Cultivating sustainable communities of practice within hierarchical bureaucracies: the crucial role of an executive sponsorship

Meri Duryan[1] and Hedley Smyth

Abstract

Purpose –This paper addresses hierarchies in a large programme of projects. It explores cultivation of communities of practice (CoP) within a hierarchical client organization that manages that manages multi-billion-euro infrastructure programmes and projects.

Design/methodology/approach – This paper is based on an exploratory longitudinal case study approach, involving action research. In-depth semi-structured interviews, company records, industry reports and observation from a case study in the hierarchical bureaucracy were translated into the language of cognitive maps for software analysis and subsequent interpretation.

Findings – The findings highlight the importance of hierarchy constraints and programme management practices in project-based firms. The involvement of senior management in CoP cultivation reinforced the community's contribution to strategic value creation in the firm under scrutiny.

Research implications – This article mobilises the concepts of boundary spanning and loose coupling as a way of analyzing the role of CoPs in bureaucratic hierarchies to promote learning and knowledge transfer. The results of the study suggest that application of those concepts can contribute to sustainability of CoPs in hierarchical organizations by giving them social space to span horizontal and vertical boundaries.

Practical implications - The authors practically contribute to the field by demonstrating the process and the impact of CoP sponsors' engagement in their cultivation. This was enabled through the research oriented action research component. The paper concludes also that cognitive mapping may provide a useful addition to engaged research, potentially simulating and influencing change in practice.

Originality/value – The academic contribution concerns understanding the roles of hierarchies, programme management and CoP cultivation in project-based firms. It offers clear guidelines for managers of hierarchical bureaucracies to cultivate CoPs to address hierarchical constraints and how CoPs differ in organizational form.

Keywords – Communities of Practice, Hierarchical Bureaucracies, Knowledge Management, Organisational Learning, Loose Coupling, Boundary Spanning, Cognitive Mapping

Paper type – Research Paper

1. Introduction

Considerable attention has been given to knowledge management (KM) and knowledge transfer across the management literature, influenced by seminal authors such as Argyris and Schön (1978), Senge (1990), and Nonaka and Takeuchi (1995). The project management literature built on this interest (e.g. Brady and Davies, 2004; Bredillet, 2004; Carrillo, 2004) with others subsequently extending the detailed understanding (e.g. Koskinen, 2012; Kelly et al., 2013; Nilson, 2013; Floricel et al., 2016). Yet, the influence of organisational hierarchies and the role of programme management have received very little attention in general and on the client side across the project literature. This action research study addresses this issue in terms of the literature, practices on the ground and how management addresses opportunities without being constrained by the identified barriers.

Traditional infrastructure organizations are known for rigid boundaries between processes, stakeholders, and functions (Gustavsson and Gohary, 2012). In project-based organizations (PBO), programme management, which is located within the lines of authority and decision making, adds to rigidities by forming another layer in a hierarchy between the senior management and the projects. These boundaries inhibit cross-functional and inter-project knowledge exchange and cooperation. Large-scale hierarchical PBOs need to break down horizontal and vertical cross-functional silos and boost collaboration and learning. Today, leading companies

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[1] m.duryan@ucl.ac.uk

realise that their competitiveness depends on how fast knowledge and innovation flow through and become embedded in the organization. For PBOs on the client and provider sides this includes facilitating knowledge transfer at the programme and project levels.

The knowledge-based view of the firm suggests that intellectual resources are key organizational assets that sustain competitive advantage (Drucker 1998; Wenger and Snyder 2000). Following a human-oriented approach to KM, knowledge resides is in the minds of individuals and is developed through joint experience and interaction in social networks (Newell et. al., 2006). Complex and wicked problems require innovation and problem-solving skills, drawing upon the knowledge base. However, control mechanisms of hierarchical bureaucracies coupled with management by objectives and hierarchically structured positions generate defensive mechanisms that discourage individuals' desire to learn beyond the well-defined job responsibilities (Argyris and Schön, 1978; Bennet, 2006; Josserand, 2004; Laumann et al., 1971; Mills and Friesen, 1992; Mintzberg, 1993; Senge, 1990). Further complexity is added in project environments through political, cultural, social and organizational factors (Love et al., 2005).

At the same time, individual and collective learning are interrelated. Hierarchal bureaucracies need to cultivate a culture of learning and knowledge exchange, where knowledge sharing is the norm, where people are encouraged to collaborate and share, and be rewarded for doing so. However, changing organizational culture in hierarchical bureaucracy can be a long and painful process, which discourages management that is already under the pressure to deliver short-term results. This is particularly the case on the client side of project and programme execution (cf. Brady and Davies, 2004). Establishing a culture of knowledge exchange in large-scale infrastructure organizations is especially difficult due to uniqueness, fragmented nature and complexity of programme and project operations.

Lave and Wenger (1991) came up with a more 'social' view of learning. They first developed the concept of CoPs, where more experienced members can share their knowledge with less experienced colleagues. The concept was further refined by Wenger (1998), who viewed CoPs as the continuing interaction by people who share common passion for a subject. While project managers play a key role in knowledge transfer, it is typically left to individual responsibility and happenstance (Kelly et al., 2013), which CoPs potentially circumvent.

CoPs do not require painful changes; they have fluid and organically evolving boundaries, play a big role in increasing problem-solving capacity at the individual and organizational level (Bolisani and Scarso, 2014), and reduce bureaucratic rigidities by enabling individual learning and knowledge exchange. CoPs are risk-free loosely coupled entities with their own culture, fostering cross-functional learning and collaboration internally and externally (Davenport and Prusak, 1998; Wenger, 2010).

Hierarchical bureaucracies need to integrate vertically organized functions and project teams with loosely-knit horizontal CoPs (McDermott, 1999; Smith and McKeen, 2004). However, there is a shortage of studies regarding CoPs within public hierarchical bureaucracies (Bolisani and Scarso, 2014). According to Wenger and Snyder (2000), it is challenging to sustain and incorporate CoPs into the organization because of their resistance to supervision and control. This research mobilised the concepts of boundary spanning and loose coupling to analyse the role of CoPs in hierarchical bureaucracies. It is argued that CoPs can be sufficiently decoupled from the rationality and constraints of reality (Spender and Grinyer, 1995) and can adjust to changing environments quicker than hierarchical organizations with their rigidities.

Although the idea of CoP cultivation is criticized for losing sight of the spontaneous nature of CoPs (e.g. Amin and Roberts, 2008; Lave, 2008), there are examples of their successful cultivation (e.g. Borzillo, 2009; Saint-Onge and Wallace, 2003; Wenger et al. 2002). This research attempts to investigate the process of CoP cultivation in a public hierarchical bureaucracy to understand whether CoPs can serve as cross-functional boundary spanners to create an arena for mutual engagement in adaptive learning. The firm under scrutiny is a large-scale hierarchical PBO owned by government that serves the public sector.

One of the barriers to effective KM in large infrastructure organizations is lack of senior management support (Carillo, 2013). Senior management sponsorship for CoPs does not threaten the power structures yet is crucial for CoPs sustainability (Borzillo, 2009; Wenger and Snyder, 2000). CoPs' sponsors support an environment of

collaboration and knowledge exchange, provide the necessary resources and link activities to the organization's strategic objectives (Borzillo, 2009; Brown and Duguid, 2001; Wenger, 2010).

The authors address hierarchy at the programme level on the client side by demonstrating the implications of involvement of potential CoP sponsors in designing mechanisms to successfully cultivate knowledge transfer in the client organisation and potentially into the supply organisations too. To this end, CoP sponsors are expected to orchestrate a broad vision of the overall learning system in the organization so that the various components of the system can contribute their value in "mutually enhancing fashion" (Snyder, et al., 2003, p.32).

Cognitive mapping (CM) technique, used in this research, helped the researchers in the methodological challenge to reduce data to a manageable form without losing the embedded meaning. The maps allowed researchers to see unique patterns used in the problem solving. In this paper, the authors first introduce the complex cognitive map (Figure II) to demonstrate rigour, then the thematic map to provide a simplified visual tool as to how the analysis and relevance of the findings were derived (Figure III). Finally, the segment of the map that provides more details about the interviewees' combined mental model regarding cultivation of CoPs is illustrated in the Figure IV.

