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# Inter-Organizational Collaboration in Dynamic, Short-Term Supply Chains

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## 1. Introduction

A new network organizational form, called dispersed manufacturing network or DMN, is emerging among companies' supply chains. The organizational form is both abetted as well as spurred by the increasing globalization of supply chains. This organizational form takes shape in the form of networks of dynamic and flexible supply chains held together by emergent and easily re-configurable short-term collaborative links between partners. Globalization allows more companies to connect and to collaborate with one another irrespective of distance or boundaries. However, globalized business environments are also more turbulent and complex. These give rise to the need for flexible DMN networks that are robust to unpredictable changes. Researchers need to identify and understand the new rules of engagement among companies that inform this novel organizational form. This chapter provides explanations for the emergence of such networks, describes their advantages, and show examples of such supply chains in the field. The chapter's domain covers the following supply chain areas;

- Design of supply chains
- Agility of supply chain
- Decision making in a supply chain
- Supply chain collaboration

## 2. Background

Agile, dynamic and flexible supply chains have become increasingly necessary to cope with the ever-changing markets, complexity and competition of a globalized world. Globalization denotes not just increased opportunities for companies, but also enhanced risks, including the augmented potential of competitive threats or changes suddenly arising from anywhere in the world (Ghoshal, 1987; Puig et al., 2009; Steenkamp & de Jong, 2010).

Globalization acts as a two-edged sword for many business organizations. On one hand, the prospect of globalization beckons to all companies with attractive vistas of wide new sourcing horizons and fresh market opportunities. Thus with globalization, every company is now in theory able to source from the very best suppliers, and to sell into every potential market. However, the rise of globalization also come attendant with special challenges. For example, all companies are now equally subject to direct competition from global players. Smaller companies may appear to be more disadvantaged due to their lack of resources as

compared with large companies. More importantly, all companies that are plugged into global networks of supply and demand are now also exposed to every disturbance or change that takes place in global business environments.

For instance, in 2010, the Canadian company Research in Motion or RIM found its landmark product, the Blackberry, in trouble over new security requirements by governments in the Middle East and in India. These Middle Eastern and Indian governments have lately realized that the tight security as provided by Blackberries may also be taken advantage of by various elements in their societies for subversion. They requested RIM to drastically change the way Blackberries work, on the pain of Blackberries being banned from those markets. Therefore, just because the Blackberry is a global product, RIM has to take into account every requirement or change that comes its way from anywhere (The Economic Times, 2011; WSJ.COM, 2011). Another example is the devastating earthquake and tsunami that struck northeastern Japan in March, 2011. The destructive effects of the disasters, compounded by the related nuclear crisis that arose from them, severely disrupted the operations of many Japanese parts suppliers. As a result, the global supply chains of many companies are unexpectedly affected by this shortage of parts (Hookway & Poon, 2011).

Companies cannot avoid globalization, because even the basic advantages confer by a globalized strategy such as lower costs and wider markets are simply irresistible. In an increasing number of industries, companies with more parochial business strategies are being outclassed and outmaneuvered by globalized competitors. For instance, companies that are able to implement flexible innovation processes that extend across supply chains are better able to manage and benefit from the effects of increasing globalization (Santos et al., 2004; Reinmoeller & van Baardwijk, 2005). However, becoming a part of globalized economies also mean that companies must be able to cope with more volatile business environments. Consider a company that seeks to be successful in such an environment. High uncertainty in the business environment means that a company cannot readily predict the types of resources it will require going forward into the future. A company could not reliably know what type of, or indeed if any, internal resources should be developed for the future. Similarly, a company may not assume that the resources of its long-standing external supply chain partners will always remain useful and relevant in an unsettled environment.

Research has shown that the higher competition and turbulence of globalized business environments could be mitigated if companies could leverage more on their supply networks (Gulati, 1995; Prashantham & Birkinshaw, 2008; Vachon et al., 2009). Specifically, companies that could build dynamic and flexible supply chains and use them for targeted co-production as and when needed, may more adroitly navigate the unpredictable challenges posed by global competition and markets (Camarinha-Matos & Afsarmanesh, 2005; Noori & Lee, 2006; Jackson, 2007; Katzy & Crowston, 2008; Dekkers, 2009b; Noori & Lee, 2009). An example of companies that rely extensively on agile supply chain partners to better cope with fast-moving environments is the Shanzhai companies found in South China. Shanzhai companies' successes depend largely on their ability to quickly assemble alliances with the right partners to address specific opportunities or threats that may suddenly arise in their environments (Shi, 2009; Noori et al., n.d.). The concept of dynamic and flexible supply chains cannot be easily described or explained in traditional supply chain terms. This chapter will seek to explain this new form of network collaboration, the advantages, the new supply chain formation process, and the new rules of engagement required for such supply chains.

