The role of brokering in healthcare networks: what does it mean for reforms, practitioners and patients?

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Abstract

Well-integrated systems are required to deliver effective healthcare services. Research suggests misaligned organisational and functional boundaries still thwart effective patient care. Using social network theory and knowledge transfer framework we examine two long-term condition health networks where brokering occurs to bridge the gaps in provision or information exchange. The experiences of patients, relatives and healthcare practitioners illustrate where information/knowledge is transferred, translated and transformed across organisational and functional boundaries. We propose brokering is essential to the integrated healthcare system. Areas of further research include power of brokers and the value and cost of brokering.

Keywords: Health, Broker, Networks

Introduction
Early studies on service management consider the interaction between service users and service providers in the process of creating services (Fuchs, 1968). Service operations management continues the focus on service desi gn, particularly the interaction between the professional and the customer/service user. Anecdotally we know that patients and relatives bridge gaps in health care processes, systems and services to ensure relevant information gets to the necessary healthcare professional(s). What is not well understood is the nature of this brokering role, the types of gaps that are brokered, and the brokering strategies used. Much of the previous research has focused on the

relationships between service users and providers. For example, Harvey's (1990) research in social services explains how relationships in professional services influence process (re)design and consequently service outcomes. The level of trust and the balance of power in professional service organizations can also influence the relationships among professionals, service users and managers. In subsequent research, Harvey (1992) recognized that the knowledge gap between the professional and the customer requires attention if services are to be improved.

It is well-recognised that agents (often-termed actors) within a network can help to bridge the knowing-doing gap by acting as conduits for the transfer of resources including advice, social support and information (Moolenaar and Sleegers, 2015). Social network theory (SNT) (Reagans and Zuckerman, 2008) helps to examine connections and information flows between the actors and across two healthcare networks to establish the 'structural holes' that may exist (Li and Choi, 2009) and identify where actors act as brokers to bridge the gap between unconnected agents or organisations in the network.

For a broker the challenge can be to transfer information to an agent who will accept and value it (Burt, 2005). Brokers can connect groups by engaging in "transferring, translating, and transforming" practices (Carlile, 2004) and developing work practices, repositories, specifications, and standards that support communication across boundaries (Fernandez-Mateo 2007). This process facilitates negotiation that allows localized knowledge to be transformed into jointly produced knowledge that transcends each group's local interests (Kellogg, 2014).

We propose brokering is an essential role in the design and delivery of integrated healthcare networks/services. Using social network theory and Carlile's framework this study aims to understand the nature of brokering roles occupied in two chronic long-term health networks. This study addresses the following research questions:

RQ1. What is the nature of the structural holes (gaps) that exist within two chronic long-term condition care networks?

RQ2. What type of brokering roles do healthcare professionals, patients and relatives play in bridging the gaps in the two care networks?

RQ3. What strategies do brokers use to ensure information flows support the effective delivery of care?

A brief review of the social network theory, specifically structural holes, follows this introduction. The next section introduces Carlile's framework and its use in understanding the transfer of knowledge and information. The methodology employed for this study is then discussed along with the results of the study. The paper concludes with a summary of the findings in relation to the research questions posed above, limitations of the study and areas of further research.

Social network theory
Social network theory has a long and distinguished history in the social sciences and psychology where it has been used to investigate human social organisation (see Scott 2000) with its main strengths being the potential to address population-level or cross-population-level problems by building up complex social structures from individual level interactions. However, the appeal of the networks approach goes well beyond sociology and psychology and has widespread technological applications as well. Anything from transport networks (Sen et al. 2003) to communication systems such as

the internet (Tadic 2001) can be considered as a system of interacting components. In biology, the network approach has been used in various areas, as biologists have realised that to better understand complex systems, we need to study interactions between components of the system not in isolation but as part of a network of interactions Kim et al., 2011). This notion of understanding the interactions and connections in the system can be applied to healthcare networks.

