CAPABILITIES FOR MANAGING HIGH-TECHNOLOGY BUSINESS NETWORKS

Fredrik Nordin, Stockholm University, Sweden
Annika Ravald, Hanken School of Economics, Finland
Jakki Mohr, University of Montana, USA

Abstract: In a business landscape characterized by increasing competition and rapid technological development, managers are exposed to particular challenges, including how an increasing speed of development can be balanced with other requirements such as being cost effective. Inter-organizational cooperation is posited as a viable strategic strategy to balance these competing challenges and is particularly logical in high tech contexts. Of particular interest in this article are the different options for how organizations in technology intensive markets can manage their business network in order to develop and capture value in both the short and long term. We identify two different perspectives on uncertainty and dynamics in high-tech contexts, the dominant perspective that views uncertainty as somewhat predictable and an emerging perspective that views uncertainty as inherently unpredictable, and hence requires a more fluid approach to network management, one grounded in the notion of complex adaptive systems. Using the theoretical lens of organizational capabilities, as applied to network management capabilities, we develop the notion that different types of network management must be adapted for the very different types of uncertainty inherent in high-tech markets. The central thesis in this article is that the requisite capabilities for network management differ, depending upon these different types of turbulence, dynamism, and uncertainty.

Keywords: Network management, complexity, scenarios, turbulence, high-tech, dynamics

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INTRODUCTION

Increasingly, success in high-technology industries is a function not just of how well one actor develops, manages and deploys its own capabilities for strategic advantage, but how well firms coordinate, govern, and manage a network of partners. Networks are particularly logical for high-tech contexts, since inter-organizational cooperation facilitates such contexts' implied balancing act of increased demands of knowledge development and efficiency (cf. Mouzas, 2006). More broadly, networks are also conceptualized as business ecosystems, relatively loosely coupled systems of companies in which the actors and their activities are coordinated or tied to some underlying purpose, whether that is based on a shared technological platform or tied to some company's focal product.

A critical question about business networks is how an actor can manage its business network to develop and capture value in both the short and long term. A business network refers to "three or more firms that cooperate in order to gain strength in numbers, to jointly solve problems, to enter new markets, or develop and produce goods (Gelsing 1992). Especially in high-tech environments, characterized by market turbulence, rapid technology development and competition based on different technological platforms, networks are particularly critical since they can enable both flexibility and risk-sharing among network partners. Much has been written in a general sense about how networks, systems and ecosystems work and can [not] be "managed" (e.g., Blankenburg & Johanson, 1992; Huuskonen, 2014; Huuskonen & Kourula, 2012; Järvensivu & Möller, 2009; Möller & Rajala, 2007; Möller & Svahn, 2003; Ritter, Wilkinson, & Johnston, 2004; Thornton, Henneberg, & Naudé, 2014; Williamson & De Meyer, 2012) with attempts to synthesize existing knowledge and develop comprehensive frameworks for network management (e.g., Järvensivu & Möller, 2009; Möller, Rajala, & Svahn, 2005). However, not much has been written that specifically address the links between the high-tech markets' characteristics, e.g., uncertainties, dynamism, complexity, knowledge intensity (see, e.g., Grönhaug & Möller, 2005; Mohr, Slater, & Sengupta, 2006; Moriarty & Kosnik, 1989; Sarin & Mohr, 2008; Steenhuis & Bruijn, 2006; Yadav, Swami, & Pal, 2006), their management and the requisite organizational capabilities. This is also something which is asked for by, for instance Thornton, Henneberg and Naudé (2013). Accordingly, this article focuses on those capabilities that an actor in a high-tech market must possess in order to carry out activities intended to manage its business networks, i.e. the various skills and competencies resulting from assets and resources of the organization (Teece, Pisano, & Shuen, 1997; Zahra & George, 1999).

One of the most fundamental challenges actors face in managing networks in high-tech contexts is how to balance between present and future needs. For example, maintaining important network partnerships and developing incremental innovations based on an existing technological platform is critical in the short-term, but long-term needs may require radical changes in both technology and partners. This challenge implies several tensions that have to be handled by network management, e.g., whether a firm should be responsive or reactive to competitive challenges or proactive and 'market-driving' to create the future.

In this paper, we merge knowledge from several streams of the literature about capabilities required for various types of network behaviors into a framework that ties those capabilities and activities to the challenging and conflicting demands of competing in high-tech environments. In doing this, we also draw on recent literature on turbulence, complexity, and adaptive systems (e.g., Choi, Dooley, & Rungtusanatham, 2001; Normann, 2001; Ramírez & Selsky, 2014). This

literature highlights two fundamentally different perspectives on the uncertainty and dynamics inherent in high-tech contexts, a traditional perspective that views uncertainty as somewhat predictable and an emerging perspective that embraces uncertainty as an "unavoidable condition that cannot and should not be reduced." As a result of this radically different lens, a fundamentally different outlook on network management, and the requisite capabilities to manage the network, is achieved.

EXTANT LITERATURE ON NETWORK MANAGEMENT AND REQUISITE CAPABILITIES

Network management has been defined as "a series of processes undertaken by a team of individuals, with various skills and capacities that are focusing on defining both the direction to be taken by an inter-organizational entity and the allocation and implementation of resources towards those ends" (Hibbert et al., 2008: 391; see also (e.g., Dhanaraj & Parkhe, 2006; Hellgren & Stjernberg, 1987; Jüttner & Schlange, 1996; Järvensivu & Möller, 2009; Knight & Harland, 2005; Möller & Rajala, 2007; Möller & Svahn, 2003, 2006; Möller & Halinen, 1999; Ojasalo, 2004; Ritter & Gemünden, 2003a; Ritter et al., 2004; Sahadev, 2002; Sahadev & Jayachandran, 2004; Storbacka & Nenonen, 2011). Relationship and network management is more about managing interactions with others than about managing others. It is a two-way process that involves influencing others on the one hand and coping with and being influenced by others on the other hand (Ritter et al., 2004).

