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Collaboration for Innovation Networks: Towards a Reference Model

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Abstract. Practitioners and scholars have argued that external collaboration has become fundamental to how organisations function. There is also an emerging rhetoric on the imperatives of innovation for competitiveness. This amplifies the relevance of innovation networks that allow partners to pool resources and share expertise. Consequently, an understanding of collaboration within these networks is crucial to better managing the complexities and uncertainties that underlie how organisations and individuals can collaborate to innovate. Along these lines, this paper has analysed the nature of collaboration in 12 real-world innovation networks with the aim of developing a reference model. The analysis showed that in order to maintain resilience, the network design and orchestration in these networks are technology-oriented. In addition, the collaborative competencies and capabilities were found to be service-oriented to provide the mentoring, business support, technological, and scientific needs that underlie the formation of these innovation networks.

Keywords: collaborative networks, innovation, resilience, virtual organisation, services.

1 Introduction

Sustaining competitive advantage of operations is a major challenge for modern firms. This is due to a variety of existing and emerging uncertainties that make it difficult to extrapolate from the past and to make forecasts for the future. *Behaviourally*, several strategies have been adopted by organisations to maintain competitiveness. Significantly, there is evidence to suggest that from the 1990s onward, organisations have increasingly shifted their main focus from efficiency and quality to innovation [1]. *Structurally*, companies are also changing their focus from knowledge gathering within a single organisation to knowledge rich distributed processes and arrangements that co-opt multiple stakeholders. The effect has been a gradual rise in corporate partnering and increasing reliance on different forms of collaboration with external entities [2]. Here, the imperatives for maintaining competitive advantage has forced companies to pool resources within intra- and inter-organisational networks in endeavours that create a critical mass of participants for survival. There are also arguments that this behavioural and structural shift has also been at play in manufacturing where firms have transitioned from global production networks targeted at new markets and lower cost production sites, to global

innovation networks motivated by knowledge potentials [3]. These arrangements are set to share risks, gain access to new markets and technologies, speed up product introduction to markets, learn from partners, and pool complementary skill [2]

Although there has been increased research and practice in innovation networks, there are still major gaps in knowledge on the intricacies and permutations of these forms of networks. For instance, related studies have highlighted paucity in research on government sponsored innovation clusters [4]. Others have conceptualised and examined organisational [5] and individual [6] challenges of designing and managing innovation aggregations. In an attempt to enhance research in this area, this study is motivated by the characteristics of collaboration that triggers and sustains the structure/behaviour of innovation networks.

The aim of this paper is to develop a reference model of collaboration for innovation networks. Reference model is used in this context, as a purpose-relevant representation for use in construction of other management models [7]. Such models have been widely used in the conceptualisation and representation of collaboration-related phenomena such as collaborative networks [8], supply chains and networks [9], collaborative value webs [10], and coalition interoperability [11]. In these models, researchers explore the nature of phenomena for use in detailing aspects such as strategy, process, information technology, and so on. With this in mind, this research is guided by the following research question: What is the nature of collaboration for innovation networks?

The rest of this paper unfolds as follows. §2 will outline the background for the research. §3 and 4 will present the research method and findings respectively, and 5 will conclude by highlighting the study limitations, contributions, implications and some unanswered questions that may offer useful paths for further research.

2 Research Background

In an attempt to answer the research question, the theoretical development began with the review and analysis of the background for the research. For this, literature was used to analyse collaboration and innovation networks. Particular attention was paid to current understanding and factors of the key factors that underlie these concepts and this insight served as the foundation for developing the conceptual framework for this research.

2.1 Collaboration

Collaboration is a key feature of a process when it involves more than one participant in durable and pervasive relationships [12]. It is frequently used to mean working together in group(s) to achieve a common task or goal. This task or goal is often beyond the capabilities of the collaborating participants and collaboration is typically achieved through activities for coordination, decision-making and teamwork [12]-[14]. Accordingly, research has shown that arrangements for collaboration are shaped by competencies and capacities [15].

