.094		136	136.542	19.477	-0.028
7TGT1Yes0No_Bin_receiver	10	9.361	3.356	0.19		10	8.644	2.859	0.474
8KPO1Yes0No_Bin_receiver	13	11.582	4.806	0.295		13	10.1	4.021	0.721
9RPIW1Yes0No_Bin_receiver	134	164.86	19.596	-1.575		132	121.102	25.058	0.435
10L4L1Yes0No_Bin_receiver	96	137.094	23.969	-1.714		95	78.425	27.233	0.609
12Q10_LeadRole_Bin_receiver	115	152.946	20.965	-1.81		114	107.059	22.537	0.308
17ProTenLessThan62_receiver	23	36.717	11.946	-1.148		23	20.574	7.606	0.319
18FamiliarYes_receiver	59	70.81	16.852	-0.701		59	45.097	16.943	0.821
19NormalYes_receiver	67	88.059	20.478	-1.028		67	57.418	18.672	0.513
Std Dev in-degree dist	2.452	2.234	0.311	0.699		2.455	1.461	0.38	2.612
Skew in-degree dist	5.247	2.267	0.425	7.01		5.241	1.332	0.689	5.672
Std Dev out-degree dist	2.325	2.57	0.198	-1.237		2.31	1.935	0.352	1.068
Skew out-degree dist	1.207	1.425	0.158	-1.379		1.222	1.382	0.225	-0.714

Table 69: Model Estimates for NHS-K Advice Provision Network

NHS K **Model A: Purely Structural Effects**			
Parameter [PNet Name]	**Estimates**	**Standard Error (SE)**	**Convergence Statistic (t-ratio)**
Arc	-6.787*	0.279	0.060
Reciprocity	0.569	0.549	0.070
2-out-star	1.752*	0.200	0.051
3-out-star	-0.539*	0.083	0.042
Multiple Connectivity [path2]	-0.135*	0.038	0.059
Popularity Spread [AinS(2.00)]	0.041	0.147	0.056
Generalized Transitivity [AT-TDU(2.00)]	1.686*	0.196	0.056
Model B: Structural & Actor-Relation Effects			
Arc	-6.705*	0.296	0.023
Reciprocity	0.482	0.594	0.062
2-out-star	1.585*	0.205	0.021
3-out-star	-0.543*	0.084	0.011
Multiple Connectivity [path2]	-0.114*	0.044	0.055
Popularity Spread [AinS(2.00)]	-0.106	0.177	0.067
Generalized Transitivity [AT-TDU(2.00)]	1.452*	0.205	0.070
Model B: Actor Effects			
Homophily (Allied healthcare Professionals Role)	0.938*	0.275	0.027
Homophily (TGT Role)	0.440	0.304	0.002
Homophily (KPO Role)	0.698*	0.320	0.048
Homophily (RPIW Participants)	0.915*	0.194	0.007
Homophily (L4L Participants)	0.468	0.368	0.033
Homophily (Leadership Role)	0.003	0.176	0.051
Sender (TGT Role)	0.973*	0.283	0.049

Estimation was conducted using the Pnet package (Wang, Robins, et al., 2009)

**** p<= 0.050***

Table 70: Model Estimates for NHS-K Trust Network

NHS K **Model A: Purely Structural Effects**			
Parameter [PNet Name]	**Estimates**	**Standard Error (SE)**	**Convergence Statistic (t-ratio)**
Arc	-6.599*	0.297	-0.046
Reciprocity	0.254	0.542	0.003
2-out-star	1.750*	0.209	-0.037
3-out-star	-0.544*	0.090	-0.032
Multiple Connectivity [path2]	-0.112*	0.037	-0.013
Popularity Spread [AinS(2.00)]	-0.200	0.164	-0.032
Generalized Transitivity [AT-TDU(2.00)]	1.802*	0.192	0.004
Model B: Structural & Actor-Relation Effects			
Parameter [PNet Name]			
arc	-6.471*	0.289	-0.047
reciprocity	0.165	0.639	-0.006
2-out-star	1.552*	0.198	-0.061
3-out-star	-0.543*	0.081	-0.064
Multiple Connectivity [path2]	-0.081	0.047	-0.059
Popularity Spread [AinS(2.00)]	-0.405*	0.185	-0.054
Generalized Transitivity [AT-TDU(2.00)]	1.516*	0.215	0.002
Homophily (Allied healthcare Professionals Role)	1.222*	0.223	0.008
Homophily (TGT Role)	0.384	0.303	0.098
Homophily (KPO Role)	0.684*	0.282	-0.050
Homophily (RPIW Participants)	1.046*	0.201	-0.049
Homophily (L4L Participants)	0.535	0.350	0.059
Homophily (Leadership Role)	-0.164	0.190	-0.086
Sender (TGT Role)	1.038*	0.312	0.001

