



# Networking Activities in Supply Networks

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## Abstract

The paper traces the origin of the concept of supply networks and focuses on eight different networking activities related to the process of establishing and operating supply networks. These activities are associated with the linking of activities, tying of resources and bonding of actors. Findings from two case studies are discussed, focusing on the process of networking in a set of relationships within each network.

## Introduction

Business markets are increasingly seen or understood as industrial networks, consisting of linked activities, tied resources and bonded actors. This paper aims to identify a number of specific processes that companies - explicitly, implicitly or even subconsciously - may try to use to achieve and maintain such interconnections. Specifically, we try to identify such activities in the case of 'supply networks' which may be seen as a specific (analytical) subset of industrial networks. The paper reports on findings from two in-depth case studies of the process of managing or operating such supply networks.<sup>3</sup> It starts by briefly outlining the background for the research, leading to the presentation of a set of networking activities that form the core of a more comprehensive conceptual framework which underpins the case study focus and approach (Zheng *et al*, 1998). Thereafter, the research questions driving the case studies and the methodology are presented. The findings from the first two of eight case studies are discussed: an automotive and a tele-communications supply network. This part focuses specifically on the set of networking activities across several supply chains within each supply network and identifies how activities performed in one relationship affects positively or negatively the performance of those activities in other relationships within the network. Also, relationships between different activities are identified and discussed. The paper concludes with a discussion of the implications of the findings and the further work to be conducted.

## The Emergence of the Concept of Supply Networks

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Supply networks can be defined as a set of supply chains, embodying the flow of goods and services from original sources to end customers (Harland, 1996). Supply networks therefore not only comprise upstream suppliers but also downstream customers and/or distributors. Supply networks include those actors, resources and activities involved in the production and delivery of a product; they do not include those purely involved in, for example, the development of that same product. Compared to industrial networks in general, the focus in the work on supply networks is on a limited, manageable set of operational tasks that meet the order-winning criteria of customer segments (Hill, 1985; Christopher, 1992).

Two distinct streams of research have been particularly influential in the recent creation of the concept of 'supply networks': 1) the research on industrial networks conducted by the Industrial Marketing and Purchasing (IMP) group and 2) the operations- and logistics-based research on supply chain management. Members of the IMP group have developed models to provide a better understanding of business markets in terms of the nature of buyer-supplier relationships and the embeddedness of these in 'industrial networks', modelled as inter-connected actors, activities, and resources (Håkansson, 1982, 1987; Ford, 1990; Håkansson and Snehota, 1995). Much of the same language is used to describe the building blocks and nature of supply networks (Harland, 1996).

'Supply chain management', on the other hand, was used originally in the early 1980s (Oliver and Webber, 1982) to refer to the management of materials across functional boundaries within an organisation, but has now been externalised beyond the boundary of the firm to include upstream production chains and downstream distribution chains. (Womack, *et al*, 1990; Harland (Jones) and Clark, 1990; and Christopher, 1992). The relatively recent incorporation of the term 'network' into supply chain management reflects an attempt to make the latter wider and more strategic by harnessing the resource potential of the network in a more effective manner than competing firms (Cunningham, 1990); Harland, 1996).

To date much of the research specifically examining supply networks, has been observational and anecdotal, describing case examples of firms that appear to have managed their networks and achieved some form of competitive advantage. Benetton (Jarillo and Stevenson, 1991), Toyota (Womack *et al*, 1990), and Nissan (Nishiguchi, 1994) are examples of such descriptive accounts which have been seminal in recent developments in supply chain management. The problem for managers who have to understand and cope with the management and operation of supply networks is that these accounts traditionally have been centred on specific industries, most notably the automotive industry. This implies that managers in other industries who may be dealing with very different business problems are left with little guidance as to how to manage their particular kind of supply network.

It is especially in the context of the recent developments within supply chain management and lean supply that our research into the creation and operation of supply networks should be seen. It is an attempt to identify how supply networks can be managed, both in the creation and operation stages, and terminology and ideas from existing theory are used to conceptualise and operationalise the research.

## **The Process of Network Creation and Operation**



Networking can be seen as a transformation process of ‘independent’ actors and resources into a more closely knit configuration of a (supply) network. This process is divided into a creation and an operation stage in which ‘creation’ refers to the formation of a set of relationships between actors (and their activities and resources) involved in the supply of a product/service package and ‘operation’ refers to the continuous effort to sustain and improve this configuration and thereby ultimately improve this package. As it is arguably difficult to identify precisely when supply networks are created and operated, both processes may take place at different points in time.

Eight networking activities have been derived from existing theory and exploratory research, reported in Zheng *et al* (1997, 1998), concerned with bonding of actors, linking of activities and tying of resources:

Networking Activity	Example
1. Partner Selection	Where manufacturers select certain suppliers for a component, or when a distributor chooses to work with a selection of retailers
2. Resource Integration	Where a supplier and customer jointly invest in a shared facility
3. Information Processing	Where a distributor cascades information on consumer demand to the manufacturer
4. Knowledge Capture	Where a manufacturer discusses the experiences in using EDI with one of its suppliers
5. Social Co-ordination	Where a manufacturer invites its dealers for a day out to the golf course
6. Risk & Benefit Sharing	Where a customer agrees in advance to recompense a supplier for future obsolete stocks arising because of inaccurate demand forecasting
7. Decision Making	Joint agreement between a supplier and a manufacturer on a specific ordering policy
8. Conflict Resolution	Joint resolution between a supplier and a manufacturer on sharing costs arising from customer warranty claims

**Table 1: Networking Activities**

While partner selection is specifically related to network creation, the remaining activities are relevant for both network creation and operation at different points in time, although these may take different forms depending on the stage of development. Table 2 provides a summary of the literature underpinning the eight activities.

Based on an exploratory survey of 16 supply networks (Zheng *et al*, 1997), we identified four specific forms of resource integration:

- equipment resource integration: e.g. where a manufacturer finances specific tooling to be used by its suppliers;
- material/inventory integration: e.g. where a supplier maintains consignment stocks at the manufacturer’s premises;
- human resource integration: e.g. where a supplier seconds a quality engineer to the manufacturer



- facility configuration: e.g. where a supplier sets up a dedicated plant near its customer.

In the exploratory studies, we also identified an additional process; ‘motivating’, for example where a manufacturer acknowledges supplier achievement through an award. It may also involve the use of specific economic incentives, such as the agreement to share future cost savings in component production costs.