Social network theory encapsulates the need to develop an understanding of structural holes (Burt, 1992) and bridging (Obstfeld, 2005) as agents can broker the movement of information and resources (Peng et al, 2010). Agents can operate as conduits for the transfer of resources including advice, social support and information (Moolenaar and Sleegers, 2015). A central position supports the agent in operating as a broker through bridging the structural hole between unconnected agents in the network. Bridging the hole allows the broker to create value where the value of the information presented resides in someone else accepting it not with its provider. The challenge for the broker is to transfer the information to an agent who will accept and value it (Burt, 2005).

For manufacturing, this necessitates the operation of an information decoupling point to bridge and deliver value across two operational approaches (e.g. from forecast-driven to demand-driven approach). Within healthcare the decoupling point occurs at several points, for example the point where patient demand meets A&E plans, or discharge from acute (hospital) care to the community. Clearly, the independent providers are aware of each other's existence but the information flows are not linked.

Brokering structural holes within and across organisations
Previously, brokering in organisations has been linked with Burt's (1992) structural holes theory. He argued that all organisations contain structural holes which can be defined as "non-redundant" relationships between two or more actors. In simple terms, if a hole is redundant this suggests the connections to bridge across are not needed for the effective functioning of an organisation or the necessary information can be provided through other equally effective and efficient routes. However, if they are "non-redundant", new connections are required. Such connections are crucial to ensuring an organisation operates effectively and achieves its objectives. In short, structural holes are places where people are disconnected in an organisation and /or information flows required to make the organisation work effectively are disrupted (Monge and Contractor, 2003). While structural holes disrupt the flow of valuable information in an organisation they provide opportunities to those who can re-make (broker) those connections. In simple terms, by spanning structural holes brokers can perform an "intrapreneurial" role within an organisation, by leveraging social capital from the new non-redundant connections between organisational actors (Kuratko et al., 1990; Heng and Loosemore, 2013). In this case, social capital is the value that can be derived from an actor's relationships in an organisation (Brass, 2003). For example, if a broker sits between two other actors and controls the flow of information between them, then they are in a powerful position.

Baker and Obstfeld (1999) argue that brokers tend to employ two distinct types of strategies in reconnecting organisations: "disunion" and "union" strategies. In the disunion strategy, the broker pursues the active separation of disconnected actors therefore becoming a bridge between two disconnected actors but not allowing them to interact directly. Conversely, in the union strategy, a broker closes the network holes between two disconnected actors enabling them to communicate directly or through a common third party. In reality, a combination of both approaches tends to be adopted. The above ideas have been informed by the social network theory which focuses on the

relationships between actors rather than the attributes of actors in an organisation (Wasserman and Faust, 1994). Social network theory argues that an actor's influence in an organisation is not only a function of their legitimate power but a function of their position in that network. "Central" actors located at the intersection of information flows between other parties command the most powerful positions while those on the periphery of a network command the least powerful positions. These ideas can inform us of the role of healthcare staff and patients/relatives might play in healthcare services. This brokering role may be more prominent due to the current movement towards integrated health and social care services, which seems to be a desire within and outside of the UK health system (e.g. The King's Fund, 2018). Much of the literature, until now, has focused on roles (often managers e.g. Currie et al., 2015) within the organisation – hence reference to it being an "intrapreneurial" role (Heng and Loosemore, 2013). Here we investigate the roles of healthcare professionals within the two healthcare networks as brokers, which can include primary and secondary care organisations. We also consider the brokering roles assumed by patients and their relatives, which could be described as an "entrepreneurial" role.

Transfer of knowledge and information
We are interested to see how the structural holes are bridged in relation to managing information flows. Specifically we draw on Carlile's framework which is used to help understand how the exchange of knowledge at a boundary is managed. In the literature distinctions are made between three types of boundaries and how these are connected to knowledge. The first is difference in knowledge which refers to a difference in the amount of ***knowledge accumulated*** (e.g. novice and expert). This in turn creates differences in levels of experience, terminologies, tools and incentives. As the difference in the amount of domain-specific knowledge increases between actors/agents, the amount of effort required to adequately share and assess each other's knowledge also increases.