Collaborative competencies are the resources (knowledge, skills and support) that serve as the basis for working together to achieve a goal. Attitudes towards group work are also important in collaboration competencies that can be oriented towards: dictatorships in which interactions are directed or dominated by a few individuals, mutuality in which interactions are managed by a set of individuals for solving uni-, inter- or multi-disciplinary problems, and exclusivity in which individuals negotiate and work with others (similar or dissimilar specialties) to achieve goals.

Collaborative capacities, on the other hand, are the practices that enable work across intra- and inter-organisational levels and boundaries irrespective of temporal and spatial separations. These practices encourage durable and pervasive relationships and processes that are necessary for gaining the full commitment of individuals to a shared mission [16]. Effective collaborations, based on these relationships and processes are assessed in terms of collaborative capital i.e. ‘who we know and how well we work together’ [15].

Focusing on innovation through collaborative competencies and capacities, firms have been able to: (i) move from traditional linear attitudes for executing process to more contemporary concurrent approaches, and (ii) tackle the problematic ‘over-the-wall’ phenomena i.e. intrinsic organisational barriers that were created due to process demarcations for functions such as manufacturing and marketing. Accordingly, the benefits of such focus has been increased competitiveness through: (i) greater awareness of potential cumulative knowledge from key stakeholders such as customers and staff, (ii) increasing informal interactions among company personnel and (iii) challenges for understanding and resolving differences between team members and groups [13].

2.2 Innovation Networks

Citing Van de Ven [17], Swan et al. [1, p.263] defined innovation that takes place in networks as “the development and implementation of new ideas by people who over time engage in transactions with others in an institutional context.” In other words these networks have innovation imperatives or outputs that lie at the heart of transactions or networking. Thus, a key challenge for organisations is to cope with the increasingly complex nature of innovation processes in tandem with increasing number and diversity of innovation network actors [4]. There is also an implied ‘voluntary’ nature of such networks that allow for resources to be mobilised and strategic alliances to be dynamically created [5].

It is for this reason that scholars have suggested that the locus of innovation in modern day organisations is situated in networks for internal and external collaboration [2]. These networks enable companies not only to retain competitive advantage but also to progressively add and accumulate value for stakeholders. There are also suggestions that these networks are characterised by innovation that is achieved through collaborative creativity, an ethos of collaboration that is underscored by a strict ethical code, and communication established by direct-contact networks [18]. However, network benefits can only outweigh advances with the

closed innovations in large corporations when resources are distributed efficiently by partners [6].

Theoretically, scholars have suggested that for innovation network arrangements to generate outputs, two determined need to be considered: network design and network orchestration [5], [6]. For both determinants, networking takes centre-stage as a social process that enables knowledge sharing among partners [1].

According to Dhanaraj & Parkhe [6], an important determinant of innovation networks is the network design. This design is reflected in (i) network membership as determined by the size and diversity of participants and ties, (ii) network structure in relation to density of topology and autonomy of participants, and (iii) network position with respect to centrality of topology and status of participants. Structurally, the diffusion of knowledge in innovation networks is shaped by cohesion and centralisation factors [19]. Cohesion refers to how participants in the innovation network are related to each other and centralisation concerns how hubs (highly connected participants) emerge in innovation networks. The former influences network connectivity while the latter affects network influence – impact on the overall network performance. Inevitably, there is a case to be made for these networks to be “flatter, less bureaucratized and more decentralised, even virtual, organizational arrangements with key areas of expertise (e.g. IT) often being provided externally” [1, p.263]. Consequently, it has been suggested that innovation networks are typically characterised by low-density and high-centrality [6].

The orchestrating of innovation networks is also another issue that requires management for knowledge mobility, innovation appropriability and network stability [6]. The output of this orchestration is often in the form of value for participants and economic growth in a wider context [4]. Network orchestration or governance [5] depends on contractual arrangements between partners [3]. With these arrangements in place, collaborations can then be monitored according to administrative mechanisms and adjusted with regards to project developments. For instance, studies have explored contractual arrangements and used insights from findings to advocate for the importance of innovation champions (i.e. individuals who informally advance the goals of innovation) in the orchestration of innovation networks [5].