Network management resides on several levels (Möller and Halinen 1999). The first level, *'network visioning'* concerns the development of valid views of relevant networks, their structures, processes, evolution, and opportunities. It also concerns the identification of technological development paths and the opportunities and risks involved (Möller et al., 2005). The second level, *'net management'*, concerns the capability to develop and manage the network and to identify, evaluate, construct, and maintain positions and relationships in a network environment. This may be compared with 'cross-relational tasks' (Ritter et al., 2004), i.e. the overall planning, organizing, staffing, coordination and controlling of the value creation system. Third, the *'relationship portfolio management'* level is about developing and managing customer/supplier portfolios. Finally, *'exchange relationships'* and management of dyadic business relationship management, the capability of creating, managing and concluding important relationships is a core resource for a firm. (See also Ritter et al. (2004) 'relationship-specific tasks'; exchange and coordination aimed at initiating, using, developing, routinizing, and dissolving the relationships with specific other actors). Further, it can be divided into activities focusing on specific relationships in the network, i.e. activities aimed at initiating, using, developing, routinizing, and dissolving the relationship, or activities concerned with several relationships and their interconnections.

Network management can also be divided into functions and activities with different purposes. In a more general sense, management can be divided into various functions composed of activities, e.g., (1) Planning function; composed of forecasting, developing objectives, programming, scheduling, developing procedures, developing policies, (2) Organizing function; composed of structuring, delegating, developing relationships), (3) Leading function; composed of decision making, communicating, motivating, selecting, and developing people), and (4) Controlling

function; composed of developing performance standards, measuring, evaluating, and correcting performance (Allen, 1973). Accordingly, Ritter et al. (2003b; 2004) divide cross-relational tasks into (1) planning, i.e. the development of an overall strategy, (2) organizing, i.e. the realization of the strategy including allocation of financial resources, (3) staffing, i.e. the allocation and management of human resources, and (4) controlling, i.e. reviewing the results of the previous tasks. Likewise, Svahn and Westerlund divide net management tasks into influencing, controlling and monitoring, coordinating and integrating. Influencing thus concerns guiding and directing the entire net and its actor towards its own and the shared goals. Controlling and monitoring concerns directing and constraining other actors (Nooteboom, 1998). Coordination has been defined as the integration or linking of different units and range from formalized and impersonal mode (e.g., rule, plans, schedules, etc.) to mutual and personal or group (meetings) mode (Van de Ven, Delbecq, & Koenig Jr, 1976). Under conditions of high uncertainty or interdependence, personal or group coordination is feasible, it is argued. Integration, on the other hand has been defined as a combination of interaction, which is a structural mechanism based on, e.g., routinized and formal meetings, and collaboration, which is affective and composed of joint efforts based on mutual interest, shared resources, etc. (Kahn, 1996). Integration has also been defined as "the process of achieving unity of effort among the various subsystems in the accomplishment of the organization's task" (Lawrence & Lorsch, 1967).

While it has been argued whether or not networks can be managed, and to what extent they should be seen as 'emergent', Möller and colleagues explain how networks or 'strategic nets' (Möller & Rajala, 2007; Möller & Svahn, 2003) can be managed by various activities of conscious and goal-oriented managers' efforts. Drawing on Agranoff and McGuire (2001) and McGuire (2002, 2003), the management functions in networks are said to be framing, activating, mobilizing, and controlling (Järvensivu and Möller 2009). *Activation* refers to the set of behaviors employed for identifying and incorporating the persons and resources necessary to achieve program goals. *Framing* refers to the set of behaviors used to arrange and integrate the structure of the network, establish the actors' roles, and create the network's operating procedures. *Mobilizing* behaviors build support for the network externally and emphasize commitment for the program goal within the network. Finally, *synthesizing* refers to actions that facilitate the conditions for productive interaction among network actors. These behaviors are integrated into a contingency model for network management which posits that the pattern of four management functions (framing, activating, mobilizing, and synthesizing) are contingent upon various context factors (the distribution of power in the network, the clarity of the cognitive frame of the networked actors at present and in the future; the degree of strategic intent, and the underlying value creation logic).

In a similar vein, drawing on the literature on strategic alliances, business networks, and relational exchange, Corsaro et al. (2011) investigate what they variously call "models of networking", "network options", or "strategic actions on how actors may manage in business relationships with others in the network" (p. 922). Accordingly, they draw on Hoffman (2007) who put forth three "strategies" for managing portfolios of alliances: (1) adapting, i.e. reacting to the dynamic environment, (2) shaping, i.e. actively influencing environmental dynamics for its own benefit, and (3 stabilizing, that is attempting to reduce and avoid change, similar to Boisot and Child's suggestion to cope with complexity and uncertainty through methods of uncertainty absorption and/or uncertainty reduction (Boisot & Child, 1999). Essentially, networking behavior depends on network pictures, it is argued, i.e. the views of the network held by

participants in that network, i.e. individual managers' mental sense-making of their company's business environment (Henneberg, Mouzas, & Naudé, 2006). Adapting and shaping are thus different ways of exploring new opportunities while stabilizing is about exploiting existing resources and to defend an existing position.

Clearly, the ability to use these various network management strategies, and to carry out the attendant activities, is a function of organizational capabilities, or "the capacity of an organization to perform a coordinated set of activities, utilizing its resources for the purposes of achieving a particular end result" (Korhonen, 2006p. 25-26). These capabilities are a first step in network management capabilities whereas strategic network capabilities are more fine-grained, and can be defined as "firm specific partnering capabilities that enable a company to place itself in a particular position in a broader network of partnerships with multiple companies" (Hagedoorn, et al, 2006). Likewise, Mitrega et al. (2012) define a networking capability as one that is "oriented towards managing business relationships along all their development stages." An actor in the network must act so that the network retains or strengthens its position at the forefront of technological and market developments, which requires certain capabilities that facilitate continuous innovation, learning and flexible integration of knowledge from internal and external actors (Grant, 1996). These definitions of network capability correspond fairly well with the more generic concept of organizational capability and also include 'dynamic capabilities', i.e. "the subset of the competences/capabilities which allow the firm to create new products and processes, and respond to changing market circumstances" (Teece & Pisano, 1994). Teece (2007) disaggregates dynamic capabilities into sensing, seizing, and reconfiguration. He also distinguishes between routines and entrepreneurial actions.