### 3. Dispersed manufacturing networks explained

The traditional view of collaborative networks has typically considers long-term and stable business relationships among companies in such networks as both desirable and necessary. These types of strong relationships are believed to be critical to prevent opportunism, to foster trust, and to encourage commitment from all involved parties (Feenstra et al., 1999; Campbell & Keys, 2002). An alternative perspective of collaborative networks, the Dispersed Network Manufacturing or DMN paradigm, describes how companies may address highly variable changes to markets and competition by entering into loosely connected networks alliances with other companies to obtain access to more diversified resources. The DMN perspective suggests that the dynamism of the market or competition should be matched by the dynamism of a company's network relationship ties, and that that these ties should be quickly switchable or reconfigurable to meet new requirements (Granovetter, 1973; Zhan et al., 2003; Noori & Lee, 2006; Dekkers, 2009b; Noori & Lee, 2009).

#### 3.1 Dispersed manufacturing networks as a concept

The DMN perspective does not ignore or negate the value and importance of strong ties among companies. Rather, the DMN perspective delineates the difference between short-term business connections and long-term interactive relationships between companies, and shows how companies can leverage on their long-term relations while minimizing the costs of network inertia (Kim et al., 2006). DMN networks can be better understood if they are compared against the characteristics of other collaborative networks such as Third Italy, Japanese keiretsu and Korean chaebol. These comparisons of characteristics are as shown in Table 1. As may be seen, a key distinguishing characteristic of DMN networks is the existence of short-term goal-specific business connections that take place within longer-term network relationships.

Another distinguishing characteristic of DMN networks from other types of collaborations networks is their location along the degrees of ownership integration versus degrees of coordination integration. Though DMN companies are independent and completely autonomous from one another, they are highly coordinated for specific purposes. Figure 1 shows how DMN networks are positioned along those integration axes. The independent nature of DMN companies is especially important because this absolved DMN networks from equity considerations to prop up failing partners, or from corporate pressure to ally with an unsuitable sister company.

In the DMN perspective, a company with agile, dynamic and flexible supply chains is one that is able to quickly locate and collaborate on co-production with appropriate partners to seize some fleeting opportunity, or to defend against a suddenly looming threat. As the opportunity fades or as the threat recedes, to be inevitably replaced by newer prospects or risks, the company will need to be able to quickly re-shuffle its portfolio of partners. In effect, this means that a company's supply chains need to be able to rapidly coalesce, and then to just as speedily split up depending on unpredictable shifts in a business environment. This form of network collaboration works optimally when companies are able to actively seek and dynamically collaborate with partners based on short-term, goal-specific, business connections (Camarinha-Matos & Afsarmanesh, 2005; Katzy & Crowston, 2008; Dekkers, 2009a; Noori & Lee, 2009).

Characteristics	"Third Italy" (Brusco, 1982; Amin, 1999; Hadjimichalis, 2006)	Japanese Keiretsu (Anchordoguy, 1990; Minor et al., 1995; Feenstra et al., 1999)	Korean Chaebol (Chang, 1988; Campbell & Keys, 2002)	DMN Model (Magretta & Fung, 1998; Noori & Lee, 2006; 2009; Shi, 2009; Tse et al., 2009)
<b>Network structure</b>	<ul style="list-style-type: none"> <li>• Decentralized</li> </ul>	<ul style="list-style-type: none"> <li>• Based around a central bank</li> </ul>	<ul style="list-style-type: none"> <li>• Based around a central company</li> </ul>	<ul style="list-style-type: none"> <li>• Range from decentralized to hub-centric</li> </ul>
<b>Equity ownership of partner company</b>	<ul style="list-style-type: none"> <li>• None</li> </ul>	<ul style="list-style-type: none"> <li>• Partial ownership by the dominant company</li> </ul>	<ul style="list-style-type: none"> <li>• Typically a subsidiary of the dominant company</li> </ul>	<ul style="list-style-type: none"> <li>• None</li> </ul>
<b>Public sector support</b>	<ul style="list-style-type: none"> <li>• Yes</li> <li>• Local level</li> </ul>	<ul style="list-style-type: none"> <li>• Yes</li> <li>• National level</li> </ul>	<ul style="list-style-type: none"> <li>• Yes</li> <li>• National level</li> </ul>	<ul style="list-style-type: none"> <li>• None</li> </ul>
<b>Dominant cross-company management link</b>	<ul style="list-style-type: none"> <li>• Professional ties</li> </ul>	<ul style="list-style-type: none"> <li>• Directorate interlocks</li> </ul>	<ul style="list-style-type: none"> <li>• Family ties</li> </ul>	<ul style="list-style-type: none"> <li>• Professional/Social ties</li> </ul>
<b>Third party intermediation</b>	<ul style="list-style-type: none"> <li>• No</li> </ul>	<ul style="list-style-type: none"> <li>• No</li> </ul>	<ul style="list-style-type: none"> <li>• No</li> </ul>	<ul style="list-style-type: none"> <li>• Yes</li> <li>• Indirect social links</li> </ul>
<b>Territorial concentration</b>	<ul style="list-style-type: none"> <li>• Yes</li> </ul>	<ul style="list-style-type: none"> <li>• No</li> </ul>	<ul style="list-style-type: none"> <li>• Yes</li> </ul>	<ul style="list-style-type: none"> <li>• No</li> </ul>
<b>Sectoral specialization by company</b>	<ul style="list-style-type: none"> <li>• Yes</li> </ul>	<ul style="list-style-type: none"> <li>• Partial</li> </ul>	<ul style="list-style-type: none"> <li>• Partial</li> </ul>	<ul style="list-style-type: none"> <li>• Yes</li> </ul>
<b>Typical business-related duration</b>	<ul style="list-style-type: none"> <li>• Long-term</li> </ul>	<ul style="list-style-type: none"> <li>• Long-term</li> </ul>	<ul style="list-style-type: none"> <li>• Long-term</li> </ul>	<ul style="list-style-type: none"> <li>• Short-term</li> </ul>