The second ***knowledge difference*** at the boundary is dependence – without dependence, difference is of no consequence (Carlile, 2004). Knowledge can be different in kind and degree, which means managing dependencies requires the capacity to develop an adequate understanding and common knowledge as resources and tasks change. The third difference relates to how ***novel*** the circumstances are. This novelty could relate to actors being asked to share knowledge with others and to access from others. Common knowledge is a boundary object (Carlile, 2002) which actors use to communicate across domains. When novelty is present both the capacity and the ability of the actors to represent the knowledge become important issues (Carlile, 2004).

Carlile's (2004) integrated/3-T framework (see figure 1) for managing knowledge across boundaries draws on Shannon and Weaver's (1949) three levels of communication complexity – syntactic, semantic and pragmatic. The most common phrase used to describe movement of knowledge in organisations is "***knowledge transfer***" (Argote, 1999). This *information processing* (also referred to as ***syntactic***) approach is the most dominant view in organisation design and forms the basis of most technology-based approaches to knowledge management, where the main focus in on storage and retrieval of knowledge (Davenport and Prusak, 1998). This assumes there is sufficient common knowledge; simply transferring knowledge can be problematic when novelty arises as it may be difficult to represent the differences and dependencies that are likely to be present.

A ***semantic*** boundary occurs when novelty makes some differences and dependencies unclear or some meanings ambiguous. This might require ***translating knowledge*** where

mechanisms or roles are developed to help create 'shared meanings' – these might include cross-functional teams, co-location and individuals to operate as brokers and translators (Hargadon and Sutton, 1997). The ability to externalise knowledge – making tacit knowledge explicit is critical to the flow of information. The ability to negotiate varying interests/ agendas of the different actors is also important.

The *pragmatic* boundary refers to situations where novelty results in different interests among actors that need to be resolved. This means that domain-specific knowledge and common knowledge will need to be transformed to effectively share and assess knowledge at the boundary. Team working is one mechanism to help transform knowledge along with boundary objects such as drawings and other visuals (Carlile, 2002).
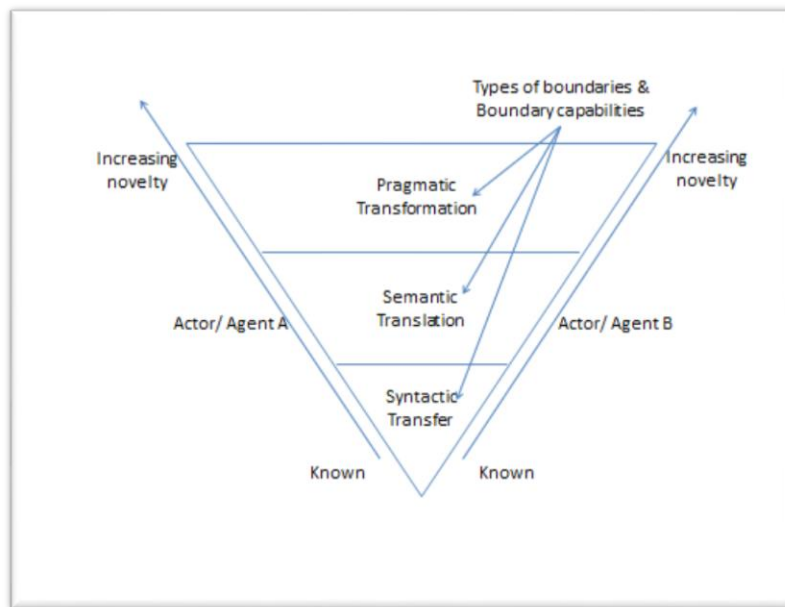