These network capabilities are also connected to marketing capabilities, or "the skills and competences a firm possesses that help it to understand the changes taking place in its markets together with those that enable it to operate more effectively in that market" (Day, 1994); including 'market sensing capabilities' such as market research, 'market bonding capabilities' such as customer relationship management and 'spanning capabilities' such as information sharing and dissemination throughout the organization.

FREQUENTLY MENTIONED CHARACTERISTICS OF HIGH-TECH CONTEXTS

The way in which a particular actor's network management capabilities are leveraged to effectively manage the turbulence and dynamism of high-technology networks remains an open question. For example, some actors choose to develop very tightly-controlled network strategies, such as Apple in which their proprietary and "walled garden" approach offers both pros and cons to network partners and to customers; Tesla has adopted a similar strategy. However, other companies, such as Google, choose to develop very different network strategies, in which an open sharing approach offers different pros and cons to network partners and to customers. In our framework we posit that network activities are influenced by the market context (in our case: high tech markets) and the capabilities of actors.

Some of the often mentioned peculiarities of high tech markets to consider are market uncertainty, technological uncertainty, and competitive volatility (Mohr, 2000; Mohr & Shooshtari, 2003; Moriarty & Kosnik, 1989; Yadav et al., 2006). Actors on high tech markets

thus have to handle a comparatively high degree of *market uncertainty* which is defined as the level of ambiguity about behavior of actors and customers on the market, concerning things such as composition of customers and their preferences, substitutes that may appear, and the degree of customer anxiety regarding future standards and usefulness of the emergent technology. The latter is sometimes called 'network externalities' (Bonardi & Durand, 2003; Gretz & Basuroy, 2013), and means that the value any particular customer gets from adopting/using the new innovation is exponentially related to the number of other adopters (as in instant messaging applications, for example). *Technological uncertainty* is another characteristic of high-tech markets and addresses the fact that it is often not possible to know whether the technology or company providing a new technology will be able to deliver on its promise to meet specific needs; e.g., if the product will work and be compatible with other products and services. High-tech markets involve significant amounts of leading-edge technologies or technological sophistication of output, which not only make activities in high tech organizations comparatively complex, but the lack of standards for emerging technologies also makes such uncertainty particularly high. Moreover, supply side conditions, including frequent changes in the competitive landscape often force participants in high-tech industries to make decisions with insufficient information, thereby creating a perception of risk in participants at both the supply and demand side of the industry (D'Aveni 1994). There is thus a comparatively high *competitive volatility* on high tech markets, including rapid and unpredictable changes on the competitor market, what competitors do, etc. The product life cycles are comparatively short and high tech firms operate in dynamic networks where pace of change is relatively high, which also increases market and technological uncertainties.

In essence, the aforementioned characteristics imply that one of the most fundamental challenges companies face in managing networks in high-tech contexts is how to manage both present and future needs. The uncertainty and dynamism of high-tech markets makes it particularly pertinent to address the future and the present simultaneously. For example, maintaining important network partnerships and developing incremental innovations based on an existing technological platform is critical in the short-term, but long-term needs may require radical changes in both technology and partners. This fundamental challenge results in several central challenges that address different tensions of the network and that network management must be capable to juxtapose effectively. These challenges include tensions between flexibility and stability, formality and informality, tight and loose couplings, and known and unknown actors and technologies.

This paper takes such challenges into account and focuses on capabilities required to manage the network and to deal with these challenges. In doing thus, two fundamentally different perspectives on uncertainty and dynamics in high tech contexts are also presented, a traditional perspective focusing on predictable uncertainty, and an emerging perspective addressing unpredictable uncertainty. The network management literature appears primarily to consider the dynamics and uncertainty within existing structures, and that more fundamental and revolutionary changes that cut across traditional industry borderlines are not sufficiently addressed. Using the terminology of Levinthal and March (1993), the traditional view exhibits a kind of temporal and spatial myopia, or a tendency to ignore the bigger picture in the long run. These issues will be further addressed in the following section.

The following section contrasts fundamental, but not always explicit, assumptions regarding uncertainty in the dominant perspectives in the literature on network management with a less common but emerging perspective in the literature. In essence, while the dominant perspective tends to view uncertainty as "predictable", the emerging perspective takes unpredictability into account more explicitly and embraces it as an unavoidable condition that cannot, and should not be reduced. We argue that these assumptions have implications for how the networks are managed, the capabilities required, and also for the prospects for the network to survive.

ALTERNATIVE ASSUMPTIONS RELEVANT FOR NETWORK MANAGEMENT

While in reality, the literature is admittedly both vast and multifaceted, and should rather be positioned along a continuum than as two separate classes, for pedagogical purposes we divide it into two distinct schools of thought, each in which there are essential commonalities but also considerable variation. The mainstream literature on networks and network management, here called 'traditional view', builds on fundamentally different assumption compared with more recent perspectives, here called 'emergent view'.

In essence, for the traditionalists the future is depicted as if it can somehow be assessed, and thus have a *predictable uncertainty* of supply, demand, internal process fluctuations, macroeconomic and natural ecological factors, resulting from competitive dynamics (Ramírez & Selsky, 2014). Uncertainty can be handled in a more or less rational manner through competitive moves that are selected by actors within the industry based on available information and observed behavior among players from the past, extrapolated into the future. A "calculative rationality" is thus often assumed, where available information can be processed to reach a solution (Levinthal & March, 1993). In the literature on networks, dynamism is indeed often acknowledged, including the unpredictability of networking outcomes (Ford and Mouzas, 2013), and the difficulty of managing networks by individual actors. Usually though, the assumptions about such dynamics appears to lie within the confines of an industry and within existing relationships between actors, their actions and reactions (Ford & Håkansson, 2006). The outlook of the business and network environment is thus *bounded* to the transactional environment and accordingly the scope of the management activities are predominantly delimited to known actors within the network structure of the same industry.