The research findings demonstrate that CoP sponsorship by senior level management gives them 'voice' in the organization and increases the chance of successful integration and achievement of tangible outcomes. Based on the outcomes of this research, CoPs can influence behaviours and can dramatically facilitate knowledge transfer. The pilot project implemented in the scope of this research indicates that CoPs can co-exists with administrative hierarchy, facilitate a risk-free learning environment and even escape the rules when necessary, on the conceptual basis of being a loosely coupled mechanism. What is remarkable is the significant contribution of a commercial CoP within a relatively short period.

2. Theoretical background

2.1 Hierarchical bureaucracies

Hierarchy and bureaucracy are not interchangeable concepts. Kuntz (1968, p.162) defines hierarchy as "an order of some complexity, in which the elements are distributed along the gradient of importance". Each part of hierarchical organization is determined by its position in relation to the central point. Thus, each function can only be understood in its relation to the whole system. Traditional hierarchies are ideal tools for centralised administration and are better suited for large-scale organizations. They can gain efficiency through the top-down coordination and control (Miller, 1992); however, a high degree of formality may lower knowledge creation and transfer vertically and horizontally.

According to Weber (1864-1920) bureaucracy is the division of labour applied to administration. His bureaucratic model was built on the management of power and line management for control and efficiency. Rules, procedures and predefined routines are dominant (Burnes, 1992). Bureaucracies are operational, whereas hierarchies are structural. Bureaucracies require hierarchy, but hierarchies are not automatically bureaucratic (Bennet, 2006). In complex adaptive hierarchies, employees are involved in different tasks-related objectives, which can facilitate individual learning over a wide range of competencies and interests. However, not only positions but also social relations are organized hierarchically in bureaucracies (Laumann et al., 1971). That does not encourage individual learning beyond the immediate task (Bennet, 2006). Thus, organizations are confronted with a tension between their need to learn and share knowledge, individualism and controls (Trauth, 1999). Moreover, individual expert knowledge is viewed as competitive advantage, and hence a bridge to obtaining power in the organisation at the expensive of overall performance.

2.2 Knowledge management in hierarchical bureaucracies

Hierarchical bureaucracies lack the flexibility to coordinate internal relationships and leverage knowledge to adapt to strategic change (Baum and Wally, 2003; Kotter, 2012). This constrains front-line operations. Further, hierarchies differentiate between strategic thinkers at the top and tactical doers at the operational level, hence discouraging the creation of know-how, failing to foster adequate mechanisms and inducing a lack of

awareness of the value of knowledge transfer (Brown and Duguid, 2001). Hierarchical control mechanisms make people risk averse and less open to share successes, mistakes and failures. Professionals end up working in their silos with control focus, especially regarding costs. PBOs are particularly prone to the 'silo' effect considering that project governance is viewed as an activity driven from the top, struggling to realize business benefits and enhance inter-project learning (Thiry, 2004). Programme management in PBOs serves as another layer in a hierarchy between the senior management and the projects. Recent research on KM challenges in PBOs (e.g. Lee-Kelley and Turner, 2017; Pemsel and Müller, 2012; Nilsen, 2013) has not fully addressed the programme level, particularly on the importance of cross-functional tacit knowledge exchange in hierarchical bureaucracies. Functions (i.e. commercial, procurement, estimating) deal with multiple projects and their collaborative learning is crucial for strategic value creation. However, hierarchical bureaucracies create silos that inhibit effective learning.

Large-scale infrastructure organizations generate a great deal of tacit project knowledge which is a product of experience, innovative problem solving and insights (e.g. Kelly et al., 2013). There are different ways of conceptualizing tacit knowledge, and some definitions are mutually exclusive. Michael Polanyi was first to define 'tacit knowledge' or 'tacit knowing' in his book '*Personal Knowledge: Towards a Post-Critical Philosophy*' (1958). In his later work Polanyi (1966) stated that people know more than they can tell and that they usually are not aware of the knowledge they have. Following Polanyi's philosophy, all knowledge includes a degree of tacitness and cannot be fully documented. Thus, in order to transfer operational knowledge stored in the heads of individuals, a guided joint social interaction is required (Davison and Blackman, 2005; Hayes and Allison, 1998; Lave and Wenger, 1991). Knowledge holders need to be part of a network or a CoP (Lave and Wenger, 1991).

Various studies provide evidence that organizational culture creates norms regarding what is 'right' and 'wrong' in the organization and influences how people communicate and share knowledge (De Long and Fahey, 2000). It is difficult to create an environment that will facilitate the necessary level of cooperation in hierarchical organizations. There is a need for another strategic operating system that can be used alongside the 'business as usual' one to encourage organizational learning and to boost knowledge transfer. Organisations need to focus on human systems, where knowledge resides; not on the collection of data and IT depositories (Churchman, 1972; Davison and Blackman, 2005; Rubenstein-Montano et al., 2001).

2.3 Communities of practice

Concepts of knowledge transfer that isolate knowledge from practice have been criticised by learning theorists regardless of context (Brown and Duguid, 1991; Lave and Wenger, 1991). They therefore developed a view of learning as a social construction in context in which the meaning resides. This understanding is process-based; it is inseparable from work (Barley and Orr, 1997; Blackler, 1995) and involves acquiring knowledge "developed and framed in a crucially communal context" (Brown and Duguid, 1991, p. 48). The term 'community of practice' was first introduced by Lave and Wenger (1991) in their book on situated learning and was then developed by Wenger (1998) as part of a broader conceptualisation of a learning organization. Lave and Wenger (1991) state that the process of learning and becoming an expert is aligned with full participation in a socio-cultural practice. According to the model of situated learning, learning occurs in social relationships with other learners "who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis" (Wenger, et al. 2002, p. 4). Another definition describes a CoP as a group of people needing to work together to share and apply know-how (Brown and Duguid, 1998).

CoPs are evident where the community members volunteer to share their tacit knowledge, 'continually expand their capacity to create the results they truly desire where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning to see the whole together', without any formal hierarchy or management structure controlling their activities (Senge, 1990, p.3). By contrast, formal work groups and teams are always organized by management to deliver a specific task (Katzenbach & Smith, 2001). Although not all work groups are teams and there are differences in a) measurement (direct vs. indirect), b) accountability (individual vs. personal), and leadership (clearly focused vs. shared roles), both forms of collaboration have allocated resources, clearly defined job specifications and official voice in their organizations (Katzenbach & Smith, 2001).

CoP members voluntarily join the community and establish norms and relationships through mutual engagement (Wenger, 1998). Within CoPs, identity is not defined by a task, as it would be within a team, but by an area of knowledge that needs to be explored and developed (Wenger, 2004). As opposed to CoPs, the members of work groups and teams are selected for their skills and potential to develop (Katzenbach & Smith, 2001). According to Orr (1990, p. 33) CoPs have "little hierarchy; the only real status is that of member". Due to their fluid and organically evolving boundaries, CoPs can serve as a better loosely coupled form for overcoming cross-functional barriers created by the hierarchical structure.

The concept of CoPs has been widely acknowledged by academics and practitioners to have high potential in crossing boundaries created by functions, workflow, geography, and time to facilitate knowledge exchange and reuse (APQC, 2013; APQC, 2016; Bolisani and Scarso, 2014; Jagasia et. al., 2015; Josserand, 2004; Wenger, 2010). The key structural dimensions of CoPs are: domain, community, and practice (Wenger, 1998; Wenger et al., 2002). Their effectiveness and sustainability strongly depend on their strength in all three areas.