Figure 1. An integrated 3-T Framework for Managing Knowledge across boundaries
Source: Adapted from Carlile 2004:258)

The framework is helpful to categorise and show the relative complexity of a boundary and to identify the different types of processes that exist. The arrows moving from known to increasing novelty indicates new differences and dependencies exist and these need to be identified and understood. Although the line between each type of boundary is clearly demarcated, the transition where one ends and another begins is not often easily identified by the actors/agents involved. The figure also depicts the hierarchy of increasing complexity, where a more complex boundary requires the capabilities below it. This framework can be used to describe the mismatches that can occur between the type of boundary and the capacity/process used to share knowledge. In this study, we employ the framework to help to understand the gaps and boundaries between patients, relatives and staff within two patient networks.

Methodology
This qualitative study was conducted within two healthcare networks for the delivery of services for two long-term conditions in the UK, respiratory and Huntington's disease (HD). Experienced-based interviews were conducted with 45 healthcare practitioners, patients and relatives (see table 1) from the two pathways, which included secondary (hospital) and primary (GPs) care. NHS ethical approval was obtained and consent

sought from participants. The inclusion and exclusion criteria for selection of participants are shown in table 2.

Table 1. Interview participants

Participants	HD Pathway	COPD Pathway
Healthcare practitioners	5	20
Patients	2	10
Relatives	6	2

Table 2. Inclusion and Exclusion criteria for the selection of research participants

Inclusion criteria	Exclusion criteria
Male or female	Participants who are unable to consent for themselves
18 years of age or older	
Able to consent for themselves	
Care-giver or receiver (including relatives/carer) for the selected conditions	

The semi-structured interviews were conducted either at the participants place of work or, in the case of patients and relatives, at their home. The duration of the interviews was typically between 45 to 90 minutes. The interviews were transcribed verbatim, and manually coded and analysed using King's (2004) thematic framework. This paper reports on the themes that related to the type of boundaries, the processes used to transfer of information and brokering roles operating within and across the two networks. Other themes directly associated with the design of the patient pathway/network are outside the scope of this paper and have been previously reported (Williams, 2017).

Results and Discussion
From the analysis of the interview data, it was evident healthcare practitioners, patients and relatives occupy brokering roles in both pathways. Using SNT and Carlile's (2004) framework, this paper identifies the gaps and structural holes in the network and reports on the activities used by the participants to transfer, translate and transform information across these interfaces. Much of this activity occurred at the interface of professional, functional and organizational boundaries. Patients (and relatives) were asked to describe their journeys prior to and since their diagnosis. Healthcare professionals from both the community and hospital providers were asked to share their understanding of the care network and how it works. Mapping the experiences of participants enabled us to identify the structural holes in the network and classify the activity in terms of the type of brokering undertaken. The results show patients and relatives assume or expect the healthcare network to be connected but in 'reality', they have to pick up a brokering role. For both respiratory and HD patients and relatives this largely required transferring information between healthcare professionals and their organisations. In some instances, particularly for HD patients and relatives due to the rarity of the disease, translation of the information and knowledge of the condition was also required on admission to acute services.

Specialist healthcare practitioners often occupied a brokering role within both networks. These can be located in the hospital (respiratory) or in the community (respiratory and HD) and regularly 'inreach' or 'outreach' to services in order to bridge

the gap between acute and community care and/or health and social care. For example, one respiratory staff participant explained, "If the patient is not known to us on the ward we contact the community respiratory team." Although there is rhetoric to move to integrated care in reality this model of care is not fully implemented in the UK health and social care system and is largely dependent on the informal brokering roles bestowed on practitioners, patients and relatives.

