Context-Adaptive Business Networks

Jing Jing He, Elke Wolf, and David Sundaram[(✉)]

University of Auckland, 12 Grafton Road, Auckland, New Zealand
jji917@aucklanduni.ac.nz, {e.wolf,d.sundaram}@auckland.ac.nz

Abstract. Businesses are facing turbulences in an environment that includes social, political, technical and economic challenges. Traditional business networks lack the adaptability to rapidly reconfigure their strategy, people, structure, business processes, and systems to respond to such challenges. In this paper we analyse structures and limitations of traditional business networks (Sect. 2). Based on the literature on adaptive business networks (ABN) which have been discussed for about two decades (Sect. 3) we outline the most important conceptualisations of ABN. In order to emphasise the integrated perspective on the strategic, social, structural, business process, and information systems level - which we consider to be essential for adaptability - we create the term "Context-Adaptive Business Networks (CABN)" (Sect. 4). We discuss the necessary features of context-adaptability in more detail (Sect. 5) and conclude with suggestions how this context-adaptability can be achieved on all five levels (Sect. 6).

Keywords: Adaptability · Agility · Learning · Co-opetitive · Co-evolution · Context-adaptive business networks

1 Introduction

The information age has raised new challenges for business competitiveness. Customers in today's market are demanding better products and services at faster speeds and lower prices. Understanding customers' changes in needs and the ability to translate their needs into unique value-added products and service are vital in maintaining business competitiveness. Product life cycles and process execution times have reduced since the last century. Therefore, modern enterprises cannot survive as isolated and independent entities in this competitive environment.

Further, organisations have been facing increasing pressure to improve their financial performance and profitability. The speed with which an organisation can transform these to align with the uncertain environment is the key to survival.

These problems can be addressed by establishing both internal and external flexible environments which include a company's business partners, suppliers and customers. Organisations need real-time information from these stakeholders for fast decision-making in order to be adaptive to environmental changes. For this reason, many businesses are keen to create business networks to support the increased adaptiveness required in rapidly changing markets.

In particular, the increased pressure is moving organisations towards adopting Adaptive Business Networks (ABNs). An ABN is a network formed by a group of adaptive organisations in which specifically selected business partners contribute their core competencies in order to meet changing customers' demands, competition and government regulations collaboratively.

In the following we analyse structures and limitations of traditional business networks (Sect. 2). Based on the literature on adaptive business networks (ABN) which have been discussed for about two decades (Sect. 3) we outline the most important conceptualisations of ABN. In order to emphasise the integrated perspective on the strategic, social, structural, business process, and information systems level - which we consider to be essential for adaptability - we create the term "Context-Adaptive Business Networks (CABN)" (Sect. 4). We discuss the necessary features of context-adaptability in more detail (Sect. 5) and conclude with suggestions how this context-adaptability can be achieved on all five levels (Sect. 6).

2   Traditional Business Networks – Structures and Limitations

The structure of a business network determines the relationships and functions of firms in the network. Vasara et al. [1] discuss two complementary measures of a network: density and centrality. Density refers to the measurement of the number of links (relationships) between the members in the network; it is the average intensity of contacts between actors maintained by a certain actor. Thus, in a high density network, the number of relationships is higher and the network has a higher interdependency level between members. Network centrality is described as the structural attribute of nodes in a network [1]. It measures the number of dominant nodes in the network.

In a traditional linear supply chain the originator of the network does not get any direct feedback from the last member in the chain. There is no circulation of information and the resources and information are directional. The controller of the network coordinates the business activities of the entire supply chain. This linear supply chain implies a high centralisation and low density type of network.

In an ego-centred (star-shaped) network, the network is fully concentrated. The only links to members are through the central actor of the network. The central actor has significant control over the multiple relationships with its business partners. This network has high centralisation and low density [1].

A hierarchical network is similar to an organisational structure which is characterised by a single commander. This type of business network has a high level of control and is effective for inter-organisational coordination of activities. The bureaucracy of this type of network results in ineffective communication and decision making, and therefore has low adaptability and is vulnerable to a turbulent environment, in which constant changes are needed to survive.