Table 71: NHS-K Model A Selected Goodness-of-Fit (GOF) Results

Goodness-of-Fit (GOF) details for Model A: Advice Provision Network						Goodness-of-Fit (GOF) Details for Model B: Trust Network			
Parameters	Observed	Mean	**Standard Error (SE)**	**GOF t-ratio**		Observed	Mean	**Standard Error (SE)**	**GOF t-ratio**
arc	194	189.39	29.28	0.158		194	195.50	27.26	-0.055
reciprocity	10	8.61	5.49	0.254		10	9.95	5.97	0.009
2-in-star	340	179.65	63.44	2.528		384	177.27	60.66	3.408
2-out-star	383	370.45	74.50	0.168		382	384.33	71.99	-0.032
3-in-star	1164	143.22	93.34	11.937		1596	136.75	89.00	16.396
3-out-star	460	441.50	107.14	0.173		458	459.04	105.10	-0.010
path2	332	306.22	116.36	0.222		349	349.97	121.78	-0.008
T1	1	1.88	2.25	-0.392		1	2.38	2.63	-0.525
T2	8	14.50	15.95	-0.408		8	18.52	18.84	-0.558
T3	11	19.48	19.96	-0.425		11	25.29	23.90	-0.598
T4	9	11.88	11.23	-0.256		9	14.95	13.14	-0.453
T5	18	14.88	11.77	0.265		18	18.37	13.45	-0.027
T6	8	10.57	11.13	-0.231		8	13.29	12.97	-0.408
T7	72	50.83	44.01	0.481		79	61.04	49.68	0.361
T8	81	77.44	52.59	0.068		81	91.70	57.64	-0.186
T9(030T)	71	62.72	34.72	0.239		74	73.98	38.81	0.000
T10(030C)	5	9.33	8.88	-0.487		5	12.39	10.81	-0.683
AinS(2.00)	133.70	127.13	35.94	0.183		125.82	126.95	34.28	-0.033
AoutS(2.00)	225.34	214.60	39.54	0.272		225.09	222.37	37.84	0.072
AinS(2.00)	133.70	127.13	35.94	0.183		125.82	126.95	34.28	-0.033
AoutS(2.00)	225.34	214.60	39.54	0.272		225.09	222.37	37.84	0.072
Ain1out-star(2.00)	154.05	190.81	54.63	-0.673		153.06	215.51	54.30	-1.150
AinAout-star(2.00)	65.58	82.10	20.26	-0.816		64.93	91.49	19.52	-1.361
AT-T(2.00)	66.50	54.32	26.71	0.456		68.50	62.75	28.79	0.200
AT-C(2.00)	14.50	22.31	19.38	-0.403		14.50	28.92	22.69	-0.635
AT-U(2.00)	51.25	50.16	24.77	0.044		60.44	61.27	27.44	-0.030
AT-TD(2.00)	62.22	53.56	26.01	0.333		64.47	62.01	28.10	0.087
AT-TU(2.00)	58.88	52.24	25.71	0.258		61.13	60.45	27.89	0.024
AT-TDU(2.00)	58.56	52.43	25.56	0.24		60.90	60.72	27.71	0.006
Std Dev in-degree dist	2.12	1.42	0.20	3.472		2.27	1.38	0.20	4.484
Skew in-degree dist	4.94	1.20	0.33	11.377		5.60	1.16	0.36	12.425
Std Dev out-degree dist	2.27	2.22	0.17	0.27		2.26	2.25	0.16	0.076
Skew out-degree dist	1.22	1.26	0.24	-0.178		1.21	1.21	0.22	0.042