Table 1. Characteristics of Collaborative Networks [Adapted from Noori, Tan & Lee (n.d.)]

However, this does not mean that companies are transacting only in one-shot deals with total strangers. On the contrary, the various companies in such a network are typically engaged in long-term relationships with one another. These companies may have already worked with each another numerous times, and even in different supply chain relations, wherever it had suited them to have done so before in the past. Their short-term business connections therefore take place within the context of these long-term relationships. Each company's business reputation, specific talents, resources, performance record are known within their networks, and will affect its chances of being invited to take part in any new network. Therefore, even though a company may transact with other companies only through short-term connections at any time, the company also have to simultaneously take into consideration its long-term future as a member of good-standing in the network. Such a consideration acts to deter the onset of opportunism to seek benefit from making selfish short-term gains, and to encourage good faith in dealing with every partner (Heide & Miner, 1992; Miles et al., 2009).

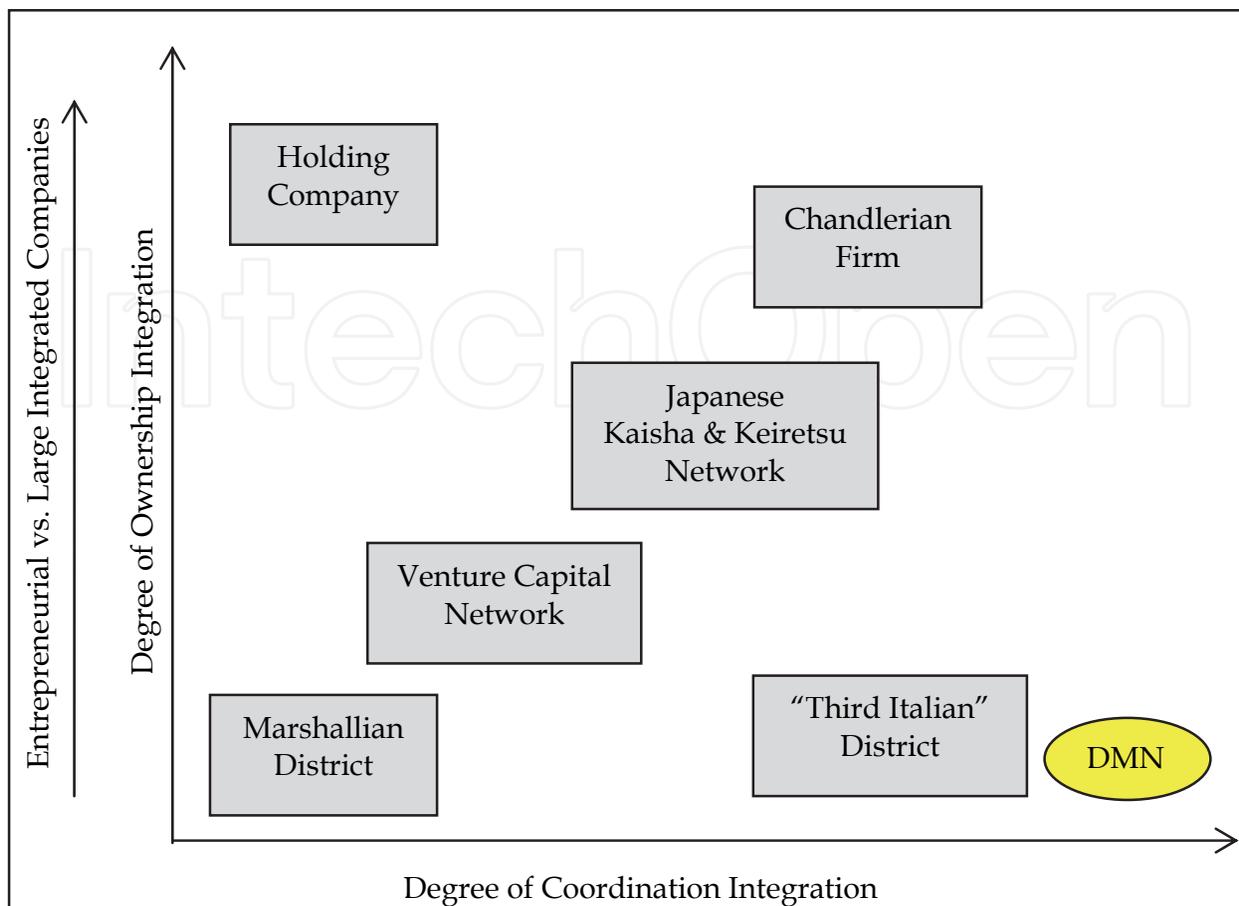


Fig. 1. Location of DMN along Ownership versus Coordination Integration Axes [Adapted from Robertson & Langlois (1995) and Noori (2009)]

These loose ties allow the companies to easily enter, exit or to shift their positions on the value chain if necessary to achieve more optimal configurations. Like a set of Lego building blocks, companies in a DMN network can easily re-sort themselves into different connections to serve various needs. Each network is temporary, and when they are no longer needed, they are as easily dissolved so that each company need not shoulder the costs of maintaining unproductive alliances. By freeing up their internal resources, companies could then easier seek to join new networks (Saeed et al., 2005; Noori et al., n.d.). The temporary nature of DMN network connections as established within long-term relationships are illustrated in Figure 2.

The prime enablers for such dispersed collaboration are the existence of affordable and pervasively widespread globalized technology that allows easy communication and interconnectivity among disparate businesses, and a shared collaboration understanding and culture among the companies (Noori & Lee, 2006). The use of standardized information technology (IT) systems is recognized as a necessary enabler for efficient collaboration and operations among companies (Upton & McAfee, 1996). Flexible IT systems allow companies to link or to de-link easily from one another without sacrificing prior investments in dedicated collaborative systems. In this respect, recent technological advances that resulted in the creation of cheap and universally available IT systems have made it possible for the first time for many companies in different industries and in different parts of the world to possibly operate as DMN networks.