Table 3 provides examples of the main boundary issues experienced by the participants from both networks. The types of boundary are classified according to the 3-T framework. Staff, patient and relative participants were found to engage in all three connecting practices – transferring, translating and transforming information. Similarly, all three types of boundaries were found to exist in one or both of the networks. The extent these practices were effective was influenced by language (ability to translate), 'power' relationships (ability to be heard/respected) and being able to bridge the gap (knowledge of network). Participants shared many examples of syntactic boundaries where they needed to transfer information. Often this was due to poorly integrated information systems across different organisations within the network. The HD network required information to be transformed by the family when interacting with services that had limited or no knowledge of the condition (e.g. hospital or GP practice). The participants from the HD specialist community team provided examples of transforming information to enable their patients and relatives to interact and access public services such as housing, benefits and transport.

Table 3. Boundary issues and capability for actors in two health networks

Boundary Issues	Respiratory (R) network	HD network	Type of boundary	Boundary capability
Patient information accuracy	If outside of GP hours then patient information less likely to be available. Some details may be available if attending local A&E department and/or chest outpatient.	Unlikely data will be available to hospital staff unless previous admission. Majority of care provided in the community – poor integration of information with the acute sector.	Syntactic (R) – need to increase capacity to process information Semantic (HD) – no common/ standard approach available	Transferring information (R) Translating information (HD)
Knowledge of patient conditions	If frequent visitors to hospital clinics/ wards and GP surgeries – knowledge of patient conditions likely to be known by various health care teams. However, information may not be integrated across the various organisations/services. Chronic Obstructive Pulmonary Disease is the second highest reason for unplanned	Rare illness estimated to be 6000-8000 cases in UK. Knowledge held by patient, relative or community specialist team (not present in all areas of UK). Less likely to be known in hospitals.	Syntactic (R) Semantic (HD)	Transferring information (R) Translating information (HD)

			Syntactic (R)	Transferring information (R)
	admissions – increasing occurrence			
Information sharing	May occur via in-reach or out-reach specialist nurses or relies on discharge letter or discharge care bundle which instructs GP or specialist nurses on follow up.	Through expert patient (relative) or multi-disciplinary team if in place otherwise unlikely to occur which may lead to the patient being missed or misdiagnosed (unless other family members already known to have condition). Multi-disciplinary specialised HD team link with wider public services – no defined common practice to follow.	Syntactic (R) Pragmatic (HD) – relies on relatives and community team if available within the region	Transferring information (R) Transforming information (HD)

Source: Authors

Many of the issues raised by staff and patient/relative participants refer to gaps and structural holes that exist within the networks. Often these gaps are due to poorly integrated IT systems where information is not transferred across the organisational boundaries e.g. primary and secondary care. Other gaps exist due to the lack of or incomplete common lexicons to translate the information e.g. discharge letter. As Carlile (2004) argues as the novelty increases in relation to the information the greater need for information to be transformed. The HD network provides examples of where healthcare professionals frequently act on behalf of their patients and families to broker the knowledge boundary between health and other services. The rarity of the HD increases the novelty of the information and highlights the need for participatory and relational nature of the actor's role. Previous research has shown that actors can misrecognise novelty as something that is already known (Martins and Kambil, 1999) or discarding what is novel as irrelevant (Perrow, 1994).

In this study, the need for brokering occurred at various points within both networks:
- Patient/relative between healthcare professionals
- Specialist healthcare professional between other healthcare professionals
- Specialist healthcare professional between patients/relatives and other public services.

Where specialist healthcare professionals are brokering across healthcare professionals in their own organisation (e.g. respiratory specialist nurse brokering between the respiratory ward and A&E) this can be described as intrapreneurial role. The role of patients and relatives bridging across organisations can be described as an entrepreneurial.