Table 72: NHS-K Model B Selected Goodness-of-Fit (GOF) Results

Model B - Advice Provision Network						Model B - Trust Network			
Parameters	**Observed**	**Mean**	**SD**	**GOF t-ratio**		**Observed**	**Mean**	**SD**	**GOF t-ratio**
arc	194	195.516	15.869	-0.096		194	193.003	13.899	0.072
reciprocity	10	10.295	3.627	-0.081		10	9.609	3.678	0.106
2-in-star	340	208.445	49.277	2.67		384	186.165	43.279	4.571
2-out-star	383	387.352	42.128	-0.103		382	380.427	39.48	0.04
3-in-star	1164	223.52	126.794	7.417		1596	188.208	104.065	13.528
3-out-star	460	466.755	68.279	-0.099		458	456.239	66.05	0.027
path2	332	337.594	74.494	-0.075		349	341.48	73.387	0.102
T1	1	3.579	2.459	-1.049		1	3.075	2.413	-0.86
T2	8	27.652	16.744	-1.174		8	24.608	16.878	-0.984
T3	11	36.925	20.499	-1.265		11	34.365	21.123	-1.106
T4	9	21.855	11.563	-1.112		9	20.438	11.815	-0.968
T5	18	21.361	9.999	-0.336		18	19.834	10.342	-0.177
T6	8	20.252	11.728	-1.045		8	18.151	11.702	-0.867
T7	72	89.714	45.456	-0.39		79	83.104	43.964	-0.093
T8	81	97.292	36.094	-0.451		81	91.24	37.093	-0.276
T9(030T)	71	80.894	28.951	-0.342		74	78.844	29.643	-0.163
T10(030C)	5	17.223	9.228	-1.325		5	16.921	9.639	-1.237
AinS(2.00)	133.696	135.78	21.103	-0.099		125.817	124.301	18.791	0.081
AoutS(2.00)	225.336	223.078	21.425	0.105		225.086	219.582	19.592	0.281
Ain1out-star(2.00)	154.047	188.351	28.184	-1.217		153.055	194.31	27.774	-1.485
1inAout-star(2.00)	154.578	142.03	27.653	0.454		162.438	143.084	26.27	0.737
AinAout-star(2.00)	65.578	80.367	11.195	-1.321		64.926	82.897	10.757	-1.671
AT-T(2.00)	66.5	62.19	17.845	0.242		68.5	60.652	17.977	0.437
AT-C(2.00)	14.5	35.925	16.513	-1.297		14.5	35.555	17.225	-1.222
AT-D(2.00)	57.938	58.421	15.972	-0.03		60.438	57.272	16.176	0.196
AT-U(2.00)	51.25	59.778	18.437	-0.463		53.75	58.464	18.4	-0.256
AT-TD(2.00)	62.219	60.305	16.839	0.114		64.469	58.962	17.022	0.323
AT-TU(2.00)	58.875	60.984	18.093	-0.117		61.125	59.558	18.135	0.086
AT-DU(2.00)	54.594	59.099	17.07	-0.264		57.094	57.868	17.175	-0.045
AT-TDU(2.00)	58.563	60.13	17.307	-0.091		60.896	58.796	17.42	0.121
2ClinicalRoleID_Bin_interaction	42	43.139	7.992	-0.143		42	42.583	7.746	-0.075
3RoleNurse_interaction	8	6.049	2.558	0.763		11	5.586	2.438	2.221
4RoleDrs_interaction	3	1.893	1.367	0.81		6	1.829	1.394	2.992
5RoleOHCP_interaction	11	11.433	4.801	-0.09		15	13.536	5.125	0.286
6RoleNCMGMT_interaction	83	61.777	9.175	2.313		89	62.828	9.092	2.879
7TGT1Yes0No_Bin_interaction	12	12.089	4.515	-0.02		12	11.511	4.44	0.11
8KPO1Yes0No_Bin_interaction	7	7.02	4.437	-0.005		7	6.762	4.181	0.057
9RPIW1Yes0No_Bin_interaction	52	52.79	10.322	-0.077		55	54.619	9.689	0.039
10L4L1Yes0No_Bin_interaction	19	19.223	4.607	-0.048		19	18.913	4.241	0.021
12Q10_LeadRole_Bin_interaction	45	45.251	7.294	-0.034		41	40.666	6.45	0.052
2ClinicalRoleID_Bin_sender	79	77.91	11.104	0.098		78	76.22	10.154	0.175
3RoleNurse_sender	26	27.891	6.712	-0.282		25	25.827	6.008	-0.138
4RoleDrs_sender	24	19.02	5.092	0.978		24	18.106	5.048	1.168
5RoleOHCP_sender	29	30.999	7.686	-0.26		29	32.287	7.381	-0.445
6RoleNCMGMT_sender	115	117.606	11.568	-0.225		116	116.783	10.464	-0.075
7TGT1Yes0No_Bin_sender	36	36.107	4.152	-0.026		36	35.599	4.409	0.091
8KPO1Yes0No_Bin_sender	22	22.951	5.2	-0.183		22	22.753	5.07	-0.149
9RPIW1Yes0No_Bin_sender	86	87.174	10.33	-0.114		87	87.906	9.639	-0.094
10L4L1Yes0No_Bin_sender	116	111.876	10.216	0.404		116	111.774	9.014	0.469
12Q10_LeadRole_Bin_sender	100	102.854	10.88	-0.262		100	99.052	9.887	0.096
18FamiliarYes_sender	56	50.843	6.116	0.843		56	51.336	5.583	0.835
19NormalYes_sender	106	101.111	9.567	0.511		105	100.914	8.383	0.487
20CognPartLowAgree_sender	113	111.465	10.121	0.152		113	111.462	8.955	0.172
21CoheLowAgree_sender	109	110.168	9.904	-0.118		109	110.109	8.695	-0.128
35ImpactBinLowNo_sender	10	10.042	3.477	-0.012		10	9.8	3.368	0.059
1Gender_receiver	79	75.366	9.263	0.392		78	74.614	8.333	0.406
2ClinicalRoleID_Bin_receiver	74	98.968	11.566	-2.159		69	96.538	10.57	-2.605
3RoleNurse_receiver	37	44.055	7.117	-0.991		34	41.742	5.934	-1.305
4RoleDrs_receiver	12	16.55	4.194	-1.085		12	15.909	3.881	-1.007
20CognPartLowAgree_receiver	23	26.657	5.73	-0.638		23	25.856	5.229	-0.546
21CoheLowAgree_receiver	22	22.241	5.12	-0.047		22	21.807	4.682	0.041
Std Dev out-degree dist	2.265	2.269	0.097	-0.045		2.261	2.255	0.096	0.068
Skew out-degree dist	1.215	1.206	0.13	0.07		1.214	1.22	0.115	-0.05