For instance, some authors that we position within the traditional view have attempted to understand how actors strategize and manage within business networks, focusing on "strategic nets" and similar. Researchers within this research stream argue that network actors can, and should, manage the networks (e.g., Dyer & Nobeoka, 2000; Lorenzoni & Lipparini., 1999; Möller & Svahn, 2003) through activities such as visioning, sensing, adapting, shaping, and stabilizing (see, e.g., Möller et al., 2005; Ritter & Gemünden, 2003b). The inherent focus essentially seems to be the same though; that is networks of actors within an industry. In effect, the systems in focus are more or less 'closed systems'; that is systems largely unaffected by their environment (Ashmos & Huber, 1987) beyond the transactional environment. Dynamic properties thus arise predominantly from interactions between actors in the system. More generally, most researchers belonging to the IMP school of thought indeed focus on network dynamics and the emergent nature of networks, but most often view them as evolutionary and continuous rather than revolutionary and discontinuous (Matthyssens, Vandenbempt, & Van

Bockhaven, 2013), with changes and disruptions emerging as a consequence of, and within, existing network structures and relationships.

At the other side of our continuum is the 'emergent view' which assumes that the future is unknowable (Grant, 2003) and accordingly that there is an *unpredictable uncertainty* associated with sudden and unprecedented events and macro-level disruptions (Ramírez & Selsky, 2014). The network is thus seen more as an open or unbounded and rather complex system, e.g., ecosystem (Iansiti & Levien, 2004; Moore, 1993; Williamson & De Meyer, 2012), or service system (Maglio, Vargo, Caswell, & Spohrer, 2009; Mele & Polese, 2011; Spohrer, Maglio, Bailey, & Gruhl, 2007; Vargo & Akaka, 2012). Today, in line with the world becoming increasingly global in its nature, and all actors and resources becoming increasingly interconnected (Normann & Ramirez, 1993; Vargo & Lusch, 2011), the adoption of such systems perspectives on the interactions between market actors seems highly relevant. It seems particularly relevant on high-tech markets, given their often comparatively complex and changing nature. Dynamics are also of a different nature here, and it is acknowledged that dynamic properties also arise "from the field itself" and the "ground" is in motion (Emery & Trist, 1965). The focus is thus not merely on interactions between actors in networks and the dynamics resulting from those.

Wieland et al. (2012, p. 12), for instance, state that "(...) the full extent of the interconnected, massively collaborative, and systemic nature of value (co) creation seems to be often underappreciated and not well understood". It also opens the door for complexity issues, which per se has implications for how the dynamics and mechanisms of networks or systems are to be understood, and thus also the process of co-creating value. Selsky and McCann (2008) distinguish between three types of disruptiveness; operational, competitive and contextual, stressing conceptual disruptiveness as increasingly salient as it represents the locus of unpredictable uncertainty. The relevance of acknowledging complexity of networks is also emphasized by Gummesson (2010, p. 629), who argues that service environments should be regarded as complex systems, since dyads represent a too limited view of reality. He concludes that an "overriding issue for social sciences today should be the understanding of complex systems and their human, social, technological and environmental dimensions", and states that complexity needs to be approached in conjunction with context and change.

Due to their complex nonlinear feedback systems (Holbrook, 2003; Stacey, 1995), social systems often become unstable and emergent, and this leads to unpredictable outcomes (Flake, 1998; Holland, 1992; Stacey, 1995). If we look at the literature on 'complex adaptive systems', it becomes apparent that some inferences may be drawn on this matter. Holland (1992, p. 21) defines a complex adaptive system as having "(…) no single governing equation, or rule, that controls the system. Instead, it has many distributed, interacting parts, with little or nothing in the way of a central control". Such nonlinear feedback systems result in uncertainty and unpredictability of the future trajectory of the system as a whole. But even more important is the fact that these characteristics are necessary conditions for the system's ability to adapt and its viability. The system could thus be described as a moving target, continuously attracted to new equilibrium states (Walker, Holling, Carpenter, & Kinzig, 2004).

To sum up the challenges inherent in the two views, from the traditional perspective the central challenge for managers in networks is to be able identify present and historical patterns within the existing network and, based on these patterns extrapolate the future and control the trajectory

of the network and the own position. This may be seen as *myopic* both in a temporal and spatial sense (cf. Levinthal & March, 1993). In contrast, the challenge according to the emergent view is to balance the system at the edge of chaos (Mason, 2007; Normann, 2001), or between too much stability and too much chaos, e.g., by continuously assessing opportunities and threats and imagining several alternative futures cross industrial boundaries, based on creative imagination and experimentation. Stressing the interdependency, complexity, uncertainty and discontinuity that characterize the contemporary business landscape, Wilkinson (2008, p. 273) claims that "the key to success is ambidextrosity to manage both for agility (i.e. speed of change) and adaptability (i.e. discontinuity)". An organization must thus be able to simultaneously drive disruptive change and adapt to it (Selsky & McCann, 2008). Accordingly, our ambition is to expose the network management dimensions that can be found in extant research, to the conditions that characterize the emergent view; will they still be valid as such, will their meaning change or will there be a need to reframe them?

TOWARDS A FRAMEWORK FOR NETWORK MANAGEMENT UNDER DIFFERENT ASSUMPTIONS

Network management in terms of activities and requisite capabilities is logically quite different depending on how uncertainty and network scope are viewed, that is depending on how the network and the embedding high tech context are perceived and understood. The stability and pre-determinism sought in the traditional context require a high degree of order in the system. Adaptability and viability on the other hand, which are central features in the new perspective, require a low degree of order and more reliance on intangible factors such as trust in others.

In other words, network management activities and requisite capabilities in unpredictable contexts, where business is run in order to balance between the unknown future and disappearing present are thus different compared with network management in a 'traditional business', that is an organization that is managed as if it exists in a comparatively stable and well-defined industry with known actors.