The structural holes identified from the interviews were largely due to poorly integrated systems and/or misaligned organisational boundaries. None of the participants described or recognised their experiences as bridging gaps in the provision or receipt of care. The brokering activities were largely about connecting (union) actors within the system to aid the flow of information, knowledge and value, which then aids patient flow. No examples were identified in this study where participants undertaking

a brokering role purposely aimed to reinforce the gap and disunion the actors within the network (Baker and Obstfeld, 1999). However, what is not clear from this research is the action taken by the organisations to ensure either the brokering role is formally recognised or steps are taken to bridge the structural hole occupied by the broker. Overlooking the brokering activity can potentially introduce vulnerability into the network. Using a range of brokering strategies and understanding the brokerage behaviour and the impact of information/knowledge brokerage on patient outcomes is an important area for healthcare organisations and networks to consider (Heng and Loosemore, 2013).

Conclusion

Uniquely this paper focuses on providing the experiences of healthcare practitioners, patients and relatives occupying a brokering role within designated long-term condition healthcare networks. Using SNT and a brokering framework, this research provides insight to the types of brokering that occur. This research considers three questions, the first being the nature of the structural holes (gaps) that exist within two networks. Using Carlile's framework the three boundaries types were identified – semantic, syntactic and pragmatic, with union bridging activity being undertaken by staff and patient/relative participants (Baker and Obstfeld, 1999). Our second area of enquiry was the type of brokering roles occupied by healthcare professionals, patients and relatives. The examples provided by the participants suggested most of the bridging (union) activity was connecting poorly-aligned organisations and functions. Building on the bridging activity, knowledge transfer, translation and transformation were all evident from the analysis of the interview data. The final question considered the strategies employed by brokers to ensure information/knowledge flows to support the effective delivery of care. All three examples of knowledge transfer were identified – transfer, translation and transformation.

We propose brokering is essential to the integrated healthcare system sought by the NHS as the future model for the health and care system in England (The King's Fund, 2018) and therefore call for formal recognition and training for those occupying this space to ensure equity across all those delivering and receiving healthcare. Although this research has a UK focus, the move towards integrated health and social care systems is a universal goal. Important areas of research not covered here is the power held by the broker, the value of brokering and the cost of brokering.

References

Argote, L. (1999). *Organisational learning: Creating, retaining and transferring knowledge*. Norwell, MA: Kluwer.

Burt, R.S. (1992). *Structural Holes: The social structure of competition*, Cambridge, MA: Harvard University Press.

Burt, R. S. (2005). *Brokerage and closure: An introduction to social capital*, Oxford: Open University Press.

Baker, W.E. and D. Obstfeld, (1999). "Social capital by design, structures strategies and institutional context", in Leenders, R. and S. Gabbay, (eds), *Corporate social capital and liability*, Boston: Kluwer Academic, pp 88-105.

Brass, D. (2003). "A social network perspective on human resources management, in Cross, R. Parker, A. and L. Sasson. (Eds) *Networks in the Knowledge Economy*, Oxford: Oxford University Press.

Carlile, P. (2002). "A pragmatic view of knowledge and boundaries: boundary objects in new product development", *Organisation Science*, Vol. 13, pp. 442-445.

Carlile, P. (2004). "Transferring, translating and transforming: An integrative framework for managing knowledge across boundaries." *Organization Science*, Vol. 15, No. 5, pp. 555-568.

Currie, G., Burgess, N. and Hayton, J. C. (2015) "HR practices and knowledge brokering by hybrid

middle managers in hospital settings: the influence of professional hierarchy", Human Resource Management, Vol. 54, No. 4, pp. 793-812

Davenport, T. and L. Prusak (1998), *Working knowledge*, Boston: Harvard Business School Press.

Fernandez-Mateo, I. (2007). "Who pays the prices of brokerage? Transferring constraint through price setting in the staffing sector," *American Sociological Review*, Vol. 72, No. 2, pp. 291-317.

Fuchs, VR. (1968) *The Service Economy*, National Bureau of Economic Research, Cambridge, MA.

Hargadon, A. and R. Sutton, 1997. "Technology brokering and innovation in a product development firm", *Administrative Science Quarterly*, Vol. 42, pp. 716-749.