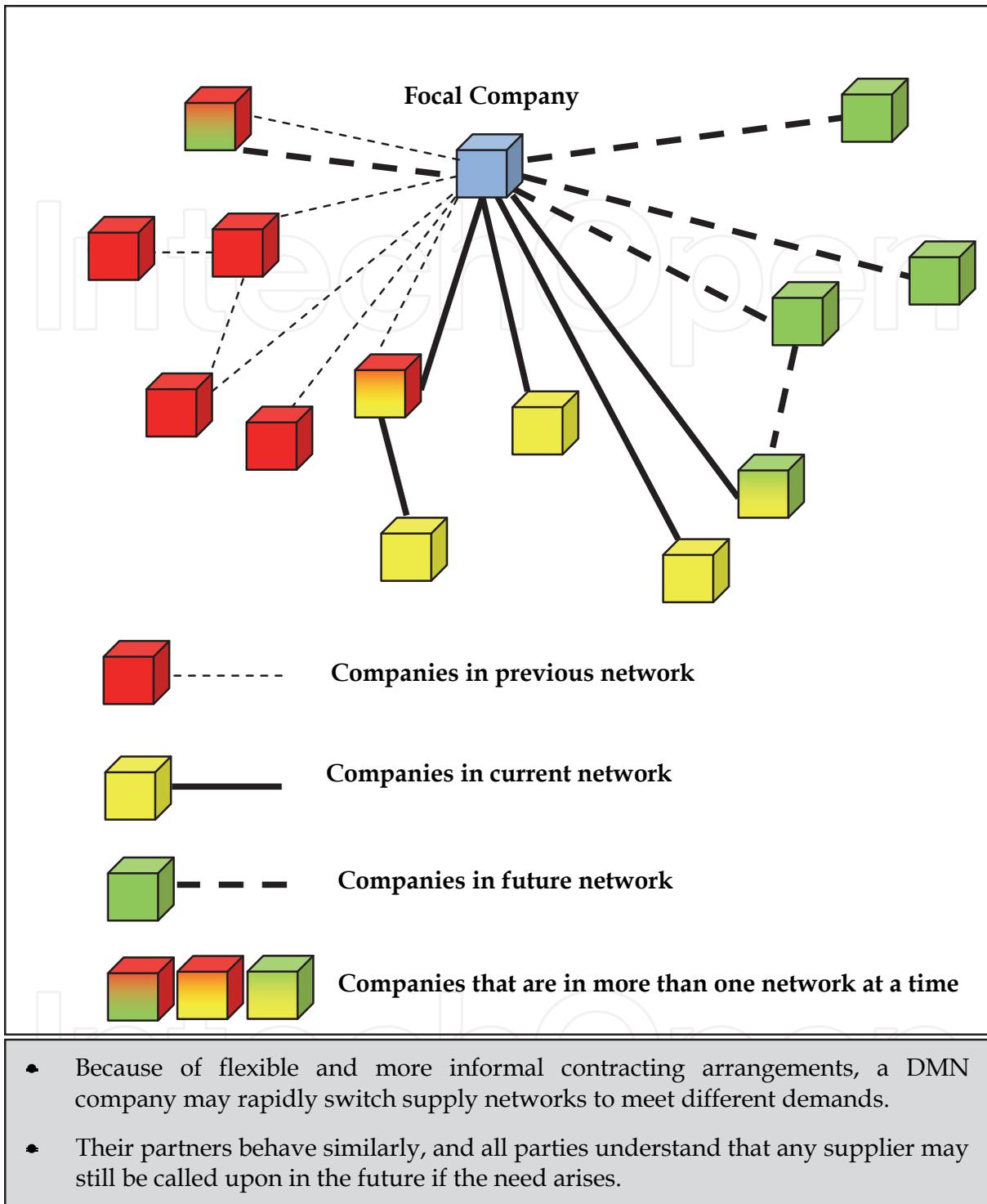


Fig. 2. Dynamic DMN Network Connections [Adapted from Noori, Tan & Lee (n.d.)]

More importantly, the effects of globalization have made companies very aware of their need for agile and nimble supply chains. Companies increasingly understand that such flexible and more innovative supply networks may only be attainable through short-term connections with other companies drawn from much wider supply networks (Camarinha-Matos & Afsarmanesh, 2005; Katzy & Crowston, 2008; Dekkers, 2009a; Noori & Lee, 2009).

The cultural change that will be necessary for companies to adopt the DMN perspective will necessarily depend on their respective industries or environments. In general, a very stable business environment is less favorable or perhaps makes it less necessary, for DMN networking. Traditional collaborative networks that emphasized long-term and stable business connections may then be more suitable under such conditions. Conversely, more chaotic industries or environments may increase the number of situations where DMN networks are perceived as advantageous by companies, and hence will lead to greater proliferation of such networks.

### **3.2 Dispersed manufacturing networks advantages**

The fundamentally transient nature of DMN processes i.e. the operations of networks that are established for specific co-production or innovation purposes, and then afterwards dispersed, provides certain performance advantages as compared with the more traditional stable collaboration networks. These advantages include higher goal attainments, improved operational efficiency and higher supply chain flexibility.

#### **3.2.1 Higher goal attainments**

The custom-build nature of DMN networks that gather together all the relevant capabilities for a particular task at hand will naturally tend to result in higher likelihood of network goal attainments. The concentrated assembly of the appropriate mix of experts, specialists, or customized resources will create the necessary attention and focus to provide the desired solutions (Katzy & Crowston, 2008). One potential danger that may arise from over-reliance on a closed set of such network partners is that it may limit the possible solutions that could be available to the group. However, this risk is itself mitigated by the nature of transitory and open-ended connections as found in DMN networks. Essentially, the dynamic and ever-changing links among DMN networks allow more opportunities for different companies to come into contact with, and to exchange information or knowledge. The objective-specific nature of DMN networks also means that a company will likely belong to different DMN networks at the same time, as to be able to fulfill all of its various objectives. A particular DMN network that is lacking in some critical skill or resource will have such deficiencies recognized by some its more experienced members, and rectified with the inclusion of additional member companies. Therefore, information and resources in DMN networks tend to be more complete for some particular purposes and hence make them more effective for the purpose of targeting joint efforts.