3 Research Method

The study applies a theory-building methodology [20] in a multi-case study [21] that was undertaken in two main stages: conceptualisation and case study.

During the conceptualisation stage, a review of literature was conducted to analyse the concepts of collaboration and innovative networks. Insights from this review were then used in the formulation of conceptual framework, as presented in §2, for use in the subsequent stage of the study. Drawing on the extant literature, Fig. 1 presents the conceptual framing of collaboration in innovative networks. The model argues that innovation imperatives are the major factors that these networks are built on. These factors in turn necessitate competencies and capabilities for collaboration as well as design and orchestration for networks.

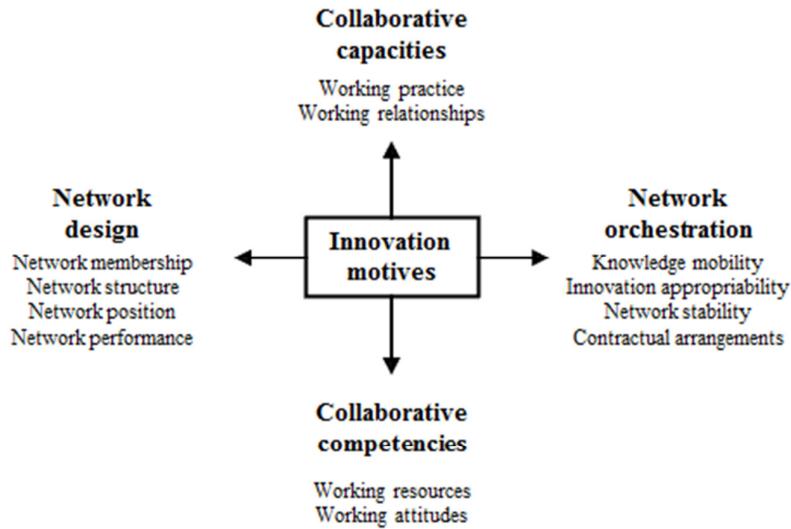


Fig. 1. Research model

Next, using the conceptual framework from Fig. 1, an exploratory study of collaboration for innovative networks was conducted with twelve real-world innovative networks (I-nets). These case I-nets (ShoreTel Innovation Network (ShoreTel I-net), Water Innovation Network (Water I-net), Genomics Innovation Network (Genomics I-net), Regional Accelerator and Innovation Network (Regional Accelerator and I-net), iNnovation Network Liverpool (i-net Liverpool), Food and Drink Innovation Network (Food and Drink I-net), Co-operative Councils Innovation Network (Co-operative Councils I-net), Menu Innovation Network (Menu I-net), Quality Insights is the Quality Innovation Network (Quality I-net), i-net: innovation networks Switzerland (I-net Switzerland), Roanoke-Blacksburg Innovation Network (Roanoke-Blacksburg I-net), and European Business and Innovation Network (European Business and I-net)) are set at industry or regional levels for various goals as summarized by Table 1. These, case I-nets were purposefully sampled, as is often the case for qualitative studies [22], by focusing on innovation motives of organisation and institutions. Data was gathered through secondary sources [23] (specifically webpages, annual reports, press releases and literature) and examined using content analysis [24] to present network and innovation orientations due to collaboration in these cases. The study is therefore based on an exploratory approach that generalises at a level of theory as opposed to statistical representativeness or significance.

4 Findings

The next subsections present the main findings from the analysis. First, the findings of network and innovation orientations due to collaboration are presented. Next, insights from the analysis are used in the development of a reference model.

4.1 Collaboration and Network Orientation

The analysis of the data indicated that network designs tended to be based on specific regions such as the Genomics I-net in Northern Switzerland and the Food and Drink I-net in the East Midlands of the UK, as summarised by Table 1.