Heterarchy (Fig. 1) is different from all other network structures as it presents multiple loci of control. A heterarchical network includes interdependent and multiple lateral relationships between units and operates under decentralised decision making, mutual interest, shared responsibilities and distributed authorities, forming a virtual

organisation to achieve a common goal. This network therefore has a large number of communication lines, and coordination is based on mutual agreements, contracts and trust. Control is weakened, which may allow the network to evolve into a community of organisations with characteristics of emergent and self-organised bodies. It also features collaboration, in which all the participants in the network feel equally motivated to contribute which, in turn, creates a high level of interactivity that promotes sharing of knowledge to improve overall performance. This network has high density and low centralisation features [2].
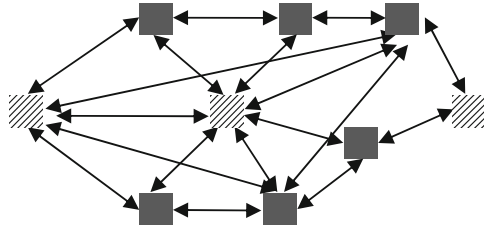

Fig. 1. Heterarchy (adapted from [2])

The key differences between a traditional supply chain and the modern adaptive network lie in their relationships, the level of involvement and the purpose of the network. A supply chain aims to deliver a product or service from supplier to customer and focuses on the relationship in a linear/sequential manner. In the adaptive network, the focus of the network is to combine the values from each business partner and ensure collaboration to deliver a product or service to their customers. The relationships in the network are multilateral. Each member has relationships with other members in the network and has equal responsibility towards the end customer's requirements.

In a rapidly changing business environment, traditional business networks lack the efficiency and effectiveness to achieve the necessary adaptability and agility. In traditional buyer-supplier relationships, the information flow and decision making are channeled through the customer service representative (CSR) and a purchasing agent from each company. Each company has its own separate divisions including marketing, management, transportation and planning. The CSR becomes the single connection for management, logistics and sales personnel in each of the companies who then communicate only indirectly. This effect is named the bow-tie effect and is deemed highly inefficient since this kind of relationship restricts information visibility and communication is ineffective [3].

The traditional supply chain is known for its "bullwhip effect". The bullwhip effect describes a phenomenon where orders to the suppliers tend to have larger variance than the order from the buyers [4]. The causes of the bullwhip effect have been identified to include order batching, price fluctuation and demand forecast updating. It leads to inefficient production and excessive inventory which reduce business performance. The bullwhip effect is a particular problem in the forecast-based supply chain. Therefore, it can be reduced by increasing the visibility of customers' demands.

A traditional business network structure typically consists of two layers: transaction and logistics. The logistics layer represents the management of relationships with partners involved in moving the goods to destinations, i.e. distributors, retailers and manufacturers. The transaction layer concerns the information and materials flow for production from the company's suppliers. Heck and Vervest [5] emphasise that the value of the traditional business network is a supply chain that has a long-term relationship with its partners, maintaining frequent information sharing with direct business partners, and having central control and decision making from the main company. However, this type of network lacks the adaptability to rapidly reconfigure its strategy, structure, social embedding, business process, and information systems in order to respond to environmental change, customer change or other new objectives. Adaptability should allow a quick 'pick, plug and play' of business partners to join the business and collaborate to achieve a new goal.

These limitations can best be addressed with a heterarchy network structure which implies less control and promotes collaboration between firms and offers the flexibility to face environmental challenges. The heterarchy network structure is the network structure closest to an ABN which will be discussed in the next section.

3   Concepts of Adaptive Business Networks

An ABN is defined as a network formed by a group of adaptive organisations in which the selected business partners contribute their competitive advantages to produce a product or service to satisfy customers' demands. The following table outlines selected important conceptualisations of ABNs from the literature over the past two decades in chronological order.