Whereas the underlying assumptions and environmental characteristics in the traditional domain make activities such as forecasting and market sensing sensible, the unpredictable nature of the emergent view make such activities less relevant. Actors in highly turbulent environments, such as those in the high-tech sector, create events and enact their future instead of relying on market research (Mason & Staude, 2009). 'Future-mindedness' (Wilkinson 2008), implying a shift from "research using futures to research into futures" where the future is regarded as an unexplored territory that can be shaped, is here a more viable approach. What is more, actors in these contexts engage in continuous short-time planning together with as many other knowledgeable actors as possible has been recommended, along with widely distributed information about how to do things rather than what to do (Mason, 2007). Apparently such behavior means that certain conditions must be met in the network, such as a comparatively high level of trust between network actors and a shared commitment which sets the boundaries of the self-organizing system (Comfort, 1994). The 'causal texture' (Emery & Trist, 1965) of these environments urges leaders to stretch the usage of their resources beyond their comfort zones (Morris, Schindehutte, & LaForge, 2002) and to "mobilize the capabilities of actors with whom we together want to create the new business eco-system", i.e. 'ecogenesis' (Normann, 2001).

Inter-organizational relationships tend to be of an exploratory nature. Exploratory alliances cross both technology and organizational boundaries, while exploitation alliances just cross the organizational boundaries with external partners (Goeltz & Das, 2012). By entering into conversations in such open-ended exploratory alliances, resources are stretched beyond what is known and opportunities may emerge, on condition that a sufficient level of trust exists and there is an adequate technological infrastructure (Normann, 2001). The style of interaction in these conversations must be very open to enable 'frame breaking' and the organization must have certain social 'interaction capabilities'. In other words, i.e. there must be free and informed discussions with open minds and courage to expose oneself to risk and to be questioned, led by the behavior of leaders who walk the talk (Normann, 2001).

The uncertainties and interdependencies of exploratory alliances suggest that they are governed through personal or group meetings rather than formally (Van de Ven et al., 1976). Such conversations, internally as well as with more or less familiar actors in the broader context 'at the edge' - require so called 'ecological interfacing capabilities'. There must also be an ability to see the value of the present on a higher level and as part of the future context - so called 'up framing' and 'time framing' (Normann, 2001). This is facilitated by futures techniques such as scenario planning (Ramírez & Selsky, 2014; Van Der Heijden, 2000; Wilkinson, Kupers, & Mangalagiu, 2013), use of metaphors, maintaining a pool of alternative business models, visions, and challenging discussions beyond the comfort zone. This is what Normann call 'framing capabilities' (Normann, 2001). 'Frame breaking' activities and capabilities, focusing on the future rather than merely the present, can be stimulated through various activities, organizing, corporate symbols. He further suggests that 'transitional objects' such as external consultants, dynamic and diverse management teams, may help in achieving this. Further, in contrast to traditional leadership which is usually rational in its orientation and with the leader in total control, here it is more 'political' and with the leader beyond total control. Leadership focuses on breaking with the old frames and creating a new one. The leader may either act as a single entrepreneur or, preferably, putting together fragments together with various internal and external actors.

From the perspective of a more traditional view, risk management and control are more in focus, and alliances are more likely to be of an exploitative nature, where the goal is to combining existing skills and resources in a more rational fashion. Since the need for knowledge protection is normally higher in exploitative alliances than in explorative (Mazloomi Khamseh & Jolly, 2008), the traditional and risk adverse managers tend to avoid too fuzzy collaborations, and "lawyers generally try to avoid writing incomplete contracts, because these arrangements typically end up in court or in arbitration when an unforeseen controversy arises" (Gomes-Casseres, 1999). From the perspective of the emergent view on the other hand, risk is sought and experimentation (Morris et al., 2002) and learning by trying (Vargo & Lusch, 2014) are central and necessary elements for the survival of the network. These activities are preferably done together with others; the further from the known the better; since opportunities usually emerge at the edge of what is known (Dyer & Singh, 1998; Normann, 2001). While this view acknowledge that the future is increasingly unpredictable, driven by environmental factors such as technological developments in the computer and telecommunications industries (Mason, 2007), for instance, it has nevertheless been acknowledged that the environment is not completely determined by external forces. It can also be influenced by the firm (Mason, 2007) through mutually beneficial relationships between members of the complex adaptive systems (Baskin,

1998). An entrepreneurial approach can thus be feasible (Mason, 2006; Mason & Staude, 2009), where the future is constructed through imagination (Aligica, 2007), or enacted (Mele, Pels, & Storbacka, 2014), rather than being predicted which may be the case in more stable environments. The relevant lens in the emergent perspective goes across industries since today actors from different industries both cooperate and compete. Hence, the broader field of inter-organizational action is more in focus rather than merely seeing the firm as the focal actor that interacts with its context (Ramírez & Selsky, 2014; Selsky, Goes, & Babüroğlu, 2007).

Drawing these theoretical threads together, network management can be divided into two central capabilities – 'context handling capability' and 'network management capability' - each composed of several sub-capabilities, see Table 1. In doing this, our central assumption is that these generic capabilities appear different when operating in turbulent and unpredictable environments. The capabilities described in the literature thus need to be reinterpreted in order to fully meet the turbulence in such environments.

First, context handling capability concerns the focal actor's capability to 'handle' its context, i.e. to grasp and apprehend it by undertaking certain activities to this end. While the existing literature and the traditional view tends to describe the abilities that have to do with measuring and analyzing factual circumstances in the current network, the emergent view is focused on the ability to prepare for various possible futures. Similarly, the traditional view on network management capabilities, e.g., as described by McGuire (2002; 2003) mainly addresses actors and events within the frame of the existing business and the existing network. In contrast, the emergent view, based on strategy research by, e.g., McCann and Selsky (1984), Normann (2001) and Ramirez and Selsky (2014) is more open-ended both in terms of time space and strives towards interaction and experimentation with a broader set of actors beyond present frames.