D5. 7 NHS-E Model Estimates Results

Table 73: Model Estimates for NHS-E Advice Provision Network

NHS E - Advice Provision Network **Model A: Purely Structural Effects**			
Parameter [PNet Name]	**Estimates**	**Standard Error (SE)**	**Convergence Statistic (t-ratio)**
Arc	-7.298*	0.292	0.071
3-out-star	-0.087*	0.019	0.047
Multiple Connectivity [path2]	-0.012	0.023	0.031
Activity Spread [AoutS(2.00)]	2.245*	0.219	0.061
Alternating-In-One-Out Star [Ain1out-star(2.00)]	-0.090	0.141	0.043
Alternating-in-Alternating Out Star [AinAout-star(2.00)]	-0.132	0.340	0.062
Popularity Transitivity [AT-TD(2.00)]	1.594*	0.100	0.010
Model B: Structural & Actor-Relation Effects			
Arc	-7.826*	0.316	-0.022
3-out-star	-0.086*	0.020	0.033
Multiple Connectivity [path2]	-0.012	0.040	0.025
Activity Spread [AoutS(2.00)]	1.614*	0.267	0.008
Alternating-In-One-Out Star [Ain1out-star(2.00)]	-0.014	0.158	0.006
Alternating-in-Alternating Out Star [AinAout-star(2.00)]	-0.214	0.352	-0.046
Popularity Transitivity [AT-TD(2.00)]	1.121*	0.141	0.078
Model B: Actor Effects			
Homophily (Doctors Role)	1.721*	0.282	0.018
Homophily (Nurses Role)	1.384	0.207	-0.167
Homophily (Allied healthcare Professionals Role)	1.335*	0.180	0.094
Homophily (Non-Clinical Management Role)	0.647*	0.129	0.039
Homophily (TGT Role)	2.184*	0.369	0.088
Homophily (KPO Role)	1.384*	0.348	0.078
Homophily (RPIW Participants)	0.280*	0.124	0.083
Sender (TGT Role)	0.831	0.300	0.105
Sender (L4L Role)	1.367*	0.207	-0.026
Receiver (KPO)	0.374	0.272	0.038