To maximize the value of CoPs, an organization must align them with the overall corporate strategy and goals. CoPs were initially viewed as self-organizing structures that could not be managed (Brown and Duguid, 1991; Lave and Wenger, 1991). However, they are contextually located on social and organizational space that are both generative and to some degree constrained. In their *Cultivated Communities of Practice* book (Wenger et al. 2002), authors make a shift from a social perspective to a managerialist conception of community (Cox, 2005). Subsequent research has demonstrated that an increasing number of organizations make systematic efforts to intentionally cultivate and develop CoPs (Wenger et al., 2002) and yet they are vulnerable because they usually lack budgets and formal voice in the organization. They need to be integrated into the business and get support from the senior management (Wenger and Snyder, 2000). CoPs need vertical elements – a sponsor at a senior level ready to use the legitimacy of their position to direct CoPs towards organizational objectives and help them overcome the barriers created by the hierarchical structure (Borzillo, 2009; Wenger and Snyder, 2000). The role of the senior management is to strengthen them as informal entities, rather than "to formalize them by making them follow procedures or meet efficiency goals" (Wenger et al., 2002, p. 217).

2.4 Communities of practice and boundary spanning

Recent studies in project and construction related KM have clearly shown that information at the operational level does not filter into and up to the organization (e.g. Carillo et al., 2013; Galbraith, 1973; Kelly et al., 2013; Mintzberg 1973). Functions and departments tend to induce silos. Barriers and boundaries pose constraints to knowledge transfer. According to Aldrich and Herker (1977), the definition of a specific boundary depends on a specific conceptual and empirical context. A 'boundary' is a borderline that marks the limits of an area that may include hierarchical, geographical, social, cognitive, and relational knowledge with cultural and other divisional and disciplinary boundaries (Carlile, 2002). A boundary can be both an enabling and a constraining structure (Hernes, 2003). One of the approaches of organisational boundaries is the theory of situated learning in CoPs (Lave, 2008; Lave and Wenger 1991; Wenger, 1998) that studies learning and change on the "micro-level of boundary action, processes and practices" (Gustavsson and Gohary, 2012, p. 367).

Diverse types of boundaries can inhibit experts in different parts of the organization from sharing knowledge and co-creating value. CoP members can be viewed as boundary spanners that cross horizontal and vertical boundaries to create an arena for mutual engagement in adaptive learning. In this context, cross-boundary collaboration is conceptualised as a form of collective learning and problem solving (Brown and Duguid, 1991). Cross-boundary learning was found to be one of the key success factors for performance improvement (Aalbers et al., 2016). Experts need to collaborate across boundaries to learn from each other, exchange resources and solve complex problems (Webster, 2007). CoP sponsors can help them deliver their messages across the boundaries to support decision making. They add a leadership role and an element of hierarchy to the form and structure of a CoP, managed with goals and targets to structure and guide practice (Snyder et al., 2003; Wenger and Snyder, 2000).

CoP members, who represent functional groups in different parts of the organization, become boundary spanners and benefit from the access to the influencers in an organization, which helps them obtain necessary resources and bring creative solutions to the attention of the decision-makers. Yet, CoPs do need to sustain their integrity and to function as a unique place of knowledge, otherwise they may lose credibility and trust (Snyder et al., 2003).

2.5 Communities of practice as loosely coupled systems

Collective practice, learning and innovating are different facets of each other and cannot be separated, which connects the concept of CoPs and loosely coupled systems (Brown and Duguid, 1991; Spender and Grinyer, 1995). The notion of CoPs emphasises collective activity and the term 'loosely coupled stresses the structural and formal aspects (Spender and Grinyer, 1995).

The term "loose coupling" was first mentioned by March and Simon (1958) in their analysis of the impact of bounded rationality in organizational change. Any part of an organization has interrelated elements that vary in the numbers and strengths of their interdependencies or coupling. The looseness of the degree of independence of those elements produces flexibility (Orton and Weick, 1990). Loose coupling may appear among people, groups, silos and hierarchical levels. March and Simon (1958) argued that although programmes in hierarchical organizations draw on the same pool of capital resources, they can still be analysed in isolation with consideration of their responsiveness to an overall system. Weick (1976) further developed the concepts of tight and loose coupling to describe organizational structure in educational institutions. He argued that although loosely coupled systems are an integrated part of a bigger system, they can still retain their uniqueness as individual elements. The problem with the loose coupling concept is to sustain reflexivity and the dialectic between the integrity of the whole and the uniqueness of the parts (Orton and Weick, 1990).

The tight coupling concept was first popularised by Perrow (1984) and is a result of strong dependencies between the elements of the system, whereby a tightly coupled systems is much more deterministic in operation. It is highly likely that efficacy in a loosely coupled system with semi-autonomous units and aspects of structural silos is greater than in a tightly coupled system (Weick, 1976). Loosely coupled systems understand their environments better and have more flexibility to experiment, explore and adjust to the changing environment without affecting the whole system. CoPs, as loosely coupled systems, fill organizational gaps in various contexts due to their elasticity and adaptability to the organizational environment (Josserand, 2004). They can be sufficiently decoupled from the rationality and constraints of reality (Spender and Grinyer, 1995) and can adjust to the changing environment much quicker than hierarchical organizations with their rigidities. They should not be viewed as a replacement for traditional operational models; they add a new dimension (Snyder et al., 2003), allowing flexibility to speed up decision-making.

Hence, CoPs facilitate and accelerate learning by engaging with loose coupling to overcome the rigidities of hierarchy. However, loosely coupled systems may not fit the organizations focused on capacity, standardisation and accountability for short-term results (Wenger and Snyder, 2000; Orr, 1990). CoPs need sponsors at a senior level who understand the "subtleties of these tensions" and can help CoPs balance integrity and integration (Snyder et al., 2003, p.32).


3 Research setting and methods

3.1 Background

This study is a part of a broader 2-year research programme aimed at studying the inhibitors to KM in the organization (see the research process and timeline on Figure I). The firm under the scrutiny is a large public-sector PBO that manages infrastructure programmes and contracts out to project providers. It relies on an extensive supply chain to deliver its multibillion-euro construction programme of projects. The organization is therefore subject to public sector funding and constraints with the challenge to manage public-private partnership, which requires an extensive consultation with multiple private and public sector stakeholders.

A deeper form of research that engages academics and practitioners is required to produce knowledge that is relevant to both theory and practice (Pettigrew, 2001, Van de Ven, 2007). The information obtained through engaged research enabled the researchers to look at and examine the findings in a real-life environment.

The research approach conforms to Yin's (2003, p.23) case study method, which involves "empirical investigation of a contemporary phenomenon within its real-life context [using] multiple sources of evidence".

Figure I Research Timeline
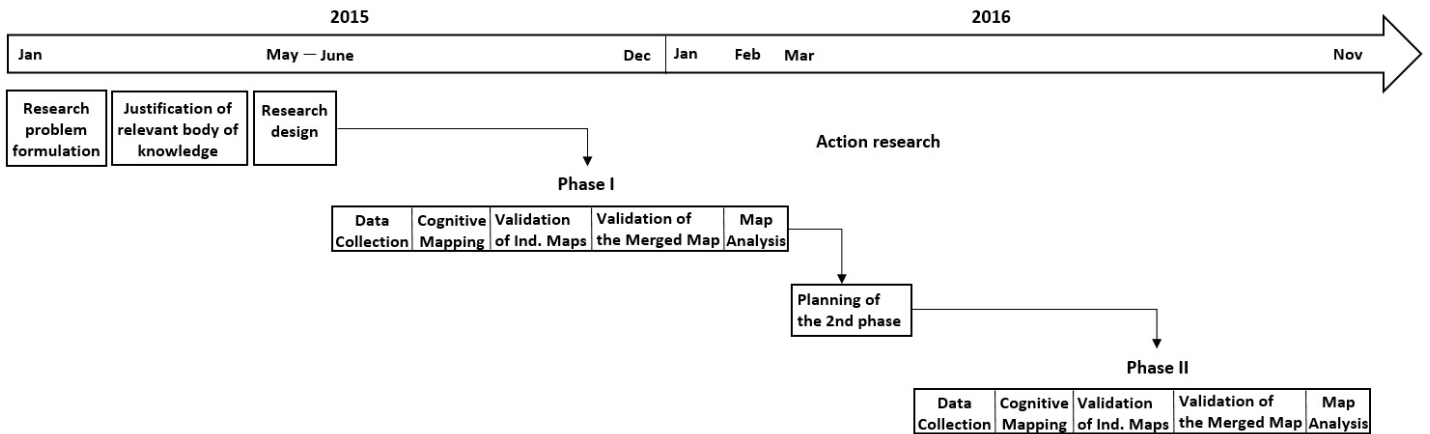
The engaged research involved an action research component that facilitated deductive evaluation of theory applicability on the ground, and inductively generated conceptual insights. A case study design was therefore developed based on the infrastructure organization, which employed an exploratory approach (Eisenhardt, 1989; Brown and Eisenhardt, 1997). Single cases are beneficial because they yield rich in-depth data (Dubé and Paré, 2003).