#### **3.2.2 Improved operational efficiency**

The dispersed nature of DMN networks also contributes to their operational efficiency. In dispersed co-production, specific manufacturing or distribution resources are employed from various companies only when needed. Unneeded resources are freed up and made available for use by other companies. These can only result in lower cost and better efficiency for the companies in the network as a whole (Noori & Lee, 2006; Dekkers & Bennet, 2009; Noori & Lee, 2009).

Operational efficiency can also be enhanced if member companies adopt beneficial process innovations. In this respect, the turnover or "churn" effect of network members in DMN networks makes them more amenable to the spread and adoption of process innovations in manufacturing and distribution operations. Firstly, the periodic entry of new member

companies into networks serves to bring in knowledge of new operational innovations that may arise from time to time. Every member company in the network is exposed to such innovations, and can gain by learning these processes from each other. Secondly, the looser connections in DMN networks that allow easy recruitment of new members also allow for the easy retirement of current member companies that are deemed to be no longer assets to the network. The real threat of getting dropped by partners due to inefficiency acts as a spur to all network companies to quickly adopt process innovations where they are valuable and necessary. A company that is not fast on its feet or that is overly reluctant to invest in new and beneficial process innovations could be easily replaced by more proactive companies. Process innovations that are initially rare will rapidly become commonplace and standard offerings in DMN networks. In due course, the proliferation of such beneficial process innovations in these networks adds up to more efficient and cost-effective operations for DMN companies (Noori et al., n.d.).

### **3.2.3 Higher supply chain flexibility**

The fundamentally dynamic nature of DMN networks also acts to create greater supply chain flexibility. Supply chain flexibility is defined as the ability of firms to adapt or react to change with little penalty to time, effort, cost or performance, and is critical to firms' survival in more turbulent business environments (Upton, 1994; Sanchez & Perez, 2005). For instance, consider the consequences to companies in the event of any major supply chain glitches. The unexpectedness and severity of such disruptions have been known to adversely affect companies' performances, reputations and market values (Hendricks & Singhal, 2003). Supply chain flexibility is viewed as an important ability to mitigate the negative effects of supply chain disruptions (Narasimhan & Talluri, 2009).

DMN companies are not only more willing but also more able to change supply chain partners whenever required. DMN companies are already accustomed to adding, switching or dropping partners as and when necessity may command such actions. In addition to that, because DMN companies are faced with lower hurdles when adjusting networks, they will be more willing to make use of supply chain flexibility as a coping mechanism to address environmental changes.

## **4. Types of dispersed manufacturing networks**

The formation process of collaboration networks among companies has been identified as consisting of three types i.e. emergent, engineered or embedded processes (Ring et al., 2005). In its purest form, a DMN network may be formed and come into being as the result of emergent and spontaneous collaborations that takes place among a group of independent companies which discovered that they share a joint objective. This emergent process occurs when companies are naturally pulled by converging interests to work together as one.

The emergent process of network formation can be likened to the adaptive process whereby companies sense and respond to potential collaborations. An example of such emergent networks is the Shanzhai companies of South China (Shi, 2009; Tse et al., 2009). Essentially, these Shanzhai companies form collaboration networks among themselves without any formal leader. Each Shanzhai company coordinates with only its immediate partners with minimal consideration for the overall network coordination as a whole.

Over time, and with repeated interactions, the formation process of some DMN networks may gradually evolve toward a more engineered process. This happens if certain DMN

companies increasingly take on the specialized roles of coordinators in the formation process of DMN networks. The engineered process comes about when these coordinating companies actively seek out to connect potentially collaborators with one another. Finally, when these companies have sufficient prior experience with one another, and have built social structures to support further collaborative efforts among themselves, the embedded process of collaboration may be said to take place (Magretta & Fung, 1998; Noori & Lee, 2006).

The engineered and embedded processes of network formation may be likened to a learning process whereby a group of companies come to gradually institutionalized collaboration routines to improve their collaborative efficiency. One example of such a coordinated network is managed by the well-known Li & Fung of Hong Kong, China. The main selling point of Li & Fung is their ability to quickly and competitively organize specialized resources from their wide range of suppliers to fulfill any customer order. Li & Fung essentially acts as a clearing house or a central hub to link their customers to their networks of suppliers (Magretta & Fung, 1998).