Estimation was conducted using the Pnet package (Wang, Robins, et al., 2009)

**** p<= 0.050***

Table 74: Model Estimates for NHS-E Trust Network

NHS E – Trust Network			
Model A: Purely Structural Effects			
Parameter [PNet Name]	**Estimates**	**Standard Error (SE)**	**Convergence Statistic (t-ratio)**
Arc	-7.299*	0.291	-0.064
3-out-star	-0.088*	0.019	-0.030
Multiple Connectivity [path2]	-0.016	0.024	-0.028
Activity Spread [AoutS(2.00)]	2.243*	0.224	-0.053
Alternating-In-One-Out Star [Ain1out-star(2.00)]	-0.081	0.146	-0.070
Alternating-in-Alternating Out Star [AinAout-star(2.00)]	-0.133	0.344	-0.085
Popularity Transitivity [AT-TD(2.00)]	1.605*	0.091	-0.034
Model B: Structural & Actor-Relation Effects			
Arc	-7.816*	0.333	0.066
3-out-star	-0.086*	0.019	0.055
Multiple Connectivity [path2]	-0.013	0.039	0.115
Activity Spread [AoutS(2.00)]	1.608*	0.254	0.085
Alternating-In-One-Out Star [Ain1out-star(2.00)]	-0.007	0.158	0.112
Alternating-in-Alternating Out Star [AinAout-star(2.00)]	-0.233	0.359	0.090
Popularity Transitivity [AT-TD(2.00)]	1.117*	0.145	0.098
Homophily (Doctors Role)	1.710*	0.316	0.091
Homophily (Nurses Role)	1.379*	0.205	0.034
Homophily (Allied healthcare Professionals Role)	1.337	0.195	0.245
Homophily (Non-Clinical Management Role)	0.643*	0.126	-0.027
Homophily (TGT Role)	2.194*	0.375	-0.007
Homophily (KPO Role)	1.391*	0.344	-0.040
Homophily (RPIW Participants)	0.284*	0.123	0.075
Sender (TGT Role)	0.856*	0.299	-0.003
Sender (L4L Role)	1.368*	0.191	0.079
Receiver (KPO)	0.377	0.276	-0.027

Estimation was conducted using the Pnet package (Wang, Robins, et al., 2009)