Table 1. Network design and orchestration in case innovation networks (i-nets)

Case	Network design	Network orchestration
ShoreTel I-net	US-based technology industry community of 93 industrial partners	Shoretel as focal partner
Water I-net	UK-based partnership of water innovators	Peterborough City Council and Anglian Water
Genomics I-net	Canadian consortium of 10 research centres	Genome Canada'
Regional Accelerator and I-net	Oregon alliance of 8 academic and economic institutions	10 member board of directors and regional mayors
I-net Liverpool	UK-based community made up of hundreds of individuals and organisations from Liverpool	Liverpool city council
Food and Drink I-net	UK-based food consortium of academic organisations in the East Midlands	The Food and Drink Forum
Co-operative Councils I-net	UK-based collaboration between 23 local authorities	6 member executive oversight committee
Menu I-net	UK-based knowledge exchange for the food industry	Inside Foodservice
Quality I-net	US community of health-care providers in New Jersey, Delaware, Pennsylvania, West Virginia and Louisiana	6 member Board of Directors
I-net Switzerland	Switzerland-based public private partnership	Management board supported by an advisory board
Roanoke-Blacksburg I-net	Virginia community consisting of hundreds of individuals and organisations	10 member Board of directors
European Business and I-net	Europe-wide community of professionals	21 member Board of directors

For network orchestration, the focus in case I-nets was on boards of directors for governance or focal organisations (Shoretel (ShoreTel I-net), Peterborough City Council and Anglian Water (Water I-net), Liverpool city council (I-net Liverpool),

and The Food and Drink Forum (Food and Drink I-net)) that are governed themselves by boards of directors. The boards act in dictatorships style arrangements in which committees are set up to help discharges duties. For instance an Executive Committee, Audit and Investment Committee, Programs Committee, and a Governance, Election and Compensation Committee were all set up by the Genomics I-net board. Advisory Committees at I-net Switzerland and Genomics I-net were also important for getting strategic and visionary advice and expertise for research and development.

The data showed that network designs were characterised by varying levels of membership according to subscription or level of expertise. For instance in the ShoreTel I-net had two levels of membership: a foundation-level membership for information and tool provision, and an alliance-level membership for validating, documenting and marketing interoperability. Similarly, at the European Business and I-net, membership was according to: quality-certified business and innovation centres, incubators, accelerators and other support organisations, and associate members that support the development and growth of innovative entrepreneurs, start-ups and SMEs. Generally, distinctions were made between founding (or core) partners and associates that participate in mutual or exclusive arrangements.

4.2 Collaboration and Innovation Orientation

Overall, the analysis found two main focal points of collaborative goals for innovation. The first was *regional-focus* and the attitudes tended to be on causes that impacted the position of unions (European Business and I-net), countries (Genomics I-net) or states (Regional Accelerator and I-net, Quality I-net, and Roanoke-Blacksburg I-net) on a global scale, or enhanced the quality of life of communities (Co-operative Councils I-net, Water I-net, and I-net Liverpool). The second was *industry-focus* and this often originated from specific regions but was targeted as novel approaches to delivering and marketing specific goods, services and technologies (ShoreTel I-net and Menu I-net). Both orientations were found in I-net: Switzerland and the Food and Drink I-net where the focus was on innovative IT from Northern Switzerland and food/drink from the East Midlands respectively.

The analysed data showed that collaborations in the case I-nets were technology-oriented irrespective of the goals and motivation for collaboration. The technologies as suggested by Herstad et al. [3] are embodied in the resources and exchanges between partners. Additionally, the study found that these technologies play important roles in the innovation network competencies. In all case I-nets, orientations were not only according to pooled capabilities and competences but were also on 'networks of networks' i.e. establishing and communicating the international collaborative linkages that would be available to potential network partners. Support for capabilities was provided through avenues such as training and mentoring while capacities were maintained through web portals, conferences and other knowledge exchange events, as summarised by Table 2.