Action research is appropriate research method in this case as it 'emphasizes knowledge produced in the context of application' (Eden and Ackermann, 2018, p. 6) and helps 'diagnose and treat a problem of a specific client' (Van de Ven, 2007, p. 28). It has become popular as a form of professional learning (McNiff and Whitehead, 2011). CoP was an action research solution and therefore was prejudged and this was reflected in the way the literature review unfolded above.

During the last decade, the organization pioneered several KM initiatives, yet failed to gain traction to overhaul its existing processes. These hierarchical efforts were reliant upon various IT platforms, such as Sharepoint ©, that were perceived as being remote from operations. Those in charge of KM initiatives retained a bureaucratic perspective, viewing knowledge as a static resource like any other product or input. Yet multiple organizational inefficiencies led to systemic shortfalls and failures to share and re-use knowledge across functions, regions, programmes and projects. The problem was vertical and horizontal. The lack of KM at a programme level inhibited timely knowledge transfer across projects and between projects. The geographical separation of functional teams made the diffusion of knowledge difficult. There were also pressures from government stemming from changing financial regimes. Thus, to remain flexible and adaptive the organization needs to put more effort to capitalise on knowledge and experience of their experts internally and across the supply chain.

This research aimed at understanding the key challenges of current KM initiatives and feasibility of cultivating alternative processes. An interpretative methodology was employed to recognise the importance of human worldviews and perceptions, while preserving the systematic approach to analysis. Systems thinking is an overarching theory addressing the interrelationships between variables and their connections to a whole system and was employed to address the challenges in complex social systems (Checkland, 1981). According to Checkland (1985), in order to change our understanding of problem situation and practices, we need to orchestrate a process of learning. There is a rich literature on systems approaches and methodologies, including soft systems thinking. Soft systems thinking (or soft operations research (OR)) that "keeps in touch with the human content of problem situations" (Checkland, 1985, p. 765), was particularly relevant in the

context. Soft OR can be theoretically developed through action research, considering that its effectiveness depends on understanding of the problem situation to find the 'right problem' (Eden and Ackermann, 2018).

Mental models are a means by which organizations and individuals create and share meaning, thereby enabling a common understanding and the development of knowledge (Davison and Blackman, 2005; Hayes and Allison 1998). People 'see' the same things differently, behave in different ways to the same things and sometimes act in the same way in response to different things because of taken-for-granted thinking and informal routines. A systematic approach was needed to examine the range of subjectivities and provide a basis for analysis. Cognitive mapping (CM) was employed.

3.2 Cognitive mapping

CM used in this research, is a problem structuring method of the strategic options development and analysis (SODA) developed in the late 1980s and labelled as soft OR (Eden and Ackemann, 2018). CM is a fundamental part of the SODA approach that has been developed through 'JOURNEY Making' (JOintly Understanding Reflecting and NEgotiating strategY) (Eden and Ackermann, 1998). Axelrod (1976) first used CM as an approach to study managerial decision-making processes.

A significant strength of CMs is that it supports elicitation of mental models and generation of creative ideas using the participants' language. The formal basis for cognitive maps derives from Kelly's (1995) personal construct theory which proposes an understanding of how people 'make sense' of their world by seeking to manage and control it (Eden, 2004). A cognitive map is a two-dimensional directed graph that represents the issue from the perspectives of an interviewee and gives an indication of why a situation is problematic and what can/cannot be done about it (Eden, 1994). The links between the nodes on the cognitive map represent logical implications between the concepts.

The maps allow capturing statements in the hierarchical manner and demonstrating the causal or implication links among them (Eden and Ackermann, 1998). Cognitive maps allow "exploration of both detailed and holistic properties using various forms of analysis" (Eden and Ackermann, 1998, p. 285). Causal mapping supports the process of 'thinking together' which is aligned with is Polanyi's (1962) idea of indwelling. The technique helps describing people's tacit knowledge about a certain problem, particularly in ill-structured decision problems without reducing the complexity (Axelrod, 1976; Eden, 1989). CM helps participants develop answers to strategic questions, create shared meaning, facilitate negotiations and communicate agreements about further actions.

3.3 Data collection

Data for this study were collected through formal semi-structured interviews, and were supplemented with background information obtained from organizational documentation (internal and industry reports, notes and minutes of informal and formal meetings respectively) and observation. The documentation, observation and informal conversations regarding multiple KM initiatives that did not survive or engage people provided additional understanding of organizational context and the reasons for failure of KM initiatives. The different data sources permitted employment of triangulation as a comprehensive case analysis.

The data analysis was conducted in two stages over 2 years. The first stage covered the main opportunities and challenges in knowledge creation, sharing, retention and reuse. The impact of failing to share better practices in the company across multi-billion-euro infrastructure programme was researched too. We interviewed twelve employees, occupying different positions within the programme management team: director, commercial and procurement managers, project managers, programme planner, designers, engineers, and learning and development experts. The data saturation has been achieved by the 11th interview. The purpose of this step was to elicit the personal constructs of interviewees, with minimal intrusion from the facilitator. Each recorded interview lasted about 1,5 hours. The next step involved interview transcription into the cognitive maps to depict interviewees' perception of the prevailing situation. Content validation of individual cognitive maps was conducted during half-an hour follow-up meetings. The individual maps were merged into a single map to develop a unified view of multiple perspectives. Following CM guidelines (Eden, 1989; Eden, 2004; Eden and Ackermann, 2018), the map was presented to the interviewees during the workshop (2-3

hours) to test whether it correctly interpreted their views and was worked on until everyone found it acceptable.

The agreed merged map set contrasting opinions in context and was analysed using CM tools, namely head, centrality, domain and cluster analyses (Eden, 1989). Analysis of the combined map with the help of Decision Explorer software (http://www.banxia.com) revealed the key inhibitors to and enablers for knowledge sharing in the organization. It allowed deeper understanding of problem situation and served as a basis for the second stage of the interviews with five potential CoP sponsors (as data saturation has been reached) using the same methodology.

Head analysis was conducted to identify goals. The heads of a map are the concepts represented by the nodes that have only arrows going inside. They are the goals expressed in terms of final ends or effects. Domain and centrality analyses were used to identify the key issues from the perspectives of the interviewees. Density of the direct links around the concepts identify the best elaborated ones. The nodes with complex domain (high density of direct links) are the potential key issues from the perspectives of the interviewees (Eden, 2004). They can become the subjects for further examination.

Centrality analysis extends the domain analysis by considering both, direct and indirect links. It reflects the downstream effect and allows a more accurate view of key issues than domain analysis (Eden, 1989). Centrality analysis measures the complexity of the concept's implication chain, considering that the greater the complexity, the more central is the concept (Eden et al., 1989). If a concept appears in both analyses, it means that it is both 'locally and globally significant, confirming its position at the core of a potential key issue' (Eden and Ackermann, 1998, p. 405).

Decision Explorer software allows detecting clusters, that are separable from other parts of the map (Eden, 2004). The aim of this analysis is to produce hierarchical sets or groups based on a specified set of concepts. The analysis takes the key issue specified by the modeller and drills down all the chains of argument impacting the key statement.

4. Research findings and analysis

4.1 The outcomes of the interviews with the programme management
The first stage of this research aimed at understanding the reasons for failure of KM initiatives and assessing the KM gap. Based on the interviews with twelve members of the multi-billion-euro client infrastructure programme management, eight potential and subject to the detailed CM procedure interrelated key issues required resolution to improve KM in the organization. In descending order of importance, the emergent issues are: 1) 'share knowledge'; 2) 'change the organizational culture', 3) 'make the organization a better place to work', 4) 'create a learning environment, organization', 5) 'share best practice', 6) 'create more comfort and security at work', 7) 'improve top-down communication' and 8) 'create and maintain an effective knowledge repository'.