Table 1. Tentative framework for network management in emergent vs traditional view

	TRADITIONAL VIEW	EMERGENT VIEW
Assumptions regarding context	Uncertainties can be reduced, a vision (one) of the future can be developed, main scope of focus is the transactional environment	Uncertainties cannot be reduced, there are many possible futures, main scope of focus is the contextual environment
Context Handling Capabilities	*Information Systems Building* = Forecasting & predicting *Market Sensing* = Surveying & mapping	*Future mindedness* = A strategic futures capability that involves having a contextual foresight, learning with the future and scenario thinking and analysis *Boundaryless sensing* = Transcending traditional borders of context and space, and imagining, envisaging, and experimenting
Network Management Capabilities	*NW Activating* = Identifying and incorporating actors and resources needed in the existing network to achieve goals *NW Orchestrating* = Indirect ways of influencing, shaping and guiding the development of the joint activities. *NW Framing* = Influencing the operating structure of the network, its prevailing values and norms, and creating a shared purpose or vision. *NW Mobilizing* = motivating network participants, gaining support from stakeholders, fostering their commitment *NW Synthesizing* = promoting information exchange among network actors, developing procedures of interaction	*NW Casting* = Identifying, selecting and deselecting relevant and irrelevant actors and resources in the broader network to achieve goals. *NW Jamming* = Chasing and effectuating a felt experience and insight that may become a business opportunity, by entering into free and open conversations with other actors, without extensive preparation or predefined arrangements. *NW Framebreaking* = Recurrently breaking the operating structure of the network, its prevailing values and norms, and creating new purposes and visions when suitable or required. *NW Culture Building* = Developing norms, values, beliefs and assumptions that are open-minded and progressive. *NW Energizing* = Seeking productive tensions at the edge of chaos, and disrupting existing procedures of interaction
Role of focal actor	Governor, controller, conductor	Facilitator, pathfinder, pathbreaker

CONCLUDING REMARK

In his article about Kyocera, Hideki Ishida once wrote that "future global corporations must be like amoebas - always changing and interacting with the surroundings but yet retaining its integrity and unique identity. Truly global organizations must also be schizophrenic, i.e. combining a strong identity with openness to different ways of doing business and values of different cultures" (Ishida, 1994). In a nutshell, this quote captures the essence of the discussion in this article and the challenges of balancing on the edge of known and unknown, present and future. In this article, we have attempted to delineate the essential dimensions put forth in the literature on the management of business networks and analyze how these depend on fundamentally different assumptions regarding uncertainty. Our conclusions based on what we found are tentative and should be seen as a first attempt to theorize on network management in high-tech contexts. Nevertheless, in the spirit of Normann (2001), we deliberately chose to express ourselves a bit boldly in some places, and to go a bit outside our comfort zone. Thus we also took the risk of stepping on the toes of other authors. Hopefully though, the article will not lead to chaos but rather serve as a signpost, shedding light on the topic and providing ideas for future developments in industry as well as in academia.

REFERENCES

Agranoff, R., & McGuire, M. (2001). Big questions in public network management research. *Journal of Public Administration Research and Theory*, 11(3), 295-326.

Aligica, P. D. (2007). Uncertainty, human action and scenarios. *The Review of Austrian Economics*, 20(4), 293-312.

Allen, L. A. (1973). Professional Management: new concepts and proven practices: McGraw-Hill Companies.

Ashmos, D. P., & Huber, G. P. (1987). The systems paradigm in organization theory: Correcting the record and suggesting the future. *Academy of Management Review*, 12(4), 607-621.

Blankenburg, D., & Johanson, J. (1992). Managing network connections in international business. *Scandinavian International Business Review*, 1(1), 5-19.

Boisot, M., & Child, J. (1999). Organizations as adaptive systems in complex environments: The case of China. *Organization Science*, 10(3), 237-252.

Bonardi, J.-P., & Durand, R. (2003). Managing network effects in high-tech markets. *The academy of management executive*, 17(4), 40-52.

Choi, T. Y., Dooley, K. J., & Rungtusanatham, M. (2001). Supply networks and complex adaptive systems: control versus emergence. *Journal of Operations Management*, 19(3), 351-366.

Comfort, L. K. (1994). Self-organization in complex systems. *Journal of Public Administration Research and Theory*: J-PART, 393-410.

Corsaro, D., Ramos, C., Henneberg, S. C., & Naudé, P. (2011). Actor network pictures and networking activities in business networks: An experimental study. *Industrial Marketing Management*, 40(6), 919-932.

Day, G. S. (1994). The capabilities of market-driven organizations. *Journal of Marketing*, 58(4), 37-52.

Dhanaraj, C., & Parkhe, A. (2006). Orchestrating innovation networks. *Academy of Management Review*, 31(3), 659-669.

Dyer, J. H., & Nobeoka, K. (2000). Creating and managing a high-performance knowledge-sharing network: the Toyota case. *Strategic Management Journal*, 21(3), 345-367.

Dyer, J. H., & Singh, H. (1998). The relational view: Cooperative strategy and sources of interorganizational competitive advantage. *Academy of Management Review*, 23(4), 660-679.

Emery, F., & Trist, E. (1965). The causal texture of organizational environments. *Human Relations,* 18(1), 12-32.

Flake, G. W. (1998). The Computational Beauty of Nature: Computer Explorations of Fractals, Chaos, Complex Systems, and Adaptations: The MIT Press.

Ford, D., & Håkansson, H. (2006). IMP – some things achieved: much more to do. *European Journal of Marketing*, 40(3/4), 248-258.

Goeltz, D., & Das, T. (2012). The dynamic fit of alliance portfolio characteristics with competitive strategy and industry dynamism. Strategic Alliances for Value Creation, 215-236.

Gomes-Casseres, B. (1999). Routledge Encyclopedia of International Political Economy.

Grant, R. M. (1996). Prospering in dynamically-competitive environments: Organizational capability as knowledge integration. *Organization Science*, 7(4), 375-387.

Grant, R. M. (2003). Strategic planning in a turbulent environment: Evidence from the oil majors. *Strategic Management Journal*, 24(6), 491-517.

Gretz, R. T., & Basuroy, S. (2013). Why Quality May Not Always Win: The Impact of Product Generation Life Cycles on Quality and Network Effects in High-tech Markets. *Journal of retailing*, 89(3), 281-300.

Grönhaug, K., & Möller, K. K. (2005). High-tech marketing: facto or fiction? *Finnish Journal of Business Economics*, 2(5), 91-104.

Gummesson, E. (2010). The future of service is long overdue Handbook of Service Science (pp. 625-642): Springer.