Networking Activity	Themes	References
<i>Partner selection</i>	<ul style="list-style-type: none"> <li>• Supplier selection</li> </ul>	<ul style="list-style-type: none"> <li>• Cousins (1992), Ellram (1991)</li> </ul>
<i>Resource integration</i>	<ul style="list-style-type: none"> <li>• Physical, site and human assets specificity</li> <li>• Human assets and site specificity and supply network performance</li> <li>• Employee integration in supplier networks</li> <li>• Information systems integration: VMI, continuous replenishment</li> <li>• Buyer supplier adaptations</li> </ul>	<ul style="list-style-type: none"> <li>• Williamson (1979, 1985)</li> <li>• Dyer (1996)</li> <li>• Hines (1996)</li> <li>• Scott-Morton (1991), Lamming (1996)</li> <li>• Brennan &amp; Turnbull (1995)</li> </ul>
<i>Information processing</i>	<ul style="list-style-type: none"> <li>• Lean supply</li> <li>• Supply chain management/logistics</li> <li>• IT</li> </ul>	<ul style="list-style-type: none"> <li>• Lamming (1996), Womack <i>et al</i> (1990)</li> <li>• Christopher (1992), Bowersox <i>et al</i> (1986)</li> <li>• Scott-Morton (1991)</li> </ul>
<i>Knowledge capture</i>	<ul style="list-style-type: none"> <li>• Organisational learning</li> <li>• Collective entrepreneurship</li> <li>• Shared learning</li> <li>• Exchange of tacit and proprietary know how</li> <li>• Learning in buyer-supplier relationships, Kyoryokukai</li> <li>• Learning networks</li> </ul>	<ul style="list-style-type: none"> <li>• Argyris and Schon (1978)</li> <li>• Lundvall (1992)</li> <li>• Garvin (1993)</li> <li>• Helper (1990)</li> <li>• Lamming (1996), Hines (1996)</li> <li>• Powell <i>et al</i> (1996)</li> </ul>
<i>Social co-ordination</i>	<ul style="list-style-type: none"> <li>• Stable relationships based on group norms, reputation and peer control</li> <li>• Trust, fine grained information transfer and joint problem solving</li> </ul>	<ul style="list-style-type: none"> <li>• Grandori and Soda (1995), Ouchi (1979, 1980)</li> <li>• Uzzi (1997)</li> </ul>
<i>Risk and benefit sharing</i>	<ul style="list-style-type: none"> <li>• Lean supply and cost transparency</li> <li>• Incentive systems</li> <li>• Trust</li> <li>• Benefit sharing and allowances</li> </ul>	<ul style="list-style-type: none"> <li>• Lamming (1993), Womack <i>et al</i> (1990)</li> <li>• Grandori and Soda (1995)</li> <li>• Ring and Van de Ven (1992), Sako (1992)</li> <li>• Stuart and McCutcheon (1996)</li> </ul>
<i>Decision making</i>	<ul style="list-style-type: none"> <li>• Connectedness</li> <li>• Interdependency</li> <li>• Shared decision making and control</li> </ul>	<ul style="list-style-type: none"> <li>• Anderson <i>et al</i> (1994)</li> <li>• Hakansson and Snehota (1995)</li> <li>• Killing (1988)</li> </ul>
<i>Conflict resolution</i>	<ul style="list-style-type: none"> <li>• Conflict and co-operation as features of business relationships</li> <li>• Values, mutual understanding, mediation and arbitration</li> <li>• Plans and controls</li> <li>• Broker rules</li> </ul>	<ul style="list-style-type: none"> <li>• Håkansson and Snehota (1995)</li> <li>• Kumar (1996)</li> <li>• Lorange (1988)</li> <li>• Snow and Miles (1992)</li> </ul>

**Table 2. Literature Related to Eight Networking Activities**

All of these nine activities (or 12, distinguishing four different resource integration activities) lead to the creation or maintenance of either actor bonds (e.g. through social co-ordination, but in some cases also human resource integration), activity links (through information processing, decision making, partner selection) and/or resource ties (through resource integration, knowledge capture, motivating). Rather than illustrating how bonds, links and ties are the result of various networking activities, this



paper focuses on identifying the connections between different activities. Such connections may exist between activities within individual relationships, or between different relationships within specific activities.

### **Empirical Findings From Two In-depth Case Studies of Supply Networks**

Eight in-depth case studies of supply networks have been carried out, involving both UK and continental European companies. The cases cut across a range of different industries, including automotive, pharmaceuticals, tele-communications, food and drinks, computers, and domestic appliances. Apart from seeking a broad coverage of a variety of industries, the selection of the case studies also took into account the type of product being supplied and the manufacturing process for producing the product. The focal firms in the centre of each case study are generally major firms that may be expected to be trying to manage part of their supply network. This paper reports findings from two of these cases, one involving (as the focal point) a vehicle manufacturer (VM) and the other a tele-communications equipment manufacturer (TEM), and their respective supply networks. The central research question driving the case studies is how and to what extent firms try to manage their supply networks to satisfy end customer requirements and under which circumstances. Within the broad term 'management' the research focuses specifically on the process of creating and maintaining a network through the eight different networking activities.

#### *4.1. Methodology*

Each case adopts the total supply network as the unit of analysis, captured by the physical flow of a particular product. Semi-structured interviews have been carried out with the focal firms and selected 1st, 2nd and 3rd tier suppliers and customers, totalling 24 interviews of app. 2 1/2 hours each. Interviews with the focal firms were carried out in two stages: the 1st was designed to identify a suitable product on which to focus and established the type of manufacturing process, the nature of the environment, the structure of the network in terms of components and major actors, and strategic issues such as what the network is trying to achieve and the distribution of power within the networks; the 2nd stage examined the nature of the focal firm's supply strategy and discussed the eight networking activities. Interviews with suppliers and customers identified their perceptions of strategic issues, the effectiveness of the focal firm in managing the supply network and the eight networking activities. Respondents were assured that all information disclosed during interviews would be treated as confidential, thereby enabling potentially critical viewpoints about other actors to be expressed.

All interviews within the two cases have been taped, transcribed and analysed. The major vehicle for analysis was interactive discussions between three researchers, two of which were part of the project team (and of which at least one had been present during the interview) and the third who had not been present at any of the interviews but who acted as an independent observer. This process tried to limit the extent of subjectivity that may exist in interpreting semi-structured interview data

The analysis aimed to identify the specific contexts of each case at the three levels of the network, the specific component chain and the individual relationship. Specifically, this part sought to identify features of the company, the product and manufacturing



process, the environment, the network structure, and the most important supply network problems. Having analysed the specific context of each case, the researchers analysed the networking activities within each relationship studied, seeking to identify any possible links between activity and context. Furthermore, we sought to identify 'network effects' in terms of connections between the different activities and between activities performed by different actors.

For this purpose, we have tried to summarise the information from the various interviews in a way that enables us to identify and indicate these connections (see Tables 3 and 5). These tables summarise, for each of the network relations studied, the type of networking activities taking place and the possible problems involved. Arrows indicate the connections between different activities.

The following section discusses the findings, focusing predominantly on the nature of networking activities and context.

#### *4.2. Case 1: VM Supply Network*

##### *Context*

The automotive market is very competitive with few manufacturers possessing more than 4 or 5 per cent market share on a world-wide basis. The market is furthermore characterised by over-capacity, which has led to a global process of consolidation. As a result of the high degree of competition, the industry is highly dynamic, which is evident from the continuous model innovations/updates.

The product in focus of this supply network can be described as innovative, both from the point of view of the market, as it represents a new combination of two traditionally different types of car, and the company, as it is much higher volume than the company is used to produce and supply (although still not a high volume car). The product represents a traditional and strong brand and introduced several innovative features when it was launched. It is now recognised as being highly successful, which is evident in the sales figures. Despite an effort to limit the degree of component variety and complexity, the car can still be described as high variety, which represents a major supply challenge. As initial demand was very high and has resulted in long lead times, capacity planning was identified as a critical process. Whereas volume flexibility initially seemed to be a problem, it gradually became apparent that it is the product mix that poses the main challenge.

The upstream part of the supply network is very large and complex, due to the number of components that make up a car, although the characteristic tiering structure provides some level of organisation. The downstream part of the network is formed by dealers, usually being franchisees. These dealerships are well sought-after, which implies that the focal firm has some power and control downstream whereas upstream it is facing a large network of often major suppliers. These suppliers frequently deal with other, often even more powerful, vehicle manufacturers as well.

Whereas the company has traditionally largely dual sourced, the new product introduced a strategy of single sourcing. The supply network strategy is characterised by a deliberate effort to influence 1st tier suppliers. Only in cases of 2nd tier suppliers simultaneously being 1st tier suppliers in other products and during major price



negotiations (to use its bargaining power), is the company directly involved beyond 1st tier. This effectively means that they only attempt to manage immediate relationships and view it as the responsibility of 1st tier suppliers to manage their end of the business, including their (2nd tier) suppliers. In essence, the company tries to put a substantial effort into guiding and teaching its 1st tier suppliers how to manage their suppliers i.e. a strategy of cascading (Lamming, 1993).

*VM Supply Network Analysis*

This section reports on analysis of networking activities within the VM supply network. This analysis is divided into four supply chains. Within each chain some overall observations are provided, identifying the context of each chain and what seems to be the main networking problems. Thereafter, the relationships within the chain are briefly discussed, focusing on the main networking features i.e. activities that appear to be performed in a particular (positive or negative) way. Following the analysis of each of the four chains, we identify how activities performed in one relationship affect - positively or negatively - the performance of those activities in other relationships. Also, the ways in which activities affect each other are discussed. Table 3 provides an overview of the characteristics of the four chains.