'Share knowledge' concept has the highest domain and centrality scores, which emphasises the importance of knowledge sharing from perspectives of the management of the programme. In large public organizations, it is very common to repeatedly solve similar problems because of lack of awareness of and support for the developed and technically tested solutions (Davenport and Prusak, 2000). This was evident in the case organisation. The respondents emphasized a need for promoting tacit knowledge exchange. They agreed that the organization needs a human system that will encourage direct interactions among individuals and will enable a culture of sharing to motivate knowledge exchange among professionals working in functional 'silos'. Organizational culture was recognised as a critical barrier to KM. The importance of a knowledge sharing culture as an enabler for the transfer of knowledge was alluded to and this point is well documented in other research (e.g. Bukowitz and Williams, 1999; Davenport and Prusak, 2000). This invokes the comment that the culture is "perhaps the most difficult constraint that knowledge managers must deal with" (Davenport, et al., 1997, p.14-15). The respondents reported that current organizational culture demotivates experts from sharing knowledge and experience and that the organization need secure and comfortable working environment with more efficient top-down communication. This is particularly critical where knowledge is

"sticky". The tacit knowledge form is predominant due to its non-repetitive nature and context of much project work (Szulanski, 2000). In the case where repetition was present, locational and social space differed and were defined geographical, hierarchical and functional boundaries.

Based on the 'potency' analysis of the map, some of the options that have consequences for a bigger number of the key issues above are: a) 'create an environment of mutual trust and understanding rather than who shouts louder gets his way in', b) 'increase staff motivation', c) 'stop reshaping the business', d) 'eliminate blame in the corporate culture' and e) 'be fast with the [top-down] feedback rather than do not respond at all'. The merged cognitive map allowed the participants see the big picture with contrasting opinions in context, which facilitated more constructive discussion, respondent interpretation and researcher validation. During the workshop, some of the participants voiced their opinion regarding the complexity and time-consuming nature of cultural change projects, especially considering that there are different cultures in the organization with offices and staff geographically dispersed throughout the country, making the management of any change project even more difficult. The idea of cultivating professional CoPs emerged through action research dialogue with the participants. This was the main mechanism hence solution arising from the action research. It was recognised that professionals need a means to generate optimal and relatively quick solutions. A vehicle to create the means can also create its own culture free of blame and silo thinking and can eventually contribute to changing current behaviours.

It emerged during the interviews that there are some informal learning communities in the organization, where not only success stories but also failures are shared without fear of blame. However, those communities are siloed and do not share knowledge across functions, projects and programmes. There was consensus among the workshop participants regarding the importance of the support by the senior management to ensure that CoPs have allocated budget and formal voice in the organization. Sponsors can help them overcome the barriers created by the hierarchical structure by using legitimacy of their position to promote CoPs' integration into the business as loosely coupled operational systems (Josserand, 2004; Snyder et al., 2003). It was also recognised that the conduct and behaviour of the sponsor needed to be different from the mainstream hierarchy in order to create the environment of trust by facilitating better top-down and bottom-up communication and providing timely feedback, especially when there is an urgent issue to resolve. In other words, the first stage of the research found hierarchy to be a major barrier and that CoPs linking senior management and programme managers would help circumvent the structural barriers. This concluded the first stage of the research. While its presentation is straightforward, opposition and a lack of buy in had to be overcome and legitimacy secured through the general engagement and specifically through the action research component. The preparation and the first stage took about 14 months to fully complete.

4.2. The outcomes of the interviews with the heads of functions, potential CoP sponsors

The second stage of this research involved presenting the results of previously discussed analysis to five potential CoP sponsors (the commercial and development director, heads of commercial, procurement, and cost estimates functions) to get their feedback regarding the challenges specified by the programme management team. This followed by individual semi-structured 1,5-hour interviews around the key issues specified by the infrastructure programme management and about their perceived role in CoP cultivation and sustainability. The interviews were mapped and merged into a single map after validation. As the merged cognitive map illustrates (Figure II), majority of the respondents view CoPs as the most feasible way for expert knowledge retention and exchange in the organization. The research on CoPs has pointed out that the sponsors are not responsible for their design and the outcomes. They are expected to work with the leaders of the community to provide the appropriate resources (e.g. Wenger and Snyder, 2000; Wenger, 2010).

There was greatest similarity in mental models of potential CoP sponsors regarding the importance of a formal voice of CoPs in the organization (node 31, Figure IV). Based on the interviews, all five respondents see their role in providing budget and formal voice to CoPs. All five interviewees reported willingness to take part in designing the vision, mission statements and defining key strategic directions of the communities to ensure that they are linked to the organizations' strategic objectives.

It was interesting to observe that the heads of functions want to take more proactive role in CoPs' cultivation, support and promotion to ensure their sustainability. This can be explained by the previous multiple failures of KM initiatives in the organization. The functional leaders came to realise that for CoPs to facilitate

collaboration and learning across the vertical and horizontal boundaries and support decision making in the organization with high degree of formality, they need a stronger support by the senior management. At the same time, they agreed that the CoPs will need flexibility to shape their own boundaries, make their own decisions and become risk-free spaces where people can build trust and share good practices. One of the potential sponsors mentioned that CoP members should "involve heads of professions only when an issue cannot be resolved without them" (node 75, Figure VI). The heads of functions see their role in providing CoPs with flexibility to initiate collaboration across boundaries as loosely coupled. This recognition points to CoPs not only circumventing current constraints but potentially adapting the hierarchical domination in the culture, but that depends upon the sustainability of CoPs as independent yet contributory processes.

4.2.1 'Head, Domain and Centrality' analyses of the merged map

Based on the 'head' analysis of the map, the concepts 'improve safety and performance' (node 58), 'improve reputation of the company across the industry' (node 59) and 'be the client of choice for the supply chain' (node 60) were defined as the goals that can be achieved by implementing robust KM strategies (Figure II). Concepts with the top eight highest domain and centrality scores (the key potential issues) have been reported in the Table I (underlined in Figure II). All respondents agreed that addressing the key issues mentioned by the infrastructure programme management, i.e. 'break silos', 'change the organizational culture', 'create a learning environment', 'improve knowledge exchange internally and across the supply chain', will increase organizational capacity in decision making and complex problem solving. They all agreed with the programme management that an enjoyable working environment plays a significant role in promoting knowledge exchange and innovation within CoPs, which may eventually contribute to a better learning environment in the company (the direct inward link to the node 54 from the node 4, Figure II).

Overall, there is an understanding in the company about the importance of becoming a learning organization (node 56) that involves systematic problem solving, experimentation with new approaches, learning from own experiences and good practices of others, and transferring knowledge throughout the organization.

Table I	The results of Domain and Centrality analyses
The key potential issues	*The number of the node on the map (Figure I)*
organize professional CoPs in the company	1
break professional silos in the company	55
create an enjoyable working environment in CoPs	54
create a better learning environment in the company	4
organize cross-professional discussion of complex problems	10
promote excellence in the company internally and externally	62
become a learning organization	56
improve collaboration with supply chain	108

The leadership of the organization is actively promoting continuous improvement programmes with quite low rates of success because they require commitment to learning and overcoming the cultural constraints, such as 'silo' and 'blame' mentalities. This study found that the reasons behind professional 'silos' are: willingness to protect own knowledge that is considered as competitive advantage, lack of time, internal politics and scarce dialogue between the functional units.

The analysis of the merged map illustrates that there is an evidence in the organization of insufficient collaboration with the supply chain (node 108, Figure II). According to the map there is a need to work collaboratively across disciplines and functions with the involvement of supply chain experts to co-create value. Cross-functional collaboration across supply chain will drive internal cross-functional collaboration (node 214) and will make the organization 'the client of choice for the supply chain (node 60), which is one of the organizational goals. The research findings point to the potential to use CoPs beyond the client boundary

to engage with the supply chain in future. While low learning and transfer was identified as part of the broader remit in this research, although not reported upon here, a means to address this problem is noted if CoPs grow sustainably in the public client organisation.