Hellgren, B., & Stjernberg, T. (1987). Networks: an analytical tool for understanding complex decision processes. *International Studies of Management & Organization*, 88-102.

Henneberg, S. C., Mouzas, S., & Naudé, P. (2006). Network pictures: concepts and representations. *European Journal of Marketing*, 40(3/4), 408-429.

Hoffmann, W. H. (2007). Strategies for managing a portfolio of alliances. *Strategic Management Journal*, 28(8), 827-856.

Holbrook, M. B. (2003). Adventures in complexity: An essay on dynamic open complex adaptive systems, butterfly effects, self-organizing order, coevolution, the ecological perspective, fitness landscapes, market spaces, emergent beauty at the edge of chaos, and all that jazz. *Academy of Marketing Science Review*, 6(1), p181.

Holland, J. H. (1992). Complex adaptive systems. Daedalus, 121(1), 17-30.

Huuskonen, A. (2014). Managing Strategic Service Networks: Contingency View of Integration in the Context of Component Services.

Huuskonen, A., & Kourula, A. (2012). Network management: A review of an emerging cross-disciplinary field. Paper presented at the 28th IMP-conference, Rome.

Iansiti, M., & Levien, R. (2004). Strategy as ecology. *Harvard Business Review*, 82(3), 68-81.

Ishida, H. (1994). Amoeba Management at Kyocera Corporation. *Human Systems Management*, 13(3), 183-195.

Jüttner, U., & Schlange, L. E. (1996). A network approach to strategy. *International journal of research in marketing*, 13(5), 479-494.

Järvensivu, T., & Möller, K. (2009). Metatheory of network management: A contingency perspective. *Industrial Marketing Management*, 38(6), 654-661.

Kahn, K. B. (1996). Interdepartmental Integration: A Definition with Implications for Product Development Performance. *Journal of Product Innovation Man*agement, 13(2), 137-151.

Knight, L., & Harland, C. (2005). Managing Supply Networks: Organizational Roles in Network Management. *European Management Journal*, 23(3), 281-292.

Korhonen, S. (2006). A capability-based view of organisational renewal: combining opportunity- and advantage-seeking growth in large, established European and North American wood-industry companies. Dissertationes Forestales.

Lawrence, P. R., & Lorsch, J. W. (1967). Organization and environment: managing differentiation and integration. Boston, Mass: Harvard Business School Publications.

Levinthal, D. A., & March, J. G. (1993). The myopia of learning. *Strategic Management Journal*, 14(S2), 95-112.

Lorenzoni, G., & Lipparini., A. (1999). The leveraging of interfirm relationships as a distinctive organizational capability: A longitudinal study. *Strategic Management Journal*, 20(4), 317-338.

Maglio, P. P., Vargo, S. L., Caswell, N., & Spohrer, J. (2009). The service system is the basic abstraction of service science. *Information systems and e-business management*, 7(4), 395-401.

Mason, R. B. (2006). Coping with complexity and turbulence-an entrepreneurial solution. *Journal of Enterprising culture*, 14(04), 241-266.

Mason, R. B. (2007). The external environment's effect on management and strategy: a complexity theory approach. *Management Decision*, 45(1), 10-28.

Mason, R. B., & Staude, G. (2009). An exploration of marketing tactics for turbulent environments. *Industrial Management & Data Systems*, 109(2), 173-190.

Matthyssens, P., Vandenbempt, K., & Van Bockhaven, W. (2013). Structural antecedents of institutional entrepreneurship in industrial networks: A critical realist explanation. *Industrial Marketing Management*, 42(3), 405-420.

Mazloomi Khamseh, H., & Jolly, D. R. (2008). Knowledge transfer in alliances: determinant factors. *Journal of Knowledge Management*, 12(1), 37-50.

McCann, J. E. and Selsky, J. (1984). Hyperturbulence and the emergence of type 5 environments. *Academy of Management Review*, 9(3), 460-470.

McGuire, M. (2002). Managing networks: Propositions on what managers do and why they do it. *Public Administration Review*, 62(5), 599-609.

McGuire, M. (2003). Is it really so strange? A critical look at the "network management is different from hierarchical management" perspective. Paper presented at the Public Management Research Association Conference, Washington, DC.

Mele, C., Pels, J., & Storbacka, K. (2014). A holistic market conceptualization. *Journal of the Academy of Marketing Science*, 1-15.

Mele, C., & Polese, F. (2011). Key Dimensions of Service Systems in Value-Creating Networks. In H. Demirkan, J. C. Spohrer, & V. Krishna (Eds.), The Science of Service Systems, Service Science: Research and Innovations in the Service Economy: Springer.

Mitrega, M., Forkmann, S., Ramos, C., & Henneberg, S. C. (2012). Networking capability in business relationships—Concept and scale development. *Industrial Marketing Management*, 41(5), 739-751.

Mohr, J. (2000). The marketing of high-technology products and services: Implications for curriculum content and design. *Journal of Marketing Education*, 22(3), 246-259.

Mohr, J., & Shooshtari, N. (2003). Introduction to the special issue: marketing of high-technology products and innovations. Journal of Marketing Theory and Practice, 1-12.

Mohr, J., Slater, S., & Sengupta, S. (2006). Foundations for successful high-technology marketing. Managing technology and innovation: An introduction, 84-105.

Moore, J. F. (1993). Predators and prey: a new ecology of competition. *Harvard Business Review*, 71, 75-75.

Moriarty, R. T., & Kosnik, T. J. (1989). High-tech marketing: concepts, continuity, and change. *Sloan management review*, 30(4), 7-17.

Morris, M. H., Schindehutte, M., & LaForge, R. W. (2002). Entrepreneurial marketing: a construct for integrating emerging entrepreneurship and marketing perspectives. *Journal of Marketing Theory and Practice*, 1-19.

Mouzas, S. (2006). Efficiency versus effectiveness in business networks. *Journal of Business Research*, 59(10), 1124-1132.

Möller, K., & Rajala, A. (2007). Rise of strategic nets — New modes of value creation. *Industrial Marketing Management*, 36(7), 895-908.