Contextual variables: components/chains	Component 1	Component 2	Component 3	Component 4
1. Component process complexity/time	high	medium	low	medium
2. Component complexity	medium	high	medium-high	high
3. Component variety	low	medium	high	low
4. Component uniqueness	high	medium	medium	medium
5. Component innovation	medium	low	Low-medium	low
6. Component value	high	medium	medium	medium

**Table 3: Contextual Variables of Four VM Component Chains**

*Chain of Component 1*

The chain of component 1 represents a critical and complex supply operation. The component itself is fairly complex, but more importantly the process time is very long compared with other component groups. Variety, however, is very low. Furthermore, component 1 is characterised by being a specific component, tailored to VM's specifications. Finally, it is important to understand that the component is high value, and therefore critical to VM.

The main overall networking activity problem in this chain is cascading of VM's demand information, which is crucial due to daily fluctuating volume and build (i.e. mix) information. This is a particular problem for this chain as the process time is long. Therefore, this chain needs relatively more and better demand information as the suppliers are less flexible.

There is little evidence of risk and benefit sharing, although some between the 3rd and the 2nd tier suppliers. The lack of risk and benefit sharing includes elements of conflicts and blaming over materials quality. We found an interesting example of human resource integration in the relationship between the 3<sup>rd</sup> and the 2<sup>nd</sup> tier supplier where an advisory engineer is seconded to the 2<sup>nd</sup> tier supplier. This is perceived by both parties as being a very useful arrangement, enabling mutual sharing of technical knowledge.



### *Chain of Component 2*

This component is also a critical operation for VM. It is highly complex, and higher variety than component 1. Also it is relatively lower value than component 1, yet still an expensive component. The variety is higher than component 1.

Also in this chain, we found evidence of problems with cascading of VM's demand information/signal, but interestingly the actors seem to cope better than the actors in the component 1 chain, probably because the throughput time is much shorter, particularly that of the 2nd tier supplier. However, there seems to be a lack of a more direct link between VM and the 2nd tier supplier, which feels somewhat left out, most importantly during NPD where this supplier does not feel its expertise is properly utilised by VM. In contrast with chain 1 there appears to be more risk sharing in NPD work through guarantees of work and also benefit sharing regarding mutual cost savings i.e. there is a mutual perception that any cost improvements would be shared evenly between the two parties. This was most evident in the relationship between the 1<sup>st</sup> and the 2<sup>nd</sup> tier suppliers.

### *Chain of Component 3*

The chain of component 3 is slightly lower value than the two other chains discussed, most notably compared with the component 1 chain, but the variety is very high. Also the processing complexity and time is less than component 1 and component 2. This makes stocks unnecessary, and JIT operation a logical choice.

Again there is evidence of problems with the cascading of VM's demand information/signal, but this chain is coping very well with the problem. Due to the high variety, but low processing complexity and time, this is perhaps not surprising as this type of operation is easier to turn around and the 1st tier supplier is able to react on very short notice. The component was out-sourced to the 1st tier supplier after the start of VM's production of the car in focus, so the 1st tier supplier inherited VM's existing supplier base leading to some problems.

The human interaction is close, including one employee from the 1st tier supplier who was temporarily seconded to the 2nd tier supplier to develop a continuous replenishment system. This open system for inventory management seems to be the solution those two companies have co-developed to cope with the poor demand information/signals from VM.

The arrangement for risk and benefit sharing is much in line with industry practice, i.e. one way, and the 2nd tier supplier is not satisfied with the lack of input it had in developing the component. There are now, according to the 2nd tier supplier, some problems of sub-components not fitting together properly.

There is evidence of sharing of packaging equipment between VM and the 1<sup>st</sup> tier supplier which seems to be related to the JIT based relationship with the 1st tier supplier supplying on a sequential supply basis. The 1st tier supplier's plant is also dedicated to VM only.

### *Chain of Component 4*





Component 4 is complex although perhaps not as complex to produce as component 1. Like component 1 it is low variety, but not as high value. It is not customised to the same extent as component 1, but rather on par with the two other components.

The 1st tier supplier is generally not very satisfied with VM's supply chain management. The main theme relates to VM's short term cost focus most notably evident in its supplier development activities. This also implies that the knowledge flow is mostly one way i.e. supplier to VM. The supplier does not feel it is involved enough in NPD, and little strategic information is disclosed concerning new products in the pipeline and changes in technology which could render the supplier's product obsolete. The supplier also struggles with poor processing of demand information/signal. As the component is in many ways similar to component 1 it is perhaps not surprising that this chain seems to be struggling with the same kind of problems as that chain.

#### *Customer relationships*

On the customer or dealer side, the findings indicate that dealers appear to be treated differently according to their positions as either 'cabinet' members or 'non-cabinet' members. One of the two dealers interviewed is clearly in a privileged position as it has been elected as a cabinet member which means it represents the local dealerships and receives more information from VM than the individual dealer. This includes early information of the launch of new products, in which case this dealer provides feed-back and takes part in discussions of production and supply issues within the cabinet. The non-cabinet member on the other hand is not very happy with VM: it feels like "a mushroom left in the dark". This dealer does not seem to be very well informed about new products to be launched or about product quality problems. It circumvents the long lead times and poor delivery reliability by ordering vehicles well in advance, thereby not using the vehicle configuration computer system, which is supposed to enable ordering and supply to specific customer order.

#### *Connections between networking activities and network effects*

One of the interesting aspects of focusing on the network instead of the dyadic relationship, is that it becomes possible to identify connections between individual relationships in the network. The major connections have been mapped in Table 4 in which the columns contain all relationships investigated and the rows contain the list of networking activities. This table distinguishes positive and negative effects, depicting positive effects in solid arrows and negative effects in dotted arrows. Furthermore, effects may be primarily one-way or two ways.

Table 4 shows that there are many connections between activities. Information processing seems to be closely connected to a range of other activities, most notably human resource integration (in this case positive), decision-making (positive and negative) and knowledge capture (in this case negative). Human resource integration and knowledge capture are also directly related. Also risk and benefit sharing seems to be connected to other activities, mainly materials and inventory integration. Further analysis of these links may provide a better understanding of the ways in which specific activities can support or potentially harm each other.

The analysis of connections between relationships shows that the process of partner selection in component 3 performed in the relationship between VM and the 1st tier supplier also has a negative bearing on partner selection in the relationship between the 1st tier and the 2nd tier supplier, as the 1st tier supplier inherited its supplier base and



therefore did not select that supplier by itself. Also within that relationship, there is evidence of an activity link related to materials and inventory integration, although this effect is positive and works two-ways. There also seems to be a connection between human resource integration during NPD work within the relationship of VM and the 1st tier supplier and its relationship with the 2nd tier supplier. Information processing 'travels' from one relationship to another, in this case most evident in one chain where the poor demand signal affects a whole chain of relationships.

In addition, Table 4 shows that a large number of networking activities are performed across tiers i.e. between VM and 2nd tier suppliers, including also the 3rd tier supplier. There are two (possibly three) examples of 2nd tier equipment owned by VM. There is also evidence of human resource integration between VM and 2nd tier suppliers, particularly during NPD work.<sup>4</sup> Despite some existence of human resource integration between 2nd tier suppliers and VM, more direct human interaction during NPD is often advocated by the suppliers. Indirect exchange of strategic information mainly takes place between VM and the 3rd tier supplier, mainly because of the crucial position of the 3rd tier supplier. Other indirect VM suppliers again often ask for more communication of strategic information to be communicated direct with them, not least information about new products.

The exercise of identifying and mapping networking activities that are performed between actors with no direct supply relationship indicates that VM does not merely manage these activities with its direct relationships, but performs a range of these at a higher level. The fact that many suppliers positioned further upstream (i.e. beyond 1st tier) are asking for more activities to be performed directly with VM also strongly suggests that this is not just in the interest of a dominating vehicle assembler, but evidently also in the interest of individual suppliers wanting to be more involved in and contribute more to the development and supply of VM's products.