4.2.2 'Cluster' analysis of the merged map

Cluster analysis was used to identify groups of concepts that are linked together and cover a particular area of the issue (schematic map, Figure III). Cluster analysis organizes data entities into relatively homogenous groups. The key strategic issues can be the heads of the clusters that can be analysed individually. The links among the clusters can indicate their interrelatedness (dotted arrows, Figure III). The literature on loose coupling suggests that decomposable structures have certain desirable properties, such as recombination and adaptability of knowledge (Weick, 1976). The map on Figure III demonstrates that CoP cluster that is loosely connected with the rest of the map (in terms of inward connections from the other clusters) significantly and concurrently contributes to strategic resolutions. That can be viewed as another indication of CoPs providing loosely coupled remedies to bureaucratic barriers through knowledge generation and exchange, unconstrained by the control mechanisms of hierarchical bureaucracies. An interplay was therefore evident between the loose coupling and the CoPs concept.

The Figure III illustrates that CoPs have the potential to dramatically change how organizations operate. The cluster 'organize professional communities of practice in the company' directly contributes to the clusters: 'organize cross-professional discussion of complex problems', 'create a better environment in the company' and 'break professional silos in the company'. CoP cluster contribute to the clusters labelled 'become a learning organization' through the node 'promote knowledge sharing' and 'improve collaboration with supply chain' via the node 'provide a better pipeline for work'. The cluster indirectly affects the heads of the map, which are the goals of the robust KM strategy according to the heads of functions (Figures II and III). A spin off of this boundary spanning and learning is the induction of a more stimulating and satisfying working environment in which to work.

A deeper analysis of the cluster 'organize professional communities of practice in the company' (Figure IV) demonstrates that the potential CoP sponsors have developed a shared mindset regarding CoP facilitation (node 19), expected outcomes (node 71), the profile of potential CoP members (node 226), importance of having a robust CoP strategy (node 44), sponsorship (node 17), and requirements for centralised IT platforms to share the outputs from different CoPs (node 118). They agreed that to stimulate the involvement of the best experts in CoPs, cooperation should be grounded on concrete and practical realisation to partially satisfy the need for reification. There was also consensus regarding the role of regional directors and line managers. The management can contribute significantly to strengthening the role of communities within an organization by encouraging participation of their experts. The heads of functions realise that it is important to provide CoPs with necessary time (node 191, Figure IV) and freedom to develop new knowledge and innovation.

4.3 A pilot commercial CoP

CM served as a roadmap for designing CoP cultivation guidelines and sponsorship mechanisms to suit the existing organizational culture. The head of the commercial function organized a group of experts and joined them to develop the vision, mission statements and the detailed procedure for the functional teams to nominate CoP members. The documents were shared across the commercial function to receive their feedback. After that the first commercial CoP was launched.

The head of commercial function was interviewed in approximately a year from the day the commercial CoP was cultivated. The interview lasted about an hour. Based on her retrospective feedback, the first CoP meeting was quite encouraging and her presence at the first CoP session brought positive results. As she mentioned: "the launch event meant that everyone [CoP members] had the opportunity to meet me as their head of practice, but more importantly they realised that… they as individuals all had a part to play in the process and it is an on-going success". She mentioned that collaborative work on the design and development of all necessary documents and forms built more trust within the commercial function. "My approach to this [collaboration with the experts] had always been to 'do-with' rather than 'do-to' as far as it was reasonably practical as there would be no other way to ensure that it was sustainable and to drive the right behaviours".

Figure II Merged Map (dotted lines represent the links to hidden nodes)
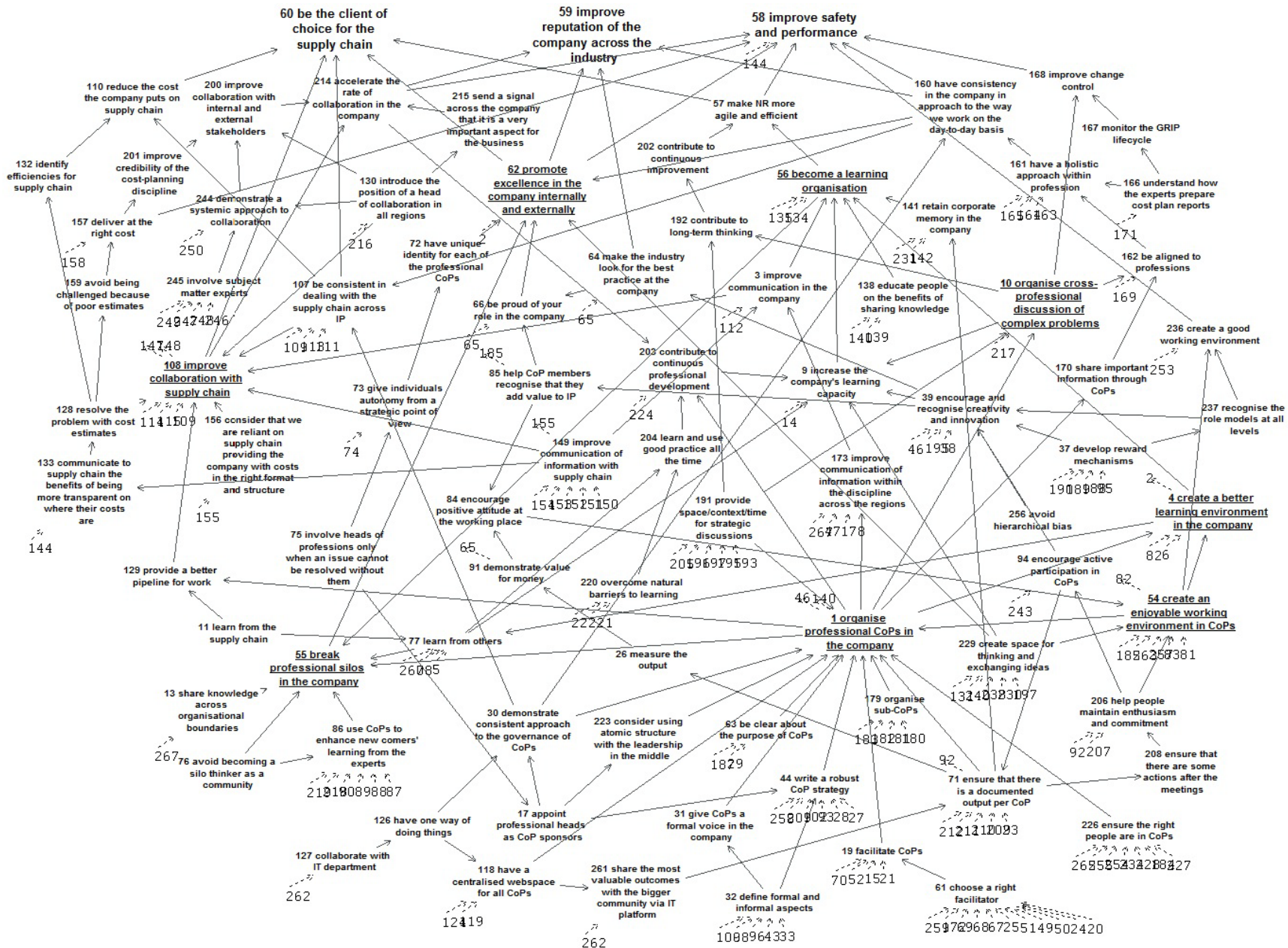
Despite the criticism of CoP cultivation (Amin and Roberts, 2008; Lave, 2008), there are success stories that demonstrate the crucial role of the CoP sponsors in best practice adoption throughout the organization (e.g. Borzillo, 2009; Saint-Onge and Wallace, 2003). The findings of this research support the importance of the sponsor. The greatest contribution of the commercial CoP sponsor, as a senior-level champion, was to help the CoP achieve "self-generating state of strategic value creation" (Snyder et al., 2003, p. 55). The commercial CoP significantly contributed to breaking the cross-functional 'silos' by embedding one-vision-one-way mind-set in commercial function across the entire organization.