Concepts
Yusuf et al. [6]: Four key concepts for agile competition (competition based on core competence management, virtual enterprise formation, capability for re-configuration and knowledge-driven enterprise) result in a virtual enterprise that integrates the core competencies from a number of selected organisations that are able to respond quickly to market changes at low cost and with high quality
Haeckel [7]: The adaptive framework requires all steps of a Sense-Interpret-Decide-Act (SIDA) loop: sense, respond, plan and execute, as well as learning in between these processes
Christopher [8]: An agile supply chain is a business network with the four characteristics: virtual, market sensitive, process integration, and network based
Heinrich and Betts [3]: Adaptive business networks link companies to serve the customer who purchases the final product or service produced by the supply chain. Information within the network is communicated instantaneously and simultaneously to the companies that need it, eliminating the costly time delays that occur within the linear supply chain. Adaptability is achieved based on the capability to rapidly add and drop partners in respond to market condition changes, to adopt pervasive technology, develop standardised business processes, and be involved in continuous change to gain competitive advantage
Zhang et al. [9]: Important elements of an adaptive business network: Consistent action, technology enabled, continuous innovation, self-learning and self-regulation (Fig. 11).

Concepts
Organisations will develop self-organisation based on individual characteristics, network goals and interaction rules
Ivanov et al. [10]: Adaptability is the ability to change the behaviour of an organisation in order to achieve business goals in a changing environment. The business network is considered adaptive if it meets three requirements: It adapts to changes (1) in the business environment, (2) in the operations execution environment, and (3) in the internal structure of the network itself

4 Context-Adaptive Business Networks

As has been shown in the previous section, while many concepts of adaptability and ABNs discussed in the existing literature show certain common elements, there is no consistent reflection on all essential levels. Delporte-Vermeiren et al. [11] stress strategic, process, and technology aspects, Ford and Mousas [12] look at strategy, structure, and process, and Rittgen [13] focuses primarily on the process level.

We propose that an integrated perspective on five context levels is essential for business networks to be truly adaptive: the strategic, social, structural, business process, and information systems level. We specifically coin the term 'Context-Adaptive Business Networks' in order to emphasise the importance of all five context levels.

(1) **Strategic:** *Which common goal to pursue to cope with current changes?* The ability to quickly sense changes in the market and in customer requirements and combining the core competencies from business partners according to a common goal that guides the actions of business partners, e.g. achieving strategic advantages and sustainability by quickly adapting to environmental shifts. The emergent behaviour of self-organising and self-learning through complex interaction.

(2) **Social:** *Which business partners to select?* Selecting business partners and emphasising the dynamics of relationships between participants in the network, i.e. rapidly establishing and terminating relationships with identified organisations that are capable of providing the necessary skills and knowledge to fulfil a specific business need. When the specific customer requirement has been met, disconnection is also critical. In order for the network to be adaptive, the organisations participating in the network themselves must also be adaptive organisations.

(3) **Structural:** *How business partners relate to each other?* The structure of the network determines the flexibility and efficiency of change to support change in business strategies. The network requires a flexible structure that is dynamically aligned to a changing environment.

(4) **Business process:** *How business partners interact and collaborate?* Standardised business processes enable business partners to exchange information and knowledge rapidly for efficient decision making and consistent action. Thus, they allow for efficiency, flexibility, and agility in responding to change and ensure performance towards accomplishing the common goal.

(5) **Information systems:** *How the interaction is facilitated?* An ABN adopts IT solutions to support collaboration, adaptability and agility of business processes by using inter-organisational technologies, for instance BPM and ARIS. For

collaboration, the network may adopt IS or architecture to integrate the disparate process models into one integrated model. IS are needed to facilitate information sharing and real time decision making. For adaptability, pervasive technologies are required, that allow sensing of and response to changes in the market. Pervasive technologies can link with many incompatible technologies that support collaboration across organisational boundaries. Web Services are a type of pervasive technology that handle immense flows of data exchange within a network environment [3]. Agility can be supported by a flexible architecture to facilitate rapid change at strategy and business process levels.

5 Features of Context-Adaptive Business Networks

This section discusses key features that ABNs need in order for their members to collaborate effectively. These features include adaptability, agility, learning, coordination, cooperation and collaboration.