#### *4.3. Case 2: (TEM) Supply Network*

The product in this supply network is offered by the major tele-communications manufacturers as part of the tele-communications network. Although highly technological and complex, it is a fairly standardised piece of equipment representing the 4<sup>th</sup> generation of its type. In fact, customers can easily switch from one supplier to another, combining different brands in the same network. This is particularly so because all products have to comply with international standards, hence the market has become commodity-based and the differentiation factors are mainly logistics-based and highly depending on lead time. From the perspective of this market, the products are produced in low-medium volume and low variety (three basic variations).

The market for the product is characterised by even capacity, but price pressure still exists due to de-regulation in the end-market. The industry as a whole is experiencing very high growth (30 per cent annually) and is very dynamic in terms of companies entering and leaving the industry. Demand can be described as 'binary': it is all or nothing since for each order, the customer usually selects one supplier, which then has to deliver a large number of units. Delivery and network establishment entails a very

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<sup>4</sup> In fact, there is more evidence of human interaction than indicated in the table, which only indicates actual 'integration' of human resources (i.e. permanent or semi-permanent exchanges).



fast ramp-up process, and depends on the customers' complex planning process, including them obtaining a network plan and site acquisition, architecture etc.. It is thus highly unpredictable, forecast accuracy being app. 30-50 per cent. As a consequence, demand management and forecasting in particular presents a critical process.

The supply network is multi-tiered, consisting of circa 30 customers/network operators (although very few in each country) and a complex supply base in which suppliers are often vertically integrated and may be competitors as well as suppliers. There is however a current trend of out-sourcing and also supply-base reduction. TEM's supply strategy is generally dual sourcing, allowing it to better cope with interruptions and capacity problems, and can be described as a cascading approach; TEM only gets involved beyond 1<sup>st</sup> tier when specifying components or when a critical capacity or quality problem arises.

In this case, we have focused on three specific component chains within the supply network of this manufacturer (see Table 5)

Contextual variables: components/chains	Chain 1	Chain 2	Chain 3
1. Component complexity	medium	high	low
2. Component variety	medium	medium	low
3. Component uniqueness	medium	high	low
4. Component innovation	low	high	low
5. Component volume	medium	medium	high
6. Component value	medium/high	high	low

**Table 5 Contextual Variables of Three TEM Component Chains**

*Chain of Component 1*

Component 1 represents a complex operation in terms of assembling and configuring different units. However, it is a commodity component, although it is customer specific and high value. The main challenge for the suppliers in this chain is that TEM requires flexible supply (i.e. short lead time and low volume) which creates a difficulty given the very fluctuating demand information and long lead times of upstream suppliers. Also, information processing is affected by TEM's strong focus on confidentiality, implying that little strategic information is cascaded to suppliers, although the 2<sup>nd</sup> and 3<sup>rd</sup> tier suppliers are closely involved with TEM Group during product innovations.

From the 1<sup>st</sup> tier supplier's point of view, the main problem seems to be risk and benefit sharing and related motivation problems due to dissatisfaction with low margins. However, this was not so much of a problem in the relationships further upstream.

*Chain of Component 2*

The component 2 chain is the most technologically complex within the supply network. The component is unique and there are only a few suppliers possessing the technology. In general the chain is much more technology-driven than chain 1. Both the 1<sup>st</sup> tier supplier and TEM struggle with high growth in terms of volume and also in this chain the demand signals are poor. Overall, there seems to be more problems of networking in this chain particularly between the 1<sup>st</sup> and 2<sup>nd</sup> tier.