Table 2. Collaborative competencies and capacities in case innovation networks (i-nets)

Case	Collaborative competencies	Collaborative capacities
ShoreTel I-net	Partnering of technology companies	Web portal Partner conferences
Water I-net	Water utility company with the supply chain	Web Portal Signposting to investment/funding opportunities
Genomics I-net	Assembling of highly-qualified personnel and leading-edge technologies used in genomics and metabolomics	Web Portal Commissioned groups
Regional Accelerator and I-net	Start-up ecosystem of connected entrepreneurs, investors and resources	Web Portal Working groups formed by the local board partners
I-net Liverpool	Commissioners, service providers, user-led organisations, creatives, and technologists	Web portal iNnovationXchange uNconference Round tables Hatching and matching event
Food and Drink I-net	Community of food experts	Web portal Booster workshops for SMEs
Co-operative Councils I-net	Local authority subject matter experts	Web portal Workshops and conferences
Menu I-net	Group menu development managers and group executive chefs	Web portal Awards Forums Social programmes
Quality I-net	Network of medical institutes and healthcare strategists	Web portal Knowledge exchange events and webinars
I-net Switzerland	Technology field experts of ICT, Life Sciences, Medtech, Cleantech and Nanotechnology.	Web portal Partner and technology events
Roanoke-Blacksburg I-net	Start-up ecosystem of connected entrepreneurs, investors and resources	Web portal outreach and awareness events
European Business and I-net	Team of experts and business and innovation centres	Web portal Online and offline networking events and technologies

Imperatives for collaboration were also for ground-breaking work with potential impacts for humanity and in such cases the network design centred on creating a cluster of specialised organisations. For instance, the Genomics I-net focused on ten research centres, termed ‘nodes’, within the British Columbia, Alberta, Ontario and Quebec regions. In others, the focus was on community building endeavours with opportunities for networking and access to talent, capital and infrastructure.

4.3 Towards a Reference Model

Fig. 2 presents a proposal for a reference model of collaboration for innovation networks. The model mainly captures sets of management models for structural design and behavioural support. It consists of sub-models that capture relationship development, support services, technology embodiments, network board, working committees, and subscribed partners. There are also rationales according to innovation, task and network imperatives.