(1) Adaptability: Heck and Vervest [5] and Vervest et al. [14] describe adaptability as the ability of a network to quickly adapt to unexpected situations through 'pick, plug and play'. Pick, plug and play is the ability to quickly connect and disconnect business partners in the network which allows the network to respond to opportunities existing in the market. Pick refers to the establishment of a temporary connection with business partners to interoperate. This step includes the ability of the network to choose the appropriate partners such as suppliers, manufacturers and complementary organisations to contribute to the business's needs. Plug is the ability of the network to plug the business partner in to the system to start business operations rapidly and efficiently. Play is the business activities performed to meet specific situations. The concept of 'quick connect' refers to the ability to quickly select the appropriate business partners and establish the relationship to start business process interaction. The capability to 'quickly disconnect' is the ability to drop business partners from the network. From the business process dimension, organisations need to provide the capability and flexibility for managers to easily assemble and reassemble business processes to deliver changes in strategy. At the information system level, Heck and Vervest [5] suggested that modularity is required to allow for adaptability. Modularised systems allow for versatility, which is the ability of an organisation to produce a variety of products and services. Systems must be designed and redesigned to support the changes in business processes. Organisation structure must also be dynamic to cope with the frequent changes required by the organisation. New organisation structures may emerge as a result of change in strategy and business process.

(2) Agility: The ability to adapt is alone not sufficient, adaptation also needs to be rapid. Agility is the ability of the network to rapidly respond to changes in the market and customer demand [15]. Agility focuses on the speed of change and is described as the effectiveness and quickness of response to change and uncertainty. Lin et al. [15] state that an ABN requires responsiveness, competency, adaptability and quickness. Responsiveness is the ability to identify changes and react proactively; competency is the ability

to efficiently realise the network's goals; adaptability is the ability to change business processes to achieve goals; and quickness is the ability to reach the goal quickly. To achieve such agility, Lin et al., (2004) propose that the network requires collaborative relationships to form a competitive network, process integration to ensure systematic operation between business partners, and information integration to allow sharing of information and customer sensitivity so the network can read customer demand and respond. Hofman and Cecere [16] highlight another critical aspect of agility: high quality. The ability to respond to customers' requirements and to do so fast is still not sufficient, a quick response with poor quality does not qualify as agile. The goal of the network is to collaborate with other skilled companies to supply high quality customised products to their customers.

(3) Learning: Organisational learning is perceived as a critical factor for an organisation to gain competitive advantage, as it leads to improved performance, adaptability and innovation [17]. Argyris [18] describes learning as a process of detecting problems, and correcting the errors. The two types of learning, Single-loop learning (SLL) and Double-loop learning (DLL) have different influences on an organisation. SLL asks questions like "Are we doing things right?" which improves current operations by making corrections that often take the form of rules and policies at the operational level. DLL asks questions like "Are we doing the right things?" This involves questioning whether the rules or goals should be changed to correct the errors. DLL requires creativity, critical thinking and insight to comprehend the problems and propose the solutions to better achieve a goal. Nielsen's [19] triple-loop learning (TLL) involves creating new strategies for learning. TLL asks questions like "How do we decide what is right?" This involves discovering how previous actions have facilitated or inhibited learning. This 'learn how to learn' skill allows participants to better understand how to respond to changes in the environment. TLL therefore influences even higher levels of the organisation, involving a change in organisational goals and strategies. For participants to respond adaptively to the business environment, all three types of learning are needed. Smith and Young [17] suggest that learning in an organisation occurs at different levels including individual, group and the whole organisation. The purpose of learning is to create, capture and transfer knowledge throughout the organisation in order to respond adequately to changes in its environment. The individual's ability to innovate and be flexible is critical for them to transfer knowledge to new and unfamiliar situations. Rose-Anderssen et al. [20] describe three levels of learning to achieve knowledge transformation to produce innovation for an organisation. Knowledge transformation is about transforming the learning from past experiences, and creating new improvements and innovations. Reactive learning and adaptive learning create marginal improvement and expansive learning creates radical innovation, while knowledge transformation creates a learning community that produces a capability to "create the future." Expansive learning would provide an ABN the potential to gain the competitive advantage required to face uncertain business environments.