Table 4: Activities within VM Supply Network

Network Relation Type of Networking Activities	Component 1: Supplier T3-Supplier T2	Component 1: Supplier T1-Supplier T2-Supplier T1	Component 2: Supplier T2-Supplier T1	Component 2: Supplier T1-VM	Component 3: Supplier T2-Supplier T1	Component 3: Supplier T1-VM	Component 4: Supplier T1-VM	VM - Dealer 1	VM - Dealer 2
Partner selection	<ul style="list-style-type: none"><li>• not totally clear but choice limited due to quality constraints</li><li>• S has gradually improved overall position at C</li></ul>	<ul style="list-style-type: none"><li>• tendering process</li><li>• S involved with C during NPJ-directly with VM</li><li>• selection by C as single source</li></ul>	<ul style="list-style-type: none"><li>• S a preferred supplier</li><li>• tendering process but also importance of social fit and references</li></ul>	<ul style="list-style-type: none"><li>• existing supplier to VM (group chosen by default)</li></ul>	<ul style="list-style-type: none"><li>• existing VM supplier has become 2<sup>nd</sup> tier</li><li>• C not involved in selection process</li></ul>	<ul style="list-style-type: none"><li>• C is outsourcing this component for all varieties after 1<sup>st</sup> production series also for final product had plant nearby</li></ul>	<ul style="list-style-type: none"><li>• existing relation</li><li>• single sourcing</li></ul>	<ul style="list-style-type: none"><li>• evolving process from getting the franchise to becoming dealer</li><li>• already dealer when product was launched</li></ul>	<ul style="list-style-type: none"><li>• C is elected as customer rep (cabinet member)</li><li>• C also outlet for other product/supplier</li></ul>
Risk & benefit Sharing	<ul style="list-style-type: none"><li>• mainly in relation to materials also in terms of cost savings</li></ul>	<ul style="list-style-type: none"><li>• No R&amp;B sharing</li><li>• almost part of service</li></ul>	<ul style="list-style-type: none"><li>• risk sharing in NPJ through guarantees of work</li><li>• benefit sharing re cost savings</li></ul>	<ul style="list-style-type: none"><li>• not a big issue</li><li>• VM may share/take risks in case of volume fluctuations</li></ul>	<ul style="list-style-type: none"><li>• one way</li><li>• arrangements for sharing driven by VM</li><li>• in line with industry</li></ul>	<ul style="list-style-type: none"><li>• risk sharing for obsolescence materials</li><li>• factory investment</li></ul>	<ul style="list-style-type: none"><li>• S takes most e.g. in NPJ should be solved in chain cultural barrier</li></ul>	<ul style="list-style-type: none"><li>• C carries the risk for unsold products</li></ul>	<ul style="list-style-type: none"><li>• C carries risk in facility investment</li></ul>
Equipment Resource Integration	<ul style="list-style-type: none"><li>• seemingly no spec tools/equipment required</li></ul>	<ul style="list-style-type: none"><li>• some tools owned by VM</li><li>• others S, others C</li><li>• S preference for owning tools to get locked-in</li></ul>	<ul style="list-style-type: none"><li>• C owns tooling</li></ul>	<ul style="list-style-type: none"><li>• some tooling paid by VM</li><li>• packaging jointly owned</li></ul>	<ul style="list-style-type: none"><li>• VM owns tooling</li></ul>	<ul style="list-style-type: none"><li>• yes e.g. stullages (fixtures/packaging)</li><li>• some tools</li></ul>	<ul style="list-style-type: none"><li>• jointly owned (leased) computerised sales support and configuration system</li><li>• C thinks it's too expensive but not with VM</li><li>• C happy with system but not with implementation/ownership by VM</li></ul>	<ul style="list-style-type: none"><li>• jointly owned (leased) computerised sales support and configuration system</li><li>• C thinks it's too expensive but not with VM</li><li>• C happy with system but not with implementation/ownership by VM</li></ul>	<ul style="list-style-type: none"><li>• is computerised sales support and configuration system + test equipment</li><li>• quite happy with system but not with implementation/ownership by VM</li></ul>
Material/Inventory Integration	<ul style="list-style-type: none"><li>• consignment stocks at DC for C (buffer stock)</li><li>• C-managed</li></ul>	<ul style="list-style-type: none"><li>• no consignment stocks or other arrangements</li></ul>	<ul style="list-style-type: none"><li>• no consignment stocks</li><li>• JIT deliveries 3 to 4 times a day</li></ul>	<ul style="list-style-type: none"><li>• probably no stocks</li><li>• kanban process</li></ul>	<ul style="list-style-type: none"><li>• stocks at minimum</li><li>• JIT at customer replenishment</li><li>• continuous replenishment full visibility &amp; responsibility of C</li></ul>	<ul style="list-style-type: none"><li>• no stocks</li><li>• sequential JIT deliveries</li></ul>	<ul style="list-style-type: none"><li>• consignment stocks at 3<sup>rd</sup> party visibility problems compared to other customers</li></ul>	<ul style="list-style-type: none"><li>• C effectively finances spare part stocks for VM</li></ul>	<ul style="list-style-type: none"><li>• dedicated stocks at VM owned by C but shared with dealer network to some extent</li></ul>
Human Resource Integration	<ul style="list-style-type: none"><li>• 1 engineer dedicated to and located at C paid by S</li><li>• some ad hoc</li></ul>	<ul style="list-style-type: none"><li>• no permanent exchanges/secondments</li><li>• C comes in to give advice on tooling</li></ul>	<ul style="list-style-type: none"><li>• close interaction during NPJ, sometimes also with VM if requested</li><li>• full days of 1 week (max) placements</li></ul>	<ul style="list-style-type: none"><li>• no permanent integration/secondments</li><li>• most interaction during NPJ</li></ul>	<ul style="list-style-type: none"><li>• close interaction ad hoc</li><li>• C person on site for 2 weeks to develop replenishment system</li></ul>	<ul style="list-style-type: none"><li>• no permanent arrangements/secondments but very close interaction related to sequential delivery</li></ul>	<ul style="list-style-type: none"><li>• some but less compared with other customers</li></ul>	<ul style="list-style-type: none"><li>• regular contacts/visitors by VM reps</li><li>• Training programmes</li><li>• C would like more visits to VM especially other parts of the org</li></ul>	<ul style="list-style-type: none"><li>• very little interaction except from training courses</li><li>• C would like people from VM seconded to dealers to understand their business</li></ul>
Facility Configuration	<ul style="list-style-type: none"><li>• no specific configuration with this C, but in the vicinity of VM and small volume</li></ul>	<ul style="list-style-type: none"><li>• existing location used already close to VM</li><li>• 2 dedicated lines</li></ul>	<ul style="list-style-type: none"><li>• not applicable already in vicinity</li></ul>	<ul style="list-style-type: none"><li>• location originally chosen close to VM Group given its position as sole customer</li></ul>	<ul style="list-style-type: none"><li>• only in terms of factory being located close to a range of customers</li></ul>	<ul style="list-style-type: none"><li>• 1 S plant for C Group sequential delivery</li></ul>	<ul style="list-style-type: none"><li>• not at all</li><li>• not needed due to product and existing location</li></ul>	<ul style="list-style-type: none"><li>• C has to adapt outlet</li></ul>	<ul style="list-style-type: none"><li>• C has to invest in and adapt outlets</li></ul>
Information Processing	<ul style="list-style-type: none"><li>• strategy info exchange with VM not very problematic</li><li>• S's process is more transparent to C than vice versa</li><li>• quarterly capacity planning</li><li>• short term fluctuations close to order</li></ul>	<ul style="list-style-type: none"><li>• frequent communication but often inaccurate info from VM</li></ul>	<ul style="list-style-type: none"><li>• schedules from C are affected by fluctuations at VM</li><li>• strategic info on NPJ with C but shared from VM</li></ul>	<ul style="list-style-type: none"><li>• not very problematic</li><li>• receive forecasts and schedules sometimes changes</li><li>• strategic info on NPJ through Engineering</li></ul>	<ul style="list-style-type: none"><li>• full visibility of stock levels &amp; flow + forecasts smooth process (but S can handle up to 24 hours)</li><li>• little sharing of strategic info (NPJ)</li></ul>	<ul style="list-style-type: none"><li>• lots of info related to last minute product mix changes (but S can handle up to 24 hours)</li></ul>	<ul style="list-style-type: none"><li>• poor accuracy operational info</li><li>• strategic info on NPJ only when top management involved</li></ul>	<ul style="list-style-type: none"><li>• VM provides much operational info mostly positive however</li><li>• lacks to inform about quality problems and little strategic info/NPJ and often late</li></ul>	<ul style="list-style-type: none"><li>• generally satisfied with info except systems often incompatible</li></ul>
Knowledge Capture	<ul style="list-style-type: none"><li>• advisory engineer is C's link into S's technical expertise</li></ul>	<ul style="list-style-type: none"><li>• S exchange technical knowledge with C</li></ul>	<ul style="list-style-type: none"><li>• one way sharing from S to C</li><li>• limited learning (despite having on-site learning centre)</li></ul>	<ul style="list-style-type: none"><li>• relatively open, two-ways</li></ul>	<ul style="list-style-type: none"><li>• C and S visiting each other suggesting improvements</li><li>• process of CI</li></ul>	<ul style="list-style-type: none"><li>• mostly one way from S to C</li><li>• still limited</li></ul>	<ul style="list-style-type: none"><li>• limited vision</li><li>• VM does not want to learn imposed &amp; control</li></ul>	<ul style="list-style-type: none"><li>• some training courses &amp; videos but mainly VM to C</li></ul>	<ul style="list-style-type: none"><li>• production &amp; supply issues discussed in customer rep Board two way</li><li>• also NPJ feedback</li></ul>
Decision Making	<ul style="list-style-type: none"><li>• some joint DM on consignment stock depletion</li><li>• joint DM on VM in relation to technical info sharing</li></ul>	<ul style="list-style-type: none"><li>• no shared DM by VM</li></ul>	<ul style="list-style-type: none"><li>• most important decisions seem to occur between VM and C</li></ul>	<ul style="list-style-type: none"><li>• price negotiations relatively flexible</li></ul>	<ul style="list-style-type: none"><li>• some joint DM e.g. re Replenishment system and re-design procedures investments</li></ul>	<ul style="list-style-type: none"><li>• C decided on S's inherited fixed design</li></ul>	<ul style="list-style-type: none"><li>• only with re to engineering issues</li></ul>	<ul style="list-style-type: none"><li>• some joint DM with VM through customer representative board</li></ul>	<ul style="list-style-type: none"><li>• relatively frequent joint DM made through customer rep Board</li><li>• fundamental decisions by VM</li></ul>
Conflicts Resolution	<ul style="list-style-type: none"><li>• smooth escalation, mainly in relation to C</li></ul>	<ul style="list-style-type: none"><li>• some conflicts over materials quality with C</li><li>• elements of blaming</li><li>• problems resolved</li></ul>	<ul style="list-style-type: none"><li>• few conflicts solved effectively</li></ul>	<ul style="list-style-type: none"><li>• usually solved through open discussions and meetings</li></ul>	<ul style="list-style-type: none"><li>• smooth escalation process</li><li>• distance prohibitor</li></ul>	<ul style="list-style-type: none"><li>• evaluation process</li><li>• no major problems</li></ul>	<ul style="list-style-type: none"><li>• not often needed</li><li>• mostly informal</li></ul>	<ul style="list-style-type: none"><li>• rare conflict resulted in C suing VM</li><li>• otherwise resolved through personal contacts</li></ul>	<ul style="list-style-type: none"><li>• through discussions</li></ul>
Social Co-ordination	<ul style="list-style-type: none"><li>• some but personal changes at S</li><li>• also direct with VM need for lower level meetings</li></ul>	<ul style="list-style-type: none"><li>• much socialisation on individual basis</li><li>• perhaps also larger events</li></ul>	<ul style="list-style-type: none"><li>• friendly but not always appreciated</li></ul>	<ul style="list-style-type: none"><li>• rather limited so far</li></ul>	<ul style="list-style-type: none"><li>• minimal, not needed according to S</li><li>• distance inhibiting factor</li></ul>	<ul style="list-style-type: none"><li>• quite strong and frequent</li></ul>	<ul style="list-style-type: none"><li>• takes place but high employee turnover at VM</li></ul>	<ul style="list-style-type: none"><li>• one VM organised competitions/campaigns</li></ul>	<ul style="list-style-type: none"><li>• ad hoc, one to one activities</li><li>• limited</li></ul>
Motivating	<ul style="list-style-type: none"><li>• not clear</li><li>• has many contacts with C and VM</li></ul>	<ul style="list-style-type: none"><li>• the knowledge of getting the business</li><li>• supplier rating</li></ul>	<ul style="list-style-type: none"><li>• S feels recognised in general</li></ul>	<ul style="list-style-type: none"><li>• limited</li><li>• supplier rating monthly</li></ul>	<ul style="list-style-type: none"><li>• performance measures</li><li>• social events</li></ul>	<ul style="list-style-type: none"><li>• not often needed</li><li>• mostly informal</li></ul>	<ul style="list-style-type: none"><li>• takes place but high employee turnover at VM</li></ul>	<ul style="list-style-type: none"><li>• one VM organised competitions/campaigns</li></ul>	<ul style="list-style-type: none"><li>• campaigns &amp; competitions</li></ul>