In addition to the above, the degree of formality in companies' business relationships will also inform their network formation processes. Like all companies, DMN companies engaged with each other through a web of both formal and informal relations. It should be noted that DMN companies are typically far more reliant on the informal social-networking aspect of business relations. Companies often find that having excellent informal relationships with partners are absolutely critical to promote information flows across supply chains (Reagans & McEvily, 2003). The extent and accuracy of supply chain information flow are especially important to companies in fast-moving or fluid business environments. At the same time, power or industry specific issues allows more dominant DMN companies to place an additional layer of formal safeguards in business transactions with partners. By seeking both benefits from informal ties, and safeguards from formal ties, these companies endeavor to obtain more relational rent from their networks (Emerson, 1962; Lavie, 2006). Therefore, the degree of formality in such relationships, which may vary from low to high, can be beneficial to certain companies by providing assurance of commitment or performance. By contrasting these two characteristics of network formation processes in a 2x2 matrix, four DMN networks types labeled as Controlling Hub, Spot Contracting, Emergent and Association are tentatively identified. The positioning of these DMN network types on the Coordination and Formal Relations Axes are shown in Figure 3.

## 5. Implications of dispersed manufacturing networks

DMN networks have clear advantages over traditional collaborative networks, especially in turbulent business environments. A DMN network can draw from a wider and more diverse pool of resources, with lesser constraint to change partners as required. A group of companies working as a DMN network will be more agile, innovative and efficient than a comparable group of companies working in a more traditional network.

However, this does not mean that a company in a DMN network may assume that it can always be successful. A DMN company will have to work even harder than a traditional company to be successful. Firstly, a DMN company has to invest more effort into relationship management with its peers. Individual companies in DMN networks have to rely on networking to gain access to various critical resources that may be too prohibitively costly for each to develop on its own (Ring et al., 2005; Katzy & Crowston, 2008). Secondly,