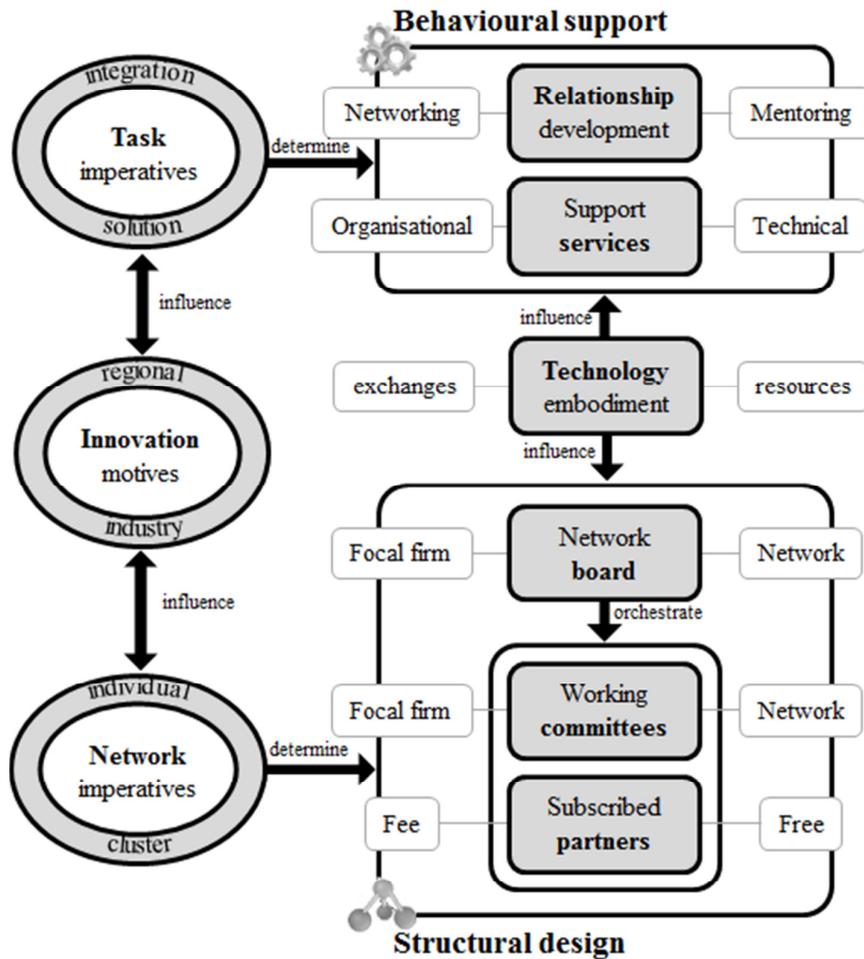


Fig. 2. Reference model of collaboration for innovation networks

Task imperatives are the motives that necessitate service support and relationship development in pursuit of collaboration goals. These services included technical services for technologies (e.g. network design validation) or scientific research (e.g. proteomics), organisational services that provide business (e.g. idea generation and networking) and process support. Task imperatives concern how businesses bring together ideas and expertise together with a view to delivering solutions. This involves interacting, exchanging information and creating synergies with peers as well as translating co-operative policy and principles into practice.

Network imperatives are the motives that shape the design and orchestration of networks. This concerns how network designs reflect involvement of individuals for equal partnership to shape and strengthen communities. It also considers clusters or hubs of organisations, institutions and regions for generating collective power for the advancement of cause and ground-breaking work. This focus has been captured by studies that examine the innovations that emerge when industry and academe collaborate in networks for economic growth in specific geographical areas [4].

Task and network imperatives ultimately impact and are impacted by innovation motives to launch new ventures, create jobs and drive economic growth. This synergetic effect is reflected in the different activities that are organised by innovation networks where feedbacks are used to review set goals. As earlier indicated, innovation motives are of two forms: regional and industrial. Networks with regional motives have focused on themes such as establishing viable companies that generate jobs, wealth and opportunities for Oregon (Regional Accelerator and I-net), unpicking big challenges facing quality health and social care delivery services in a time of austerity (I-net Liverpool), and raising the bar for healthcare in the US (Quality I-net). In contrast, case networks with industry motives include transforming the current water industry for a more sustainable future (Water I-net), developing hardware, software, and services that extend telecommunication capabilities (ShoreTel I-net) and improving the food and drink offered to consumers eating away from home (Menu I-net).

5 Conclusions

According to a Chinese adage, ‘only when all contribute their firewood can they build up a big fire’. This sentiment stresses the need for joint work and coordination during collaboration. However, during collaboration for innovation, the imperative for partners working in network extends beyond contributions and encompasses collaborative creativity through networking. With this in mind, this research has attempted to shed light on “What is the nature of collaboration for innovation networks?”

Based on a multi-case study of 12 real-world innovation networks (i-nets), the research found that collaborative competencies and capacities tended to be technology- and service-oriented with a view to providing the mentoring and networking to sustain i-nets. Similarly, network design and orchestration were predisposed towards board style arrangements with committees and subscription-based partners. Using these insights, a reference model of collaboration for i-nets was

proposed. It consists of structural design and behavioural support sub-models for relationship development, support services, technology embodiments, network board, working committees, and subscribed partners. It also elucidates innovation, task and network imperatives as rationales for modelling.

Overall, the research makes two main contributions. First it offers an assessment of the nature of collaboration for i-nets. Second, the research proposes a framework in the form of a reference model for use in the construction of other management models such as those that focus on collaborative resilience, risk and performance. Along these lines, the research contributes to the rhetoric on competitive advantage realised through collaboration but offers a prescriptive model to aid collaborative network managers in developing a grounded foundation for coping with uncertainties.

Fundamentally, this research has focused on secondary sources as avenue for the exploratory analysis of these i-nets. Further empirical work is therefore needed to qualitatively and quantitatively study the underlying themes uncovered in this study. In spite of this limitation, the analysis and insights from this study has offered a reference model for designing and managing collaborations in i-nets. As firms strive to work innovatively, using innovation network resources and delivering innovative results, the behavioural support and structural designs agreed with collaborating partners will need to ensure task imperatives for integration and network imperatives for cluster-oriented work are technology-embodied.

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