Möller, K., Rajala, A., & Svahn, S. (2005). Strategic business nets—their type and management. *Journal of Business Research*, 58(9), 1274-1284.

Möller, K., & Svahn, S. (2003). Managing strategic nets a capability perspective. Marketing Theory, 3(2), 209-234.

Möller, K., & Svahn, S. (2006). Role of Knowledge in Value Creation in Business Nets. *Journal of Management Studies*, 43(5), 985-1007.

Möller, K. K., & Halinen, A. (1999). Business Relationships and Networks:: Managerial Challenge of Network Era. *Industrial Marketing Management*, 28(5), 413-427.

Nooteboom, B. (1998). Inter-firm alliances. London: Routledge.

Normann, R. (2001). Reframing business - when the map changes the landscape. Chichester: John Wiley & Sons, Ltd.

Normann, R., & Ramirez, R. (1993). From value chain to value constellation. *Harvard Business Review*, 71(4), 65-77.

Ojasalo, J. (2004). Key network management. *Industrial Marketing Management*, 33(3), 195-205.

Ramírez, R., & Selsky, J. W. (2014). Strategic Planning in Turbulent Environments: A Social Ecology Approach to Scenarios. *Long Range Planning*.

Ritter, T., & Gemünden, H. G. (2003a). Interorganizational relationships and networks: an overview. *Journal of Business Research*, 56(9), 691-697.

Ritter, T., & Gemünden, H. G. (2003c). Network competence: Its impact on innovation success and its antecedents. *Journal of Business Research*, 56(9), 745-755.

Ritter, T., Wilkinson, I. F., & Johnston, W. J. (2004). Managing in complex business networks. *Industrial Marketing Management*, 33(3), 175-183.

Sahadev, S. (2002). Managing Marketing Channels for High Technology Products: A Behaviour Based Approach. *Decision*, 29(2), 21-39.

Sahadev, S., & Jayachandran, S. (2004). Managing the distribution channels for high-technology products: a behavioural approach. *European Journal of Mark*eting, 38(1/2), 121-149.

Sarin, S., & Mohr, J. (2008). An introduction to the special issue on marketing of high-technology products and innovations. *Industrial Marketing Management*, 37(6), 626-628.

Selsky, J. W., Goes, J., & Babüroğlu, O. N. (2007). Contrasting perspectives of strategy making: applications in 'hyper'environments. *Organization Studi*es, 28(1), 71-94.

Selsky, J. W., & McCann, J. E. (2008). Managing disruptive change and turbulence through continuous change thinking and scenarios. In R. Ramírez & K. van der Heijden (Eds.), Business planning for turbulent times: New methods for applying scenarios (pp. 167-186): Earthscan, Sterling.

Spohrer, J., Maglio, P. P., Bailey, J., & Gruhl, D. (2007). Steps Toward a Science of Service Systems. *Computer*, 40(1), 71-77.

Stacey, R. D. (1995). The science of complexity: An alternative perspective for strategic change processes. *Strategic Management Journal*, 16(6), 477-495.

Steenhuis, H.-J., & Bruijn, d. E. (2006). High technology revisited: definition and position.

Storbacka, K., & Nenonen, S. (2011). Scripting markets: From value propositions to market propositions. *Industrial Marketing Management*, 40(2), 255-266.

Teece, D., & Pisano, G. (1994). The dynamic capabilities of firms: an introduction. *Industrial and Corporate Change*, 3(3), 537-556.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, 18(7), 509-533.

Thornton, S. C., Henneberg, S. C., & Naudé, P. (2013). Understanding types of organizational networking behaviors in the UK manufacturing sector. *Industrial Marketing Management*, 42(7), 1154-1166.

Thornton, S. C., Henneberg, S. C., & Naudé, P. (2014). Conceptualizing and validating organizational networking as a second-order formative construct. *Industrial Marketing Managem*ent, 43(6), 951-966.

Walker, B., Holling, C. S., Carpenter, S. R., & Kinzig, A. (2004). Resilience, adaptability and transformability in social--ecological systems. *Ecology and society*, 9(2), 5.

Van de Ven, A. H., Delbecq, A. L., & Koenig Jr, R. (1976). Determinants of coordination modes within organizations. *American Sociological Review*, 322-338.

Van Der Heijden, K. (2000). Scenarios and forecasting: two perspectives. *Technological Forecasting and Social Change*, 65(1), 31-36.

Vargo, S. L., & Akaka, M. A. (2012). Value Cocreation and Service Systems (Re)Formation: A Service Ecosystems View. *Service Science*, 4(3), 207-217.

Vargo, S. L., & Lusch, R. F. (2011). It's all B2B…and beyond: Toward a systems perspective of the market. *Industrial Marketing Management*, 40(2), 181-187.

Vargo, S. L., & Lusch, R. F. (2014). Inversions of service-dominant logic. *Marketing Theory*, 14(3), 239-248.

Wieland, H., Polese, F., Vargo, S. L., & Lusch, R. F. (2012). Toward a service (eco) systems perspective on value creation. *International Journal of Service Science, Management, Engineering, and Technology (IJSSMET)*, 3(3), 12-25.

Wilkinson, A. (2008). Building Effective Future-Mindedness. In R. Ramírez & J. W. Selsky (Eds.), Business Planning for Turbulent Times. New Methods for Applying Scenarios (pp. 271-280): Earthscan, Sterling.

Wilkinson, A., Kupers, R., & Mangalagiu, D. (2013). How plausibility-based scenario practices are grappling with complexity to appreciate and address 21st century challenges. *Technological Forecasting and Social Change*, 80(4), 699-710.

Williamson, P. J., & De Meyer, A. (2012). Ecosystem Advantage: How to Successfully Harness the Power of Partners. *California Management Review*, 55(1), 24-46.

Yadav, N., Swami, S., & Pal, P. (2006). High Technology Marketing: Conceptualization and Case Study. *Vikalpa*, 31(2), 57-74.

Zahra, S. A., & George, G. (1999). Manufacturing strategy and new venture performance: A comparison of independent and corporate ventures in the biotechnology industry. The *Journal of High Technology Management Research*, 10(2), 313-345.