(4) Coordination, Cooperation, Collaboration, and Co-opetition: Business networks can typically fall into three categories: coordinated, cooperative and

collaborative networks. Coordinated networks are often directed by a controller. The coordinator ensures that the activities performed by participants in the network are meeting predefined goals. Coordinated networks rely on high volumes of transactions distributed across the supply chain. Prevention of disruptions and economic scales are the keys that provide efficiency and competitive advantage in the network [21]. Supply chains are often coordinated networks. A cooperative network is seen as a collective activity in which two or more participants act together to achieve their shared collective goal (end, purpose) [22]. This definition of cooperation highlights (1) cooperation in the full sense involving a collective goal and (2) a collective goal requires participants to cooperate to achieve the goal. Such collective action does not mean joint actions. Dillenbourg et al. [23] note that in cooperation, the labour is divided among participants for an activity where each participant is responsible for only a portion of the problem solving. The tasks in a cooperative network are divided into independent subtasks (hierarchically). Participants interact by sharing complementary knowledge, resources, and thus leveraging for mutual benefit [24]. A collaborative network is led by an orchestrator who poses the vision for the network and organises through influence. There is no controller dominating the network; members are equal in status and share the benefits equally. When the network performance increases, everyone benefits. Each organisation belongs to the network because of its expertise and is equally motivated to participate and contribute to the network. The network is built and maintained by trust and joint venturing, and managing relationships is critical to achieving adaptability in a collaborative network. The requirements are largely undefined in the network, which allows members in the network to deal with more complex problems and explore and develop more opportunities through their dynamic interactivity. An ABN is therefore a collaborative network rather than a coordinated network, in which the goal is to merge expertise from various disciplines to drive innovation and promote network development. The other key difference between an ABN and a supply chain is that the all members of the network are liable for the end product produced for their customers. Collaboration drives innovation: this comes from the sharing of ideas among individuals or groups which creates knowledge and therefore continuous innovation. Innovation can be achieved within the firm, through collaboration among employees or groups. Co-opetitive Network - In today's complex business environment, traditional approaches to competitiveness no longer apply. Porter [25] and Brandenburger and Nalebuff [26] mostly view business success as either competition or cooperation. The complex business landscape has shifted towards competitive strategies focusing on interdependence between firms that are characterised by the simultaneous presence of cooperation and competition at various levels, i.e., within-firm and inter-firm [27]. Cooperation and competition merge together to form a new kind of strategic advantage: Dagnino and Rocco [27] named this the 'co-opetitive system of value creation'. The value created can be classified into either economic value (i.e. revenue increase) or knowledge value (growth of knowledge). Co-opetition can occur at the macro level (relationships between firms across industry), and the meso level (between competitors, suppliers, and customers within the same industry). Dagnino [27] also suggests that co-opetition is about 'incomplete interest and goal congruence' concerning firms' interdependence. The term co-opetition is used to embrace the firm, its customers, suppliers, competitors and complementors.

(5) Co-evolution: The ABN as a complex business environment has been described as a business ecosystem - complex, self-organising, emergent and co-evolving - enabling adaptation to the changing environment [28]. Co-evolution is a key concept for business ecosystems, and interdependence is the key concept in co-evolution. Interdependence indicates that participants in a network both influence and are influenced by the network. The leadership participant influences the co-evolutionary process. The ecosystem is complex as it consists of many self-organised organisations. The relationships between these self-organised organisations are interrelated and interconnected within the network. Wycisk et al. [29] describe self-organisation as a result of autonomous interaction within the network, for instance, there is no controller that controls the operations. It has decentralised decision making, i.e. decisions are made in accordance with the impact of interrelationships with other organisations. Innovation and emergence are closely linked with self-organisation. Without an internal or external controller, organisations manage themselves. Pattern and structure arise from the interaction of the component organisations. The network as a whole adapts to its changing environment through being emergent, self-organising and co-evolutionary.

6   Conclusions

We find that many conceptualisations of ABN fall short on certain layers and coin the term 'context-adaptive business networks' in order to specifically emphasise the importance of the five context levels: strategic, social, structural, business processes, information systems. To respond to changing environments, participants require flexible organisational structures, business processes, and technologies. The concept of adaptability requires the network to quickly connect and drop partners and to establish connections. Apart from this type of modularized approach the participants of CABN need to be agile and learning organisations. Not just SLL, but DLL and TLL need to be a way of life both for the participants as well as the CABN as a whole. Co-operation, co-ordination, collaboration, and co-opetition are vital modalities and strategies for CABN but one of the key capabilities is their ability to co-evolve with their ecosystem and the world.