**** p<= 0.050***

Table 75: NHS-E Model A Selected Goodness-of-Fit (GOF) Results

Selected Goodness-of-Fit (GOF) details for Model A: Advice Provision Network						Selected Goodness-of-Fit (GOF) Details for Model A: Trust Network			
Parameters	**Observed**	**Mean**	**Standard Dev.**	**GOF Ratio**		**Observed**	**Mean**	**Standard Dev.**	**GOF Ratio**
arc	279	249.36	33.31	0.89		279	360.93	159.41	-0.514
reciprocity	13	7.90	5.68	0.898		13	19.31	18.19	-0.347
2-in-star	318	271.87	110.81	0.416		318	676.15	641.78	-0.558
2-out-star	586	512.75	115.25	0.636		586	877.89	526.21	-0.555
3-in-star	696	322.49	244.26	1.529		696	1380.53	1819.46	-0.376
3-out-star	847	683.94	221.77	0.735		847	1370.81	1001.91	-0.523
path2	611	467.61	217.31	0.66		611	1204.90	1115.73	-0.532
T1	2	1.64	2.02	0.18		2	3.41	3.85	-0.367
T2	12	15.04	16.14	-0.189		12	33.05	35.27	-0.597
T3	19	24.42	24.15	-0.225		19	58.22	61.68	-0.636
T4	9	15.37	14.15	-0.45		9	38.01	40.00	-0.725
T5	17	16.44	14.15	0.039		17	40.58	39.71	-0.594
T6	7	13.55	13.99	-0.468		7	32.34	35.53	-0.713
T7	67	81.04	73.00	-0.192		67	247.76	280.67	-0.644
T8	126	90.30	70.71	0.505		126	240.87	239.55	-0.48
T9(030T)	108	81.67	53.78	0.49		108	206.97	198.10	-0.5
T10(030C)	14	14.36	13.56	-0.027		14	38.74	42.24	-0.586
Sink	125	80.80	4.85	9.124		125	76.89	10.38	4.633
Source	16	22.77	3.54	-1.911		16	19.96	4.81	-0.824
Isolates	0	42.83	5.61	-7.636		0	32.98	12.44	-2.652
AinS(2.00)	154.32	172.54	49.82	-0.366		154.32	335.90	246.13	-0.738
AoutS(2.00)	328.66	285.71	51.14	0.84		328.66	450.88	236.77	-0.516
Ain1out-star(2.00)	297.97	238.90	66.44	0.889		297.97	461.34	312.62	-0.523
1inAout-star(2.00)	208.69	178.49	64.23	0.47		208.69	388.35	314.90	-0.571
AinAout-star(2.00)	115.47	97.64	19.11	0.933		115.47	160.77	88.38	-0.513
AT-T(2.00)	86.94	67.34	39.90	0.491		86.94	166.26	153.22	-0.518
AT-C(2.00)	38.25	32.29	28.23	0.211		38.25	88.67	95.51	-0.528
AT-D(2.00)	79.95	64.26	37.19	0.422		79.95	157.30	143.30	-0.54
AT-U(2.00)	80.13	62.11	36.96	0.488		80.13	155.39	146.40	-0.514
AT-TD(2.00)	83.45	65.80	38.53	0.458		83.45	161.78	148.24	-0.528
AT-TU(2.00)	83.53	64.72	38.41	0.49		83.53	160.83	149.78	-0.516
AT-DU(2.00)	80.04	63.18	37.04	0.455		80.04	156.34	144.80	-0.527
AT-TDU(2.00)	82.34	64.57	37.98	0.468		82.34	159.65	147.60	-0.524
Std Dev in-degree dist	1.637	1.538	0.28	0.355		1.637	2.012	0.83	-0.451
Skew in-degree dist	4.274	1.76	0.42	5.981		4.274	1.457	0.383	7.358
Std Dev out-degree dist	2.359	2.234	0.205	0.605		2.359	2.578	0.509	-0.431
Skew out-degree dist	1.477	1.489	0.133	-0.091		1.477	1.12	0.549	0.65