Compared with chain 1, the overall networking seems to be poor. Risk and benefit sharing is not too much of an issue of concern for the 1<sup>st</sup> tier supplier, but the 2<sup>nd</sup> tier supplier perceives the 1<sup>st</sup> tier supplier as behaving in an arms-length manner both in terms of risk and benefit sharing and information sharing; i.e. there is a general lack of trust. Communication from 1<sup>st</sup> to 2<sup>nd</sup> tier of both operational and strategic information is also very poor. Finally, the 2<sup>nd</sup> tier supplier has little autonomy in terms of selecting its own suppliers.

### *Chain of Component 3*

This component is less complex compared to chains 1 and 2 which are unit rather than component suppliers. It is essentially a commodity with a relatively low level of complexity and innovation.

Similar to the other chains, the main problem is that of the suppliers' struggle with poor demand signals from TEM and requirements of flexible supply and short lead times. At the other end the 1<sup>st</sup> tier supplier deals with upstream suppliers with very long lead times. Overall, the relationships tend to be more short term driven and there is limited networking with TEM e.g. in NPD, which is somewhat constrained by TEM's emphasis on confidentiality. However, there is close co-operation between the 1<sup>st</sup> tier and the 2<sup>nd</sup> tier suppliers, largely due to their strategic joint venture. Consequently, there is a large extent of sharing of people and product and process knowledge, although also in this relation there is poor risk sharing in terms of the 2<sup>nd</sup> tier supplier holding a large buffer stock and taking the risk of the customer not using it.

### *Overall downstream supply network observations:*

The downstream relationships are very dynamic in many ways. As TEM's product becomes a commodity, supply is more logistics driven. It is a high growth industry but competition has become fiercer due to the binary nature of demand. Overall, TEM drives the supply network; however the power balance in customer relationships may vary from one relationship to the other. The customer interviewed is TEM's first customer and TEM is a single source supplier for this product.

Currently the customer holds a great amount of stock to cope with demand fluctuations. Interestingly, risk sharing in stocks appear to be more one sided by the customer which indicates that the supplier is in a relatively powerful position in this relationship. The customer has been pushed by the supplier to share large amounts of forecast information and committed to order according to the forecast.

There is intensive social co-ordination and good personal relationships and bonding. Communication is helped by a close location of TEM's sales office and the customer. There are also both formal and informal mechanisms for information sharing and joint decision making.

### *Connections between networking activities and network effects*

Also in the TEM supply network case risk and benefit sharing is linked to a number of other activities. In this case risk and benefit sharing is primarily associated with inventory integration in terms of buffer stocks that are required because of demand fluctuations. This case includes examples of both positive and negative effects between these two activities; mostly negative, but positive e.g. in the relationships between TEM



and the 1st tier suppliers in chains 1 and 2 where TEM is becoming increasingly prepared to compensate costs of holding buffer stocks. The connection between risk and benefit sharing and motivation tends to be negative in most of the relationships between TEM and 1st tier suppliers but positive with other dyads in chain 1. In fact, poor risk and benefit sharing led the 1st tier supplier in chain 1 to cut down on social events to send a signal of demotivation to TEM.

In chain 1 the close relationships evolve around positive connections between human resource integration, knowledge capture, information processing and decision making. In chain 2, however, there are predominantly negative connections between these activities, which may be related to the early stage of development of the relationships in the chain. Coincidentally, no social activities occur in this chain of immature relationships, whereas the two relationships in chain 1 are more mature and open and frequently engaging in social events. Moreover, social co-ordination in both chain 1 and downstream relationships seem to enable good information sharing and conflict resolution.

There is also some negative connection between the changes in sourcing policy and motivation. As an example, in chain 1, TEM has pushed the 1st tier supplier to move from single to dual sourcing, which is de-motivating suppliers.

In the TEM supply network case there are also several links between activities performed in different relationships. The unreliable forecast information clearly has a negative effect from one relationship to another, as the demand signal becomes increasingly distorted upstream.

All the 2nd tier suppliers (including the 3rd tier supplier in chain 1 but excluding chain 2) have been involved in some form of human resource interaction directly with TEM Group, and also in knowledge capture activities with TEM Group. This is perceived amongst suppliers to be vital not least to gain visibility of the supply network in terms of more strategic information from TEM, although the policy of retaining a high degree of confidentiality within TEM clearly constrains the amount of strategic (and particularly new product/technology) information disseminated by TEM.

Finally, partner selection within the supply chain is often influenced by TEM's specification of suppliers and in some cases, 2nd tier suppliers have problems in sourcing due to TEM's control over supplier selection.

## **5. Discussion**

The two cases presented in this paper have in common that they both evolve around the supply of very successful products marketed by influential and successful players in large scale highly competitive markets. Also, the focus on short lead times and flexible supply is strong in both cases. This seems to be for slightly different reasons. In the VM case demand exceeds the supply capacity and the supply network is struggling to satisfy consumers before they look elsewhere because lead times are too long. In the TEM case the rationale for the short lead time is less clear, but related to the fact that the product is becoming a commodity and logistics factors are in consequence perceived to be of increased importance (although this was not clearly identified by the one end customer interviewed).



However, the cases clearly differ in other respects. The influence of supply chain management and lean techniques, has strongly affected the structure of the VM supply network i.e. supply base rationalisation through an increased tiering of the supplier network/out-sourcing and single or dual sourcing, the strategy of VM i.e. an attempt to look beyond 1st tier, and also increased use of what we have chosen to call 'networking processes'. The case of the TEM supply network resembles many aspects of the automotive case and, in fact, many interviewees referred to the automotive industry as a benchmark, or at least a source of inspiration, for practices within their supply network. The most obvious difference between the two cases is that the automotive industry is much more mature and the relationships are subsequently generally more established with better developed and more advanced ways of networking.

The two cases illustrate how the identified networking activities are performed in a set of different component chains. In the VM case it is evident that the activities differ considerably according to the specific contexts in which the actors within the chains operate. The activity presenting a major problem in both cases is information processing, particularly related to the cascading of forecasts through the chains. In chains 1 and 4, both low variety but complex components, information processing constitutes a particular problem, which somehow does not seem to exist to the same extent in the two other chains with much higher variety. This is interesting as manufacturers would normally assert that component variety makes production and supply very problematic. In the TEM case most chains are affected by the poor reliability of forecasts, however this is not surprising given the so-called 'binary' nature

of demand. Information processing in the TEM case is furthermore characterised by a deliberate policy of TEM not to disclose strategic information. This policy and the strong emphasis on its internal technology base appear to imply that there are limitations to the extent to which actors in the network are informed about strategic and technological developments within TEM.

Risk and benefit sharing presents another significant source of grievance amongst suppliers. In some relationships in both the TEM and VM case, specific risk and benefit arrangements, or arrangements linked to other activities (such as sharing of risk in inventory management), were observed. In the case of VM there was only evidence of risk and benefit sharing in chain 2. Generally this appears to be a supply network in which the focal firm is fairly unwilling to engage in such arrangements with other actors; despite many other examples of excellent networking in this case the picture of traditional European buyer-supplier relationships in the automotive industry, was to a large extent evident in the limited degree of risk and benefit sharing. This therefore presents one source of potential improvement in the VM case.