References

1. Vasara, P., Krebs, V., et al.: Arachne-adaptive network strategy in a business environment. Comput. Ind. **50**(2), 127–140 (2002). Elservier Science B.V.
2. Todeva, E.: Business Networks: Strategy and Structure. Routledge, New York (2006)
3. Heinrich, C., Betts, B.: Adapt or die: transformating your supply chain into an adaptive business network. The University of Auckland library database (2003)
4. Lee, H.L., Padmannabhan, V., et al.: The Bullwhip effect in supply chains. Sloan Manage. Rev. **38**(3), 93–102 (1997)
5. Heck, E.B., Vervest, P.: Smart business networks: how the network wins. Commun. ACM **50**(5), 28–37 (2007)
6. Yusuf, Y.Y., Sahardi, M., Gunasekaran, A.: Agile manufacturing: the drivers, concepts and attributes. Int. J. Prod. Econ. **62**(1), 33–43 (1999)

7. Haeckel, S.H.: Adaptive Enterprise: Creating and Leading Sense-and-Respond Organisations. Harvard Business School Press, Boston (1999)
8. Christopher, M.: The agile supply chain: competing in volatile markets. Ind. Mark. Manage. **29**(1), 9 (2000)
9. Zhang, J., Junqin, X., et al.: Complex adaptive supply chain network: the state of Art. QingDao University (2009)
10. Ivanov, D., Sokolov, B., et al.: A multi-structural framework for adaptive supply chain planning and operations control with structure dynamic considerations. Eur. J. Oper. Res. **200**(2), 12 (2010)
11. Delporte-Vermeiren, D., Vervest, P., et al.: In search of margin for business networks: the european patent office. Eur. Manag. J. **22**(2), 167 (2004)
12. Ford, D., Mouzas, S.: Is there any hope? the idea of strategy in business networks. Australas. Market. J. **16**(1), 15 (2008)
13. Rittgen, R.: A contract-based architecture for business networks. Int. J. Electron. Commer. **12**(4), 31 (2008)
14. Vervest, P., Preiss, K., et al.: The emergence of smart business networks. J. Inf. Technol. **19**(4), 6 (2004)
15. Lin, C.T., Chu, H., et al.: Agility index in the supply chain. Int. J. Prod. Econ. **46**(23), 285–299 (2004)
16. Hofman, D., Cecere, L.: The agile supply chain. Supply Chain Manage. Rev. **9**(8), 2 (2005)
17. Smith, S., Young, A.: Adapting to change: becoming a learning organisation as a relief and development agency. IEEE Trans. Prof. Commun. **52**(4), 329–345 (2009)
18. Argyris, C.: Double loop learning in organisation. Harvard Bus. Rev. **55**(5), 11 (1977)
19. Nielsen, R.P.: Woolman's "I am We" triple-loop action-learning: origin and application in organisation ethics. J. Appl. Behav. Sci. **29**(1), 117–138 (1993)
20. Rose-Anderssen, C., Baldwin, S.J., et al.: Knowledge transformation, learning and changes giving competitive advantage in aerospace. Emerg. Complex. Organ. **11**(2), 15 (2009)
21. Word, J.: Business Network Transformation. Jossey-Bass, San Francisco (2009)
22. Tuomela, R.: Cooperation: A Philosophical Study. Kluwer Academic Publishers, Dordrecth (2000)
23. Dillenbourg, P., Baker, M., et al.: The Evolution of Research on Collaborative Learning. Elsevier, Oxford (1996)
24. Osarenkhoe, A.: A coopetition strategy- a study of inter-firm dynamics between competition and cooperation. Bus. Strategy Series **11**(6), 343–362 (2010). Emerald Group Publishing Limited
25. Porter, M.E.: What is strategy? (1996). http://www.ipocongress.ru/download/guide/article/what_is_strategy.pdf. Accessed 16 Dec 2011
26. Brandenburger, A., Nalebuffm, B.: Co-opetition - a revolutionary mindset that combines competition and cooperation (1996)
27. Dagnino, G.B., Rocco, E.: Coopetition Strategy: Theory, Experiments and Cases. Routledge, London (2009)
28. Peltoniemi, M., Vuori, E.: Business ecosystem as the new approach to complex adaptive business environments. In: Frontier of E-Business Research (2004)
29. Wycisk, C., McKelvey, B., et al.: Smart parts supply networks as complex adaptive system: analysis and implications. Int. J. Phys. Distrib. Logist. Manage. **38**(2), 108–125 (2008)