Table 76: NHS-E Model B Selected Goodness-of-Fit (GOF) Results

Goodness-of-Fit (GOF) details for Model B Advice Provision Network						Selected Goodness-of-Fit (GOF) Details for Model B Trust Network			
Parameters	**Observed**	**Mean**	**SD**	**GOF t-ratio**		**Observed**	**Mean**	**SD**	**GOF t-ratio**
arc	279	277.77	21.16	0.058		279	279.91	21.76	-0.042
reciprocity	13	12.15	3.67	0.231		13	12.62	3.84	0.099
2-in-star	318	336.42	69.10	-0.267		318	341.00	70.40	-0.327
2-out-star	586	601.63	70.12	-0.223		586	608.05	71.80	-0.307
3-in-star	696	460.99	202.71	1.159		696	465.97	210.37	1.093
3-out-star	847	841.42	138.25	0.04		847	849.56	141.26	-0.018
path2	611	602.68	116.69	0.071		611	612.00	117.91	-0.008
T1	2	3.96	2.59	-0.755		2	4.17	2.65	-0.818
T2	12	31.80	17.30	-1.145		12	33.32	17.85	-1.195
T3	19	44.94	20.93	-1.24		19	46.78	21.51	-1.291
T4	9	26.63	11.57	-1.524		9	27.42	11.71	-1.573
T5	17	27.59	10.97	-0.965		17	28.70	11.37	-1.03
T6	7	24.32	12.31	-1.407		7	25.51	12.81	-1.445
T7	67	134.59	52.47	-1.288		67	137.97	52.80	-1.344
T8	126	139.04	45.30	-0.288		126	144.18	46.64	-0.39
T9(030T)	108	109.34	31.07	-0.043		108	111.74	32.17	-0.116
T10(030C)	14	22.79	9.61	-0.914		14	23.59	9.65	-0.994
AinS(2.00)	154.32	202.53	28.14	-1.713		154.32	205.35	28.79	-1.773
AoutS(2.00)	328.66	326.72	31.72	0.061		328.66	330.03	32.49	-0.042
Ain1out-star(2.00)	297.97	295.11	41.92	0.068		297.97	299.38	42.99	-0.033
1inAout-star(2.00)	208.69	220.67	35.78	-0.335		208.69	223.38	36.57	-0.402
AinAout-star(2.00)	115.47	114.77	14.16	0.049		115.47	115.84	14.74	-0.025
AT-T(2.00)	86.94	83.97	19.91	0.149		86.94	85.65	20.83	0.062
AT-C(2.00)	38.25	47.84	17.34	-0.553		38.25	49.64	17.36	-0.656
AT-D(2.00)	79.95	78.57	18.07	0.076		79.95	80.35	19.17	-0.02
AT-U(2.00)	80.13	78.24	19.55	0.097		80.13	79.73	20.23	0.02
AT-TD(2.00)	83.45	81.27	18.91	0.115		83.45	83.00	19.91	0.022
AT-TU(2.00)	83.53	81.10	19.65	0.124		83.53	82.69	20.45	0.041
AT-DU(2.00)	80.04	78.41	18.64	0.088		80.04	80.04	19.53	0.000
AT-TDU(2.00)	82.34	80.26	19.03	0.109		82.34	81.91	19.93	0.022
2ClinicalRoleID_Bin_interaction	76	76.23	11.59	-0.02		76	76.83	11.50	-0.072
3RoleDrs_interaction	9	8.54	3.93	0.118		9	8.95	4.05	0.013
4RoleNurse_interaction	21	21.17	5.73	-0.029		21	21.01	5.66	-0.001
5RoleOHCP_interaction	24	23.96	7.43	0.006		24	23.65	7.10	0.05
6RoleNCMGMT_interaction	120	120.23	13.51	-0.017		120	119.80	13.35	0.015
7TGT1Yes0No_Bin_interaction	9	8.02	5.72	0.172		9	9.75	6.58	-0.114
8KPO1Yes0No_Bin_interaction	22	21.56	4.63	0.096		22	21.49	4.59	0.112
9RPIW1Yes0No_Bin_interaction	118	117.00	13.43	0.075		118	117.59	12.96	0.031
10L4L1Yes0No_Bin_interaction	61	75.02	10.91	-1.285		61	74.99	10.95	-1.278
12Q10_LeadRole_Bin_interaction	84	76.87	11.80	0.605		84	78.61	12.36	0.436
18FamiliarYes_interaction	26	27.18	5.84	-0.202		26	26.94	5.82	-0.161
19NormalYes_interaction	44	50.06	7.94	-0.763		44	50.37	8.23	-0.774
20CognPartLowAgree_interaction	52	61.33	9.48	-0.983		52	61.40	9.67	-0.971
2ClinicalRoleID_Bin_sender	125	119.37	14.50	0.388		125	121.12	14.61	0.266
3RoleDrs_sender	37	23.78	7.00	1.89		37	25.17	6.95	1.704
4RoleNurse_sender	42	44.24	8.34	-0.269		42	44.67	8.32	-0.321
5RoleOHCP_sender	46	51.35	9.60	-0.557		46	51.28	9.69	-0.544
6RoleNCMGMT_sender	154	158.40	15.20	-0.29		154	158.79	15.22	-0.315
7TGT1Yes0No_Bin_sender	26	24.42	8.12	0.194		26	26.59	8.51	-0.07
8KPO1Yes0No_Bin_sender	39	38.63	4.98	0.074		39	38.52	4.70	0.103
6RoleNCMGMT_receiver	169	163.37	16.02	0.352		169	164.09	15.94	0.308
7TGT1Yes0No_Bin_receiver	23	22.76	8.28	0.029		23	24.53	8.66	-0.177
8KPO1Yes0No_Bin_receiver	46	45.66	7.97	0.043		46	45.61	7.85	0.05
9RPIW1Yes0No_Bin_receiver	171	167.40	16.69	0.216		171	168.46	16.38	0.155
Std Dev in-degree dist	1.637	1.688	0.170	-0.301		1.637	1.696	0.170	-0.344
Skew in-degree dist	4.274	2.098	0.465	4.683		4.274	2.074	0.467	4.709
Std Dev out-degree dist	2.359	2.391	0.115	-0.282		2.359	2.401	0.117	-0.358
Skew out-degree dist	1.477	1.381	0.123	0.786		1.477	1.364	0.126	0.902

End of PhD Thesis