Various arrangements for resource integration were observed, although few examples of actual 'integration' in the form of permanent exchanges of personnel. There were examples in both cases of a few semi-permanent exchanges of personnel between companies. In addition, there were several examples of companies where engineers interact closely during NPD and many suppliers expressed desires to increase this particular type of interaction, both across tiers and chains.





Table 5: Activities within TEM Supply Network

Networking activities	Component 1: Supplier T3-Supplier T2	Component 1: Supplier T2-Supplier T1	Component 1: Supplier T1-TEM	Component 2: Supplier T2-Supplier T1	Component 2: Supplier T1-TEM	Component 3: Supplier T2-Supplier T1	Component 3: Supplier T1-TEM	TEM - Operator 1
Partner selection	<ul style="list-style-type: none"><li>existing supplier to C &amp; FC</li><li>nominating process</li><li>S specified by FC</li></ul>	<ul style="list-style-type: none"><li>FC is pushing for dual sourcing in which case S may decide to terminate relationship</li><li>S got involved through NPD with FC</li><li>S specified by FC. FC's control over advice due to confidentiality</li></ul>	<ul style="list-style-type: none"><li>FC has basic philosophy, but lacks of implementation</li><li>S feel exploited &amp; take much risk</li></ul>	<ul style="list-style-type: none"><li>new supplier since July 1998</li><li>order process</li><li>T1 &amp; C control over sourcing</li></ul>	<ul style="list-style-type: none"><li>involved with FC 18 months ago</li><li>become No 1 supplier</li><li>nominating process</li></ul>	<ul style="list-style-type: none"><li>involved through FC (mainly NPD)</li><li>selected partly because S and C are strategic (JV) partner in other countries</li></ul>	<ul style="list-style-type: none"><li>1<sup>st</sup> tier to FC and 2<sup>nd</sup> tier to another C</li><li>involved in 2<sup>nd</sup> and 3<sup>rd</sup> generation</li><li>FC changed single to dual source</li><li>selection procedures</li><li>one-sided, S take risks</li><li>FC not guarantee quantity during NPD and opt for new parts</li></ul>	<ul style="list-style-type: none"><li>C single source failed to introduce another supplier due to problem with continuity of supply</li><li>3 yrs contract with continuous negotiation</li></ul>
Risk and benefit sharing	<ul style="list-style-type: none"><li>driving cost savings</li></ul>	<ul style="list-style-type: none"><li>open book accounting</li><li>generally satisfied. S has the power to force C onto this since it could link with FC directly</li><li>FC profit in the end</li></ul>	<ul style="list-style-type: none"><li>increasingly FC is paying for tools and info system at S</li></ul>	<ul style="list-style-type: none"><li>no risk sharing. Risks related to stocks</li></ul>	<ul style="list-style-type: none"><li>open book accounting</li><li>S carries risks in new factory investment without definite knowledge of supply</li></ul>	<ul style="list-style-type: none"><li>one-sided, FC not take risks</li><li>S hold large amount stock, risk of not using it due to customised product</li><li>risk with NPD</li></ul>	<ul style="list-style-type: none"><li>selection procedures</li><li>one-sided, S take risks</li><li>FC not guarantee quantity during NPD and opt for new parts</li></ul>	<ul style="list-style-type: none"><li>sharing cost saving</li><li>C holds large amount of stock</li><li>C has to pay if S hold buffer stock</li></ul>
Equipment resource integration	<ul style="list-style-type: none"><li>limited amount of tooling, but financed by FC</li></ul>	<ul style="list-style-type: none"><li>some tools owned by FC</li></ul>		<ul style="list-style-type: none"><li>tools invested by C</li></ul>	<ul style="list-style-type: none"><li>IV for multimedia training package used for knowledge sharing</li><li>common EDD link</li></ul>	<ul style="list-style-type: none"><li>C paying for tooling in some area</li></ul>	<ul style="list-style-type: none"><li>small amount of tooling contributed by FC</li><li>EDD paid by FC</li></ul>	<ul style="list-style-type: none"><li>S contribute tooling equip at C</li></ul>
Material/Inventory Integration	<ul style="list-style-type: none"><li>not co-managed S hold dedicated stock for C</li></ul>	<ul style="list-style-type: none"><li>S have dedicated stock for C</li><li>increasingly collab in stock</li><li>FC will share risks throughout the whole chain</li></ul>	<ul style="list-style-type: none"><li>S keeps large buffer stock to enable fast deliveries during demand fluctuations but FC more prepared to compensate costs</li></ul>	<ul style="list-style-type: none"><li>not co-managed S hold large amount stock</li></ul>	<ul style="list-style-type: none"><li>not co-manage</li><li>S holding a lot of stock, negative share of costs</li><li>terms of inventory if unexpected schedule change</li></ul>		<ul style="list-style-type: none"><li>not co-managed due to S's diversified customer compared with other S</li><li>S holding large stock to cope with short L/T</li></ul>	<ul style="list-style-type: none"><li>not co-managed C holds large amount of stock</li></ul>
Human resource integration	<ul style="list-style-type: none"><li>tech dialogues between S and FC via S's dedicated account manager for FC</li><li>some people interlinked during NPD</li></ul>	<ul style="list-style-type: none"><li>mainly in development stage with FC though not permanently and not structurally</li></ul>	<ul style="list-style-type: none"><li>various mostly temporary working short term exchange both during development and operation</li></ul>	<ul style="list-style-type: none"><li>S offers C their manufacturing expertise for NPD not followed up by C</li></ul>	<ul style="list-style-type: none"><li>some human interaction for NPD S need earlier &amp; more involve in NPD</li><li>C's people in site for 2 months on quality improvement</li></ul>	<ul style="list-style-type: none"><li>exchange people for product &amp; process innovation project with C and FC, but no exchange</li><li>ge &amp; operation</li></ul>	<ul style="list-style-type: none"><li>no permanent arrangement but S frequent visit C for up &amp; NPD</li></ul>	<ul style="list-style-type: none"><li>S people temporarily work at C mainly for commission work</li><li>S does training at C</li></ul>
Facility configuration	<ul style="list-style-type: none"><li>not issue, close by and holding stock. Main Plant in Ger and distribution point in UK</li></ul>	<ul style="list-style-type: none"><li>production location not issues, close by already</li><li>dedicated manufacturing lines</li></ul>	<ul style="list-style-type: none"><li>not issue, due to distance and product volume</li></ul>	<ul style="list-style-type: none"><li>not issue, S is local supplier</li></ul>	<ul style="list-style-type: none"><li>not at all, S get facility constraints for volume production</li></ul>	<ul style="list-style-type: none"><li>not issue, strategic location in facility layout configuration</li></ul>		<ul style="list-style-type: none"><li>no co-location</li><li>S failed to share warehouse with C due to control problem</li></ul>
Information processing	<ul style="list-style-type: none"><li>info cascading down through chain</li><li>limited NPD - strategic info but some direct from FC</li><li>through dedicated manager</li><li>C's unwilling to share strategic info due to C's team</li></ul>	<ul style="list-style-type: none"><li>inaccurate forecast info by FC and test developed into system from C</li><li>strategic info on product tests limited esp with FC, but home NPD with FC group</li><li>open &amp; trust relationship with C</li><li>add due to C's confidentiality</li><li>problems with FC on side of S but collaboration with FC does result in learning for S</li></ul>	<ul style="list-style-type: none"><li>extensive and frequent operational info (EDD) but forecasts not reliable</li><li>limited strategic info</li><li>constraints due to confidentiality from FC</li></ul>	<ul style="list-style-type: none"><li>only recently started to receive forecast info</li><li>no strategic info e.g NPD</li><li>limited comm from C</li></ul>	<ul style="list-style-type: none"><li>frequent up to but unreliable forecast info</li><li>increasingly exchange strategic info, but not yet re future products</li><li>lack of trust, due to new relationship</li></ul>	<ul style="list-style-type: none"><li>unreliable and slow info mainly related to product mix, short notice in change in forecast</li></ul>	<ul style="list-style-type: none"><li>regular up info from C but forecast info unreliable</li><li>some strategic info from C via bi-annual supplier meeting</li><li>S has problems with conflicting info from FC and other C</li></ul>	<ul style="list-style-type: none"><li>regular ops info but unreliable forecast info from C</li><li>sharing some strategic info on new products</li><li>very open relationship</li><li>use of IT restrained by C's incompatible computer system</li></ul>
Knowledge capture	<ul style="list-style-type: none"><li>encouraged by FC to implement best practice</li><li>relative limited tech co-operation with FC in NPD S concern with visibility of tech address to FC in the future</li></ul>	<ul style="list-style-type: none"><li>add due to C's confidentiality</li><li>problems with FC on side of S but collaboration with FC does result in learning for S</li></ul>	<ul style="list-style-type: none"><li>training mostly one way from FC to S</li><li>improved enough to do decision knowledge from S to FC</li><li>limited feedback from FC</li></ul>	<ul style="list-style-type: none"><li>S not involved in C's design process</li></ul>	<ul style="list-style-type: none"><li>sharing concepts with potential to disclose knowledge and supplier development training</li><li>supplier dev in quality improvement from FC to S</li></ul>	<ul style="list-style-type: none"><li>S not earlier and clearer info with FC in NPD but confidentiality problem by FC</li><li>sharing prod knowledge with C</li><li>full up dress training</li><li>no supplier develop from C</li></ul>	<ul style="list-style-type: none"><li>some op knowledge sharing on delivery rela programme from C to S</li><li>technical knowledge from S to C</li></ul>	<ul style="list-style-type: none"><li>S sharing design knowledge and new product info with C</li></ul>
Decision making	<ul style="list-style-type: none"><li>price &amp; standard JT negotiation between S group and FC group</li><li>generally good joint DM but limited visibility</li></ul>	<ul style="list-style-type: none"><li>price negotiation between S group and FC group</li><li>lack of effective decision due to poor comm between FC and C and between C and S</li></ul>	<ul style="list-style-type: none"><li>joint decision not issue except for delay issues where S feels too little involvement</li><li>problem is FC group rather than FC takes decision</li></ul>	<ul style="list-style-type: none"><li>no joint DM</li><li>high feedback from C to FC in terms of S</li><li>need more involve in sourcing</li></ul>	<ul style="list-style-type: none"><li>most decisions dictated by FC including lead time decision</li><li>S want bottom up rather than top down approach</li></ul>	<ul style="list-style-type: none"><li>need to get technical people together and involved earlier DM</li><li>some joint decision at managerial level with C</li></ul>	<ul style="list-style-type: none"><li>two way joint DM e.g JT decision discussed</li><li>S consulted FC on some operational decision</li></ul>	<ul style="list-style-type: none"><li>joint DM through regular reviews</li><li>S and C involved in a no of process improvement projects</li></ul>
Conflicts resolution	<ul style="list-style-type: none"><li>few conflicts</li><li>smooth process helped by period personal relationship</li></ul>	<ul style="list-style-type: none"><li>smooth process between S and C</li><li>little conflicts</li><li>suppressed conflicts with FC</li></ul>	<ul style="list-style-type: none"><li>normally smooth process through frequent communication except one litigation</li></ul>	<ul style="list-style-type: none"><li>way of solving conflicts mostly dictated by C, i.e no discussion</li></ul>	<ul style="list-style-type: none"><li>smooth process</li></ul>	<ul style="list-style-type: none"><li>smooth process</li></ul>	<ul style="list-style-type: none"><li>escalating process generally solved at the low level</li></ul>	<ul style="list-style-type: none"><li>smooth process</li></ul>
Social co-ordination	<ul style="list-style-type: none"><li>add how social events with C</li></ul>	<ul style="list-style-type: none"><li>good stand C relationship</li><li>S organise annual C day</li></ul>	<ul style="list-style-type: none"><li>periodical open day inviting others by S</li><li>S cut down due to margin pressure</li></ul>	<ul style="list-style-type: none"><li>no social events with C but will do next year</li></ul>	<ul style="list-style-type: none"><li>FC organised some social events</li></ul>	<ul style="list-style-type: none"><li>S organised some social activities with C</li></ul>	<ul style="list-style-type: none"><li>No</li></ul>	<ul style="list-style-type: none"><li>social events invited by S, team building exercises funded by S</li></ul>
Motivation	<ul style="list-style-type: none"><li>S motivated by mutual partnership and by business growth</li></ul>	<ul style="list-style-type: none"><li>knowledge of having business</li><li>not motivated by FC due to low margin and move to dual sourcing</li></ul>	<ul style="list-style-type: none"><li>open relationship could motivate S</li><li>FC is motivated by loyal margins</li></ul>	<ul style="list-style-type: none"><li>self-motivated</li><li>motivated by business growth</li></ul>	<ul style="list-style-type: none"><li>very motivated in terms of becoming a No 1 supplier</li><li>appropriate compliments as well as complaints</li></ul>	<ul style="list-style-type: none"><li>well motivated</li><li>rate C as one of key partners</li><li>not always S effort in NPD recognised</li></ul>	<ul style="list-style-type: none"><li>well motivated partly due to one sided JT taking</li><li>S don't feel like partner</li></ul>	<ul style="list-style-type: none"><li>both highly motivated co</li><li>financial incentive in terms of good prices</li></ul>