The head of commercial function mentioned also that one of the achievements within the year was launching a Commercial Hub to share the output of each community session, including documents and formats produced by the community, with commercial and other functions across the organization. Now, when the commercial community faces a challenge, there is a reliable memory, which is maintained and continuously updated by the community members, to access from any point and time in the organization. Based on the interview, this already proved to have a major impact on a problem-solving capacity at the individual and organizational level.

The community covers also many hot topics on the importance of record keeping, tax recovery, quantification and rate builds up, and safety. The sponsor of Commercial CoP mentioned, "the commercial team [CoP] was recognised as the champion in this work stream and is now being asked to support other functions who have seen our success and want to emulate it". The delivery of tangible results increased legitimacy of the professional community towards the CoP members. Their ability to directly contribute to the profession and recognition of their contribution by their colleagues and senior management had a strong impact on their motivation and individual resilience.
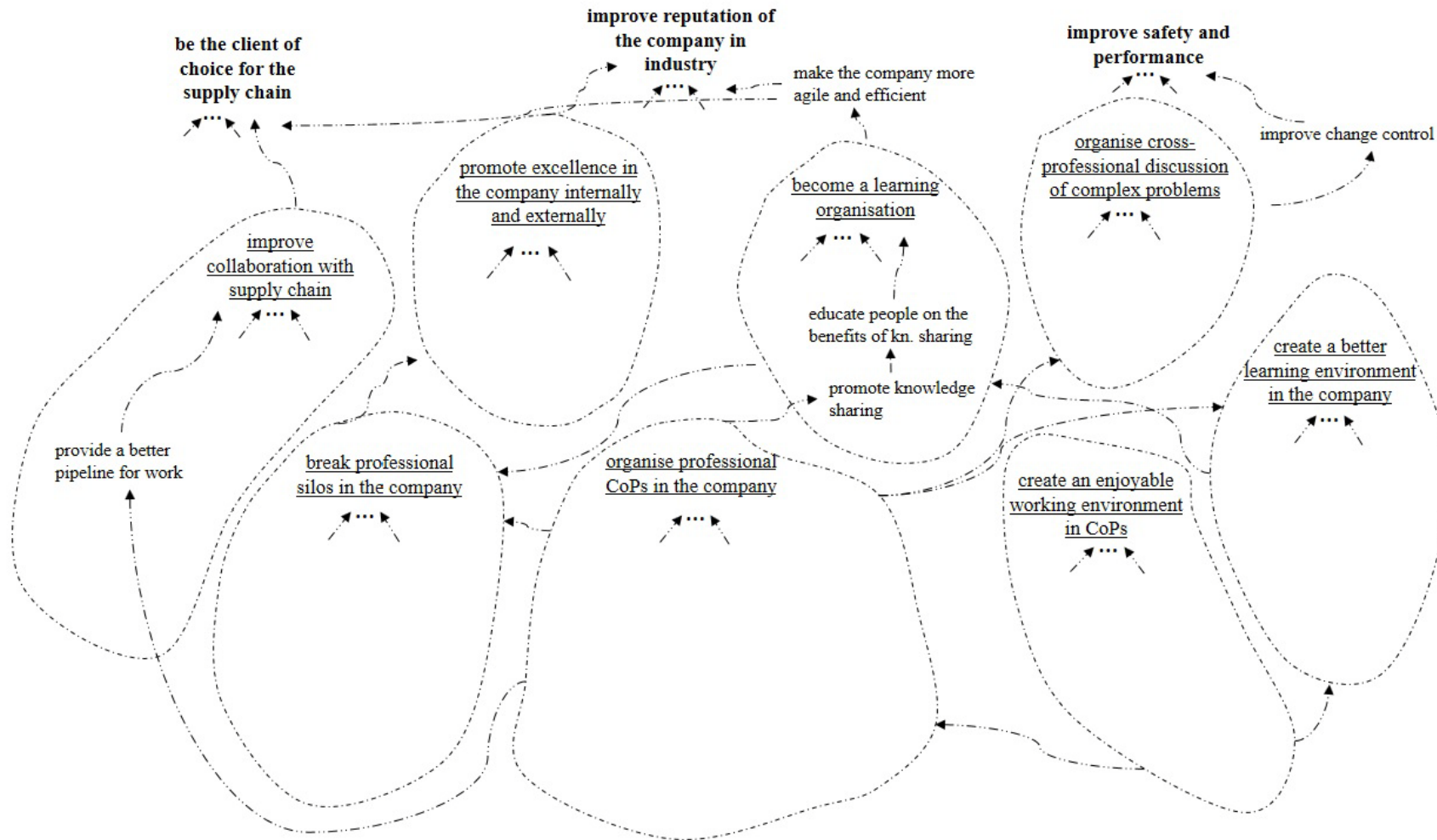
The commercial CoP established its own culture of knowledge exchange and served as a driving force for behavioural change. The head of commercial function reported that "people love to share their best practice and tools, and they have realised the power of sharing rather than keeping their ideas to themselves", which lead to "more positive and proactive knowledge sharing across all bands in commercial function". The CoP crossed the functional boundaries by sharing the community validated lessons and according to the CoP sponsor: "these lessons are important as they are now fed back to the Estimating and Engineering Departments so that the estimates become more robust and less blue sky, and repeated design issues are minimised".

Shared domain gave the CoP members sense of joint enterprise. Regular face-to-face interactions among CoP members and collaborative work contributed to shared understanding of the developed solutions. As practitioners who are not actively involved may have difficulties in understanding the nuances of new solutions, the CoP members decided to identify and train knowledge champions, potential boundary spanners, who will closely collaborate with the CoP by disseminating and implementing new approaches across the boundaries.

Other success stories of the commercial CoP within only a year include: design and implementation of technical in-house training courses, sharing them with the tier-1 supply chain, and an allocated budget to train 28 knowledge and 16 well-being champions across commercial function. As the sponsor mentioned: "we are really starting to see the difference now as we move forward and the change in activity from the centre to the functions is being noticed and commented on".

The results of this research showed that the perceptions of the respondents concerning the constraints of the hierarchy are indeed being addressed and to a large extent overcome through the implantation of this first CoP, which is centred on the commercial function yet spans vertical and some horizontal boundaries. A longer term assessment of continued success depends upon the degree to which the Cop independence is maintained. The results also demonstrated that sponsorship mechanisms engendered loosely coupled entities that facilitate knowledge exchange, build cross-boundary collaboration and promote non-threatening bureaucracy reduction. That ensures the sponsors' buy in and promotes CoPs, which is a key to their sustainability.

Figure III The schematic merged map (dotted lines represent the links to hidden nodes)