Harvey, J. (1990), "Operations Management in Professional Service Organisations: A Typology, *International Journal of Operations & Production Management*, Vol. 10, No. 4, pp. 5–15,

Harvey, J. (1992), "The Operations Management challenge in the delivery of complex human services", *International Journal of Operations & Production Management*, Vol. 12, No. 4, pp. 100-107.

Heng, H. and M. Loosemore, (2013). "Structural holes in hospital organisations: Facilities managers as intrapreneruial brokers in the tertiary health sector". E*ngineering, construction and architectural management*, Vol. 20, No. 5, pp. 474-487.

Kellogg, K. (2014). "Brokerage professions and implementing reform in an age of experts, *American Sociological Review*, Vol. 79 No. 5, pp. 912-941.

Kim, Y., Choi, T. Y., Yan, T., and K. Dooley, (2011). "Structural investigation of supply networks: A social network analysis approach". *Journal of Operations Management*, Vol. 29 No. 3, pp. 194-211

King, N., (2004). *Using templates in the thematic analysis of text*, in C. Cassell, & G. Symon, (Eds), Essential Guide to Qualitative Methods in Organisational Research, London: Sage.

Kuratko, D. Montagno, R. and J. Hornsby (1990). "Developing an intrapreneurial assessment instrument for an effective corporate entrepreneurial environment", *Strategic Management Journal*, Vol. 11, pp. 49-58.

Li, M., and T. Choi, (2009). "Triads in Services Outsourcing: Bridge, Bridge Decay and Bridge Transfer." *Journal of Supply Chain Management*, Vol. 45, No. 3, pp. 27-39.

Martins, L. and A.Kambil, (1999). "Looking back and thinking ahead: Effects of prior success on managers' interpretations of new information technologies". *Academy of Management Journal*, Vol. 42, pp. 652-661.

Monge, P. and N. Contactor (2003). *Theories of communication networks*, Oxford. Oxford University Press.

Moolenaar, N.M. and P.J. Sleegers, (2015). "The networked principal: Examining principals' social relationships and transformational leadership in school and district networks." *Journal of Educational Administration,* Vol. 53, No. 1, pp. 8-39.

Obstfeld, D. (2005). "Social Networks, the Tertius Iungens Orientation, and Involvement in Innovation", *Administrative Science Quarterly*, Vol. 50 No. 1, pp. 100-13.

Peng, T, Lin, N. Martinez, V. and C.Yu, (2010) "Managing triads in a military avionics service maintenance network in Taiwan", *International Journal of Operations & Production Management*, Vol. 30, No. 4, pp.398-422.

Perrow, C. (1994). "Accidents in high risk systems", *Technical Studies*, Vol. 1, pp. 1-38.

Reagans, R.E. and Zuckerman, E.W., 2008. "Why knowledge does not equal power: the network redundancy trade-off", *Industrial and Corporate Change*, Vol. 17, No. 5, pp. 903-944.

Scott J (2000) *Social network analysis*. Sage, London

Sen P, Dasgupta S. Chatterjee A, Sreeram PA, Mukherjee G, Manna SS (2003) Small-world properties of the Indian railway network. *Physical Review E*, Vol. 67, pp. 036-106.

Shannon, C. and W. Weaver, (1949). *The mathematical theory of communications*, Urbana: University of Illinois Press.

Tadic B (2001). "Dynamics of directed graphs: the World-Wide Web". *Physica A: Statistical Mechanics and its Applications,* Vol. 293, pp. 273–284

The King's Fund (2018). "*A year of integrated care systems: reviewing the journey so far*", The King's Fund: London. Available at: https://www.kingsfund.org.uk/sites/default/files/2018-09/Year-of-integrated-care-systems-reviewing-the-journey-so-far-report-summary.pdf (accessed: 3 January 2018).

Williams, S.J. (2017). I*mproving Healthcare Operations: The application of Lean, Agile and Leagility in Care Pathway Design*. Palgrave, London.