Other examples of resource integration were rare and generally related to suppliers deliberately establishing their facilities in the vicinity of their customers, customers financing tooling, or various consignment stock arrangements. A few examples of suppliers actually developing dedicated facilities to a specific customer also existed in the high variety/value JIT chains. One question here must be whether such activities can be classified as 'networking' i.e. to mutual benefit or whether they are examples of customers placing more risks on the suppliers.

Activities such as social co-ordination and motivating seem to be regarded as important in many relationships, often enabling, for example, information processing, knowledge capture, decision making and conflict resolution.

Finally, the analysis of network effects shows that activities such as partner selection, information processing, equipment resource integration and even social co-ordination in the VM case, are performed across 'immediate' relationships i.e. tiers. This indicates that the focal firms in these two cases are indeed looking beyond their immediate relationships, trying to manage not just at the level of the dyad, but at a higher level. The two cases included examples of intervention by the focal firms which were not perceived by suppliers as helpful, e.g. supplier selection/inheritance, but in most other activities the perceptions of suppliers towards such direct links were positive and often encouraged.

## Conclusions

The two cases provide an example of how the set of networking activities are performed in a series of relationships. The case examples show how some suppliers and customers have applied networking in their specific contexts and the analysis indicates the importance of performing not only activities related to tying of resources, but also activities related to bonding of actors and linking of activities. The analysis of connections between activities and network effects also shows that many of these activities are not just performed within immediate relationships but often extend beyond this immediate level, most notably for activities related to the early stage of supply network development e.g. NPD and supplier selection.

The actors within the two cases clearly operate in two different contexts: the TEM case includes relationships that are less developed than the VM case and activities such as risk and benefit sharing and knowledge capture are not well developed in this case, although the VM case has problems with risk and benefit sharing and actors that wish to be more closely involved. Most activities are perceived to be important and the activities of information processing, risk and benefit sharing and human resource integration are clearly important to suppliers and customers alike.

This paper has provided two examples of focal manufacturers that perform several networking activities beyond immediate relationships. The analysis of network effects showed how activities such as information processing clearly 'travel' down the chain. More importantly, the analysis showed that many activities are undertaken directly across tiers. This analysis therefore provides a first step towards a more holistic view of activities which may be performed at the level of the supply network and activities that are most relevant to be performed within immediate relationships. The further analysis of these two cases and analysis of the remaining six cases will seek to clarify this issue

and increase the understanding of the link between specific contextual factors and appropriate networking activities. Additionally, potential enablers and constraints to each activity will be identified. It is hoped that this work will improve the understanding of how companies can create and operate their supply networks in their specific circumstances by the use of appropriate networking with a large set of actors in their networks.

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