Figure IV CoP cluster (dotted lines represent the links to hidden nodes)
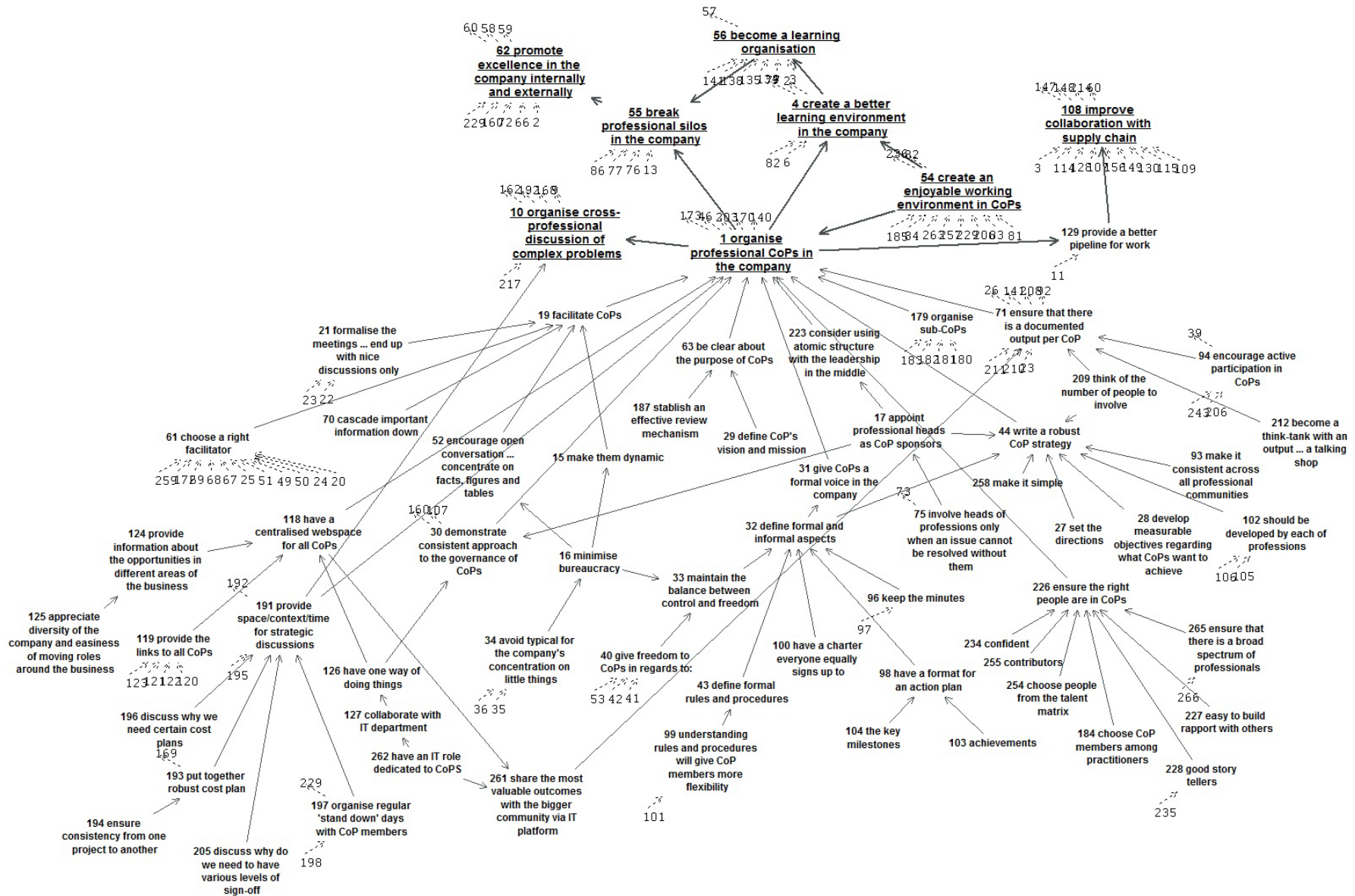
5 Conclusion

Hierarchical bureaucracies create silos with their attendant silo mentalities that result in employees' willingness to protect own knowledge, internal politics and scarce dialogue between the functional units. To remain flexible and adaptive the hierarchical PBO under scrutiny is actively promoting continuous improvement programmes with low rates of improvement due to the lack of commitment to individual learning and cross-functional knowledge exchange. The aim is to improve programme management on the client side with the potential for improving knowledge transfer in the supply chain too.

Communities of practice or CoPs were found to provide a solution to hierarchical constraints. CoPs can become risk-free loosely coupled strategic operating systems that can be used alongside the 'business as usual' structures and processes to encourage organizational learning across boundaries and can boost creativity and effective problem solving. Parts of large-scale infrastructure organizations can remain tightly coupled while other parts become open and "provide a theoretical answer to the hierarchy/learning paradox" (Josserand, 2004, p. 308). However, there is not much research on articulation between the CoPs and the hierarchical bureaucracies with their rigidities (Bolisani and Scarso, 2014; Wenger and Snyder, 2000) and none in the context of knowledge transfer on programmes and projects until now.

This research explores theory in relation to practice by investigating the process of CoP cultivation to enhance learning at a programme level in a hierarchical PBO that manages large infrastructure programmes and projects. Organisational learning and knowledge transfer are based on the introduction of CoPs, which was an action research solution and the contribution is therefore process-based and dynamic. The researchers mobilised the concepts of boundary spanning and loose coupling for analyzing the role of CoPs in creating an arena for cross-functional engagement in adaptive learning. The findings confirm the importance of the concepts in facilitating and sustaining CoPs, especially in hierarchical organizations. The problem with the loose coupling concept is to sustain the reflexivity between the integrity of the whole and the uniqueness of the parts.

Based on the research findings, the commercial CoP was able to decouple from the rationality and constraints of their environment (Spender and Grinyer, 1995) and had enough flexibility to create their own culture, contribute to speedy decision making, design their own forms and templates and ensure consistency in reporting across function. In the complex network of relations in hierarchical bureaucracies with their rigid boundaries, where learning and performance are connected, the role of leadership can be decisive (Wenger, 2010). This research demonstrated that importance of the sponsor's role in balancing CoPs' integrity and integration and helping them overcome the barriers created by the hierarchical structure.

Based on the retrospective feedback of the sponsor of commercial CoP, the pilot has achieved outstanding success since its start-up and proved that the communities can perfectly co-exist with the mechanisms of hierarchical bureaucracies. They can serve as "better pipelines for work" and can achieve self-generating state of strategic value creation with the support of the sponsor at the senior level. The sponsor played a key role in a) identifying strategic capability issues; b) guiding the development of the community's vision, mission and membership nomination procedure c) supporting community members with necessary resources and d) supporting the development of IT infrastructure necessary for sharing the CoP's output with the rest of organization.

According to Wenger (2010) intervention in a Community of Practice can bear positive results when it aims at informing and empowering, rather than building power relationships (Wenger et al., 2002; Wenger, 2010). The findings of this research demonstrated that by taking more proactive role in CoP's cultivation, support and promotion the sponsor motivated the key experts to form the core of CoP. The visibility of the sponsorship gave the community legitimacy, made necessary resources available and helped to deliver the ideas and new solutions to the decision-makers. Her support in creating a favourable environment for learning from current and previous mistakes without a fear of blame served as a driving force for behavioural change and helped the CoP member realise the power of learning together. Overall, the commercial CoP has met the needs of the senior management by enhancing problem solving and decision-making and the needs of its members by receiving freedom to make decisions and having official voice in the organisation.

Research oriented action research stimulated managers and subject matter experts to explore research literature on KM and learn from the best practices from other industries. The CM method used in this research assisted in having a very deep and rich understanding of the issues from the standpoint of professionals working in functional 'silos' with contrasting opinions in context. Cognitive maps served as an effective 'visual thinking' tool which facilitated 'thinking together' and demonstrated not only what each statement mean from the perspectives of the participants, but also why the concepts link together as they do (Eden, 1989; 2004; Pyrko et al., 2017). They allowed participants to see what has been recorded with no pressure to conform to any one point of view, which built relations of trust with the facilitator. That in its turn helped to elicit both detailed and holistic properties using various forms of analysis. CM was therefore an effective action research method, that is for theoretical understanding and generating effective practice (Eden and Ackermann, 2018; Pyrko et al., 2017).

There is no 'one-size fits all' approach in cultivating and sustaining CoPs in the organizations. Hence, there is a need for broader analysis regarding articulation, integration and sustainability of CoPs across different organizations (Josserand, 2004). The implication for managers will be first to understand that CoPs can be cultivated but not managed (Pyrko et al., 2017; Wenger and Snyder 2000; Wenger et al., 2002), and second, they will need to start CoP cultivation and other KM initiatives by understanding and aligning the mental models of the senior managers, potential sponsors.

The aim of this study is to contribute to our understanding of knowledge transfer in large hierarchical PBOs. In so doing, the role of CoPs in hierarchical infrastructure organisations and the importance of senior level sponsorship were examined. Findings of this case study are not enough for general conclusions or statements. As the study was based in one large-scale public client organization, the findings need further validation in bureaucratic hierarchies in the same or other project-based industries. Further, this study analyses the results of the pilot project that has limitations in time span, as it has been only a year that the commercial CoP functions and produces results. Orchestrating such a large-scale professional CoP is a new role for the organization. As soon as other professional CoPs are cultivated, further longitudinal research is needed to analyse their evolution and examine their interactions to understand whether they are successful in challenging boundaries and acting as boundary brokers to connect disconnected functions internally and across supply chains.

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