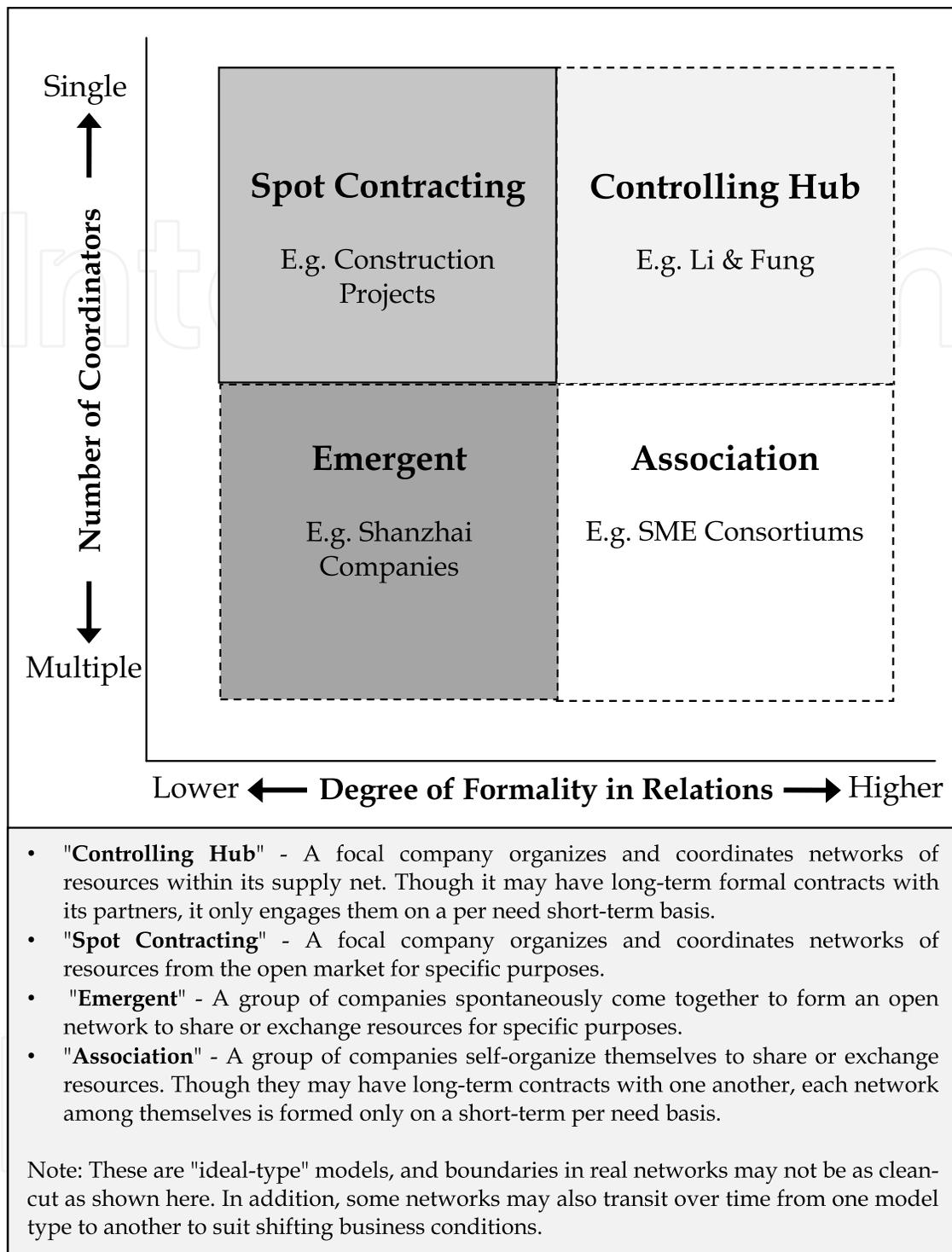


Fig. 3. Tentative Range of Dispersed Manufacturing Network Types

DMN companies have to stay competitive in its areas of competency against every other DMN company in the network with the same areas of competency. There are no permanent allies, and hence no permanent enemies in a DMN network, and the onus is on each DMN company to prove its continual worth to its peers. A DMN company that has ceased to be competitive will be unable to easily find partners to pursue new business opportunities or to fend off competitive threats.

Given that it is more difficult to be a DMN company, why should any company ever seek to be one? Simply, the performance advantages of a DMN network will eventually make joining such networks a necessity wherever they are possible. It is anticipated that traditional collaborative networks in industries with more turbulent business environments will gradually transit to become DMN networks. Competition in these industries will always exist, but increasingly, such competition may be fought out only among DMN networks.

For instance, in certain supply chain areas, i.e. in humanitarian supply chains, DMN networks are essentially already the means by which organizations collaborate with one another. Humanitarian supply chains are typically unpredictable, costly, difficult, and needed to be quickly set-up under complicated conditions. They are also usually custom-build and may be required only on a short-term basis for disaster mitigation (Oloruntoba & Gray, 2006; Thomas & Fritz, 2006; Maon et al., 2009). Given these challenges, many relief organizations operate under DMN dispersion rules. For instance, relief organizations may find themselves with limited resources in certain disaster areas. Under such circumstances, they may share resources with each other in order to meet their common goal of disaster relief. Later, these organizations may encounter one another again at a different disaster area, and will collaborate once more, though perhaps in different ways, to provide relief.

The DMN perspective suggests that small companies operating in DMN networks can have a competitive advantage against larger firms (Noori & Lee, 2006; 2009). All else being equal, smaller companies tend to have lesser overheads. Traditionally, their limitation is that they also have lesser access to internal resources enjoyed by larger companies. A DMN network allows small companies better access to all such resources, while still keeping to their advantage of lower overheads. The cost-efficiency, effectiveness, flexibility and innovativeness of a DMN network of a host of small companies can therefore compare very well against the workings of an equivalent-sized large company. An analogy from nature may be to compare swarm entities versus larger entities. In this comparison, consider how a colony of ants working in short-term collaborative clusters may carry out many more different tasks, and perform them all far more efficiently, than a single elephant could do by itself. The DMN perspective of convenient but temporary collaboration among independent entities for shared benefits may yet prove to be a more palatable and realistic form of cooperation that can be possible among different companies.

## 6. Conclusion

As a relatively new and developing perspective, only time will reveal how DMN concepts will roll out in companies. However, the continuing aggregation and intensification of global markets and competition suggest that the need for a DMN approach by businesses will become more acute over time. In the light of these trends, it is important that DMN should continue to attract both practitioner attention and scholarly research so as to ready the ground to guide current and future business practices. This chapter seeks to bring attention to this phenomenon in order to spur further investigative efforts.

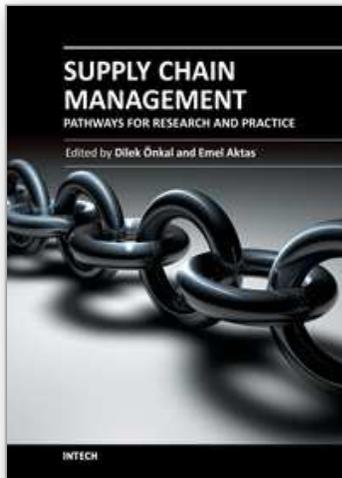
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## **Supply Chain Management - Pathways for Research and Practice**

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Challenges faced by supply chains appear to be growing exponentially under the demands of increasingly complex business environments confronting the decision makers. The world we live in now operates under interconnected economies that put extra pressure on supply chains to fulfil ever-demanding customer preferences. Relative attractiveness of manufacturing as well as consumption locations changes very rapidly, which in consequence alters the economies of large scale production. Coupled with the recent economic swings, supply chains in every country are obliged to survive with substantially squeezed margins. In this book, we tried to compile a selection of papers focusing on a wide range of problems in the supply chain domain. Each chapter offers important insights into understanding these problems as well as approaches to attaining effective solutions.

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