MANAGING COLLABORATIVE INNOVATION IN COMPLEX NETWORKS: FINDINGS FROM EXPLORATORY INTERVIEWS

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Abstract
This paper discusses why companies should consider collaboration with customers and suppliers for innovation and identifies a set of activities that appear to be critical to managing collaborative innovation. It conceptualises how these activities may be affected when performed in complex networks, thus complicating the task of trying to manage them effectively. The paper reports on findings from a small set of exploratory interviews and discusses some possible explanations for apparent cross-case differences. A note on methodological and theoretical lessons completes the paper.

Introduction
Concepts such as ‘supply chain management’, ‘partnerships’, and ‘networking’ are becoming established as best practice across a variety of sectors. Whereas these primarily concern how companies should manage their operations in some form of partnership along the supply chain they also have profound effects on the way in which companies innovate; concepts such as ‘early supplier involvement in product development’ and ‘innovation networks’ are the latest buzz words.

The majority of these concepts, however, adopt a rather isolated view of partnerships, largely ignoring the embeddedness of such dyadic relationships in complex networks. As discussed by IMP (e.g. Håkansson 1987; Håkansson and Snehota 1995) any relationship, and thus innovation performed within relationships, is heavily dependent on developments in a large range of both direct and indirect relationships. On the one hand this dependency means that innovation performed in individual partnerships is constrained by what happens elsewhere in the network. On the other hand the very same network may also permit companies to gain access to and deploy technologies located in the network. Whereas IMP have traditionally described why this may be the case, little attention has been paid to developing proactive
ways of how to better cope with the problems of networks whilst at the same time explore and exploit the pool of technologies potentially available in the network.

**Collaborative Innovation**

Innovation is increasingly recognised as being the result of the combination of different knowledge and expertise that exist within different organisations i.e. relationships may have interactive and complementary effects on technological innovation. Hence, it is not surprising that there has been a strong upsurge of various forms of inter-organisational collaborative ventures for innovation (Freeman 1991; Hagedoorn 1995; Hagedoorn and Schakenraad 1990).

Our primary focus is on vertical collaboration that takes place within buyer-supplier relationships, but which in reality is affected by a myriad of what can only simplistically be conceived as ‘vertical’ and ‘horizontal’ relationships. The following section briefly examines the literature of customer and supplier collaboration, explaining the reasons why companies should collaborate and identifying the key activities of managing these two forms of collaboration.

**Manufacturer-Customer Collaboration**

Marketing focuses on the needs and demands of the customer. Thus analysis of customer requirements has been the natural starting point of new product development in marketing. Such analysis traditionally includes initial identification of customer needs, evaluation of product potential, and eventual testing of products (using for example Quality Function Deployment techniques). However, when companies seek to develop novel or complex products and technologies and to market these into markets that are either not well defined or do not exist, traditional marketing tools are of limited use (Tidd et al 1997). Moreover, in business markets companies are less likely to conduct large scale surveys of customer needs; collaboration with individual customers - or users - is often a way to increase the chances of developing successful new products and technologies.

Von Hippel’s seminal research on user-initiated (novel) innovation from the 1970s pointed out the dominant role of users in idea generation (1988), and his studies are now supported by a large number of empirical studies (e.g. Foxall and Tierney 1984; Shaw 1985; Biemans 1989; Voss 1985; Parkinson 1982; Gemünden et al 1996). These studies also contributed to an extension and refinement of Von Hippel’s early concept of CAP, extending the role of users to include not only idea generation, but in some cases all stages of product innovation. Also Håkansson’s research on supplier-customer interaction during technological development (1987;1989) has conceptualised and provided further empirical evidence for this stream of research.

Von Hippel’s research has led to one particularly influential framework: the concept of ‘lead users’ (1986). These were defined as those users who a) face needs that will be general in a marketplace, but do so months or years before the bulk of the market and b) are positioned to benefit significantly by obtaining a solution to those needs. The research on manufacturer-customer interaction in innovation by Von Hippel and his peers, which started in the mid 1970s and continued into the 1980s, was seminal in that it blurred the picture of the initiator of innovation. It explored how the source of innovation can vary between industries and
specific cases, but that one important source in many industries was the customer, or user, who took an active part in the whole innovation process.

In the 1990s various attempts have been made to try to provide some form of guidelines for industry on how to manage interaction with customers. Biemans (1995) has identified a series of potential disadvantages of collaborative product development that are often ignored. These include increased dependency, increased cost of co-ordination, requirements of new management skills (most notably the ‘boundary spanner’), changed management of personnel (need to ensure co-operative behaviours), access to confidential information and proprietary skills, dominance by the partner, lack of commitment and loss of critical knowledge and skills. Biemans, however, asserted that a successful co-operation strategy can minimise most of these disadvantages, consisting of four key activities: - partner selection, identifying and motivating the right person(s), formulating clear-cut agreements, and managing the on-going relationship. Biemans’ focus within these activities is on similarity of the parties involved balanced by complementarity to ensure compatibility. He also promoted the explicit clarification of the basis of the collaboration, including division of tasks, link with responsibilities, reasons for entering the partnership, goals, project life, contributions, divisions of costs and benefits etc.. Clear communication appeared to be Biemans’ main success factor.

Apart from Von Hippel’s very specific concept and Biemans work, which tended to generalise on industry and situation specific findings, the research on manufacturer-user innovation to date has been largely descriptive. The presumed advantage of collaborating with customers for innovation relates to the generation of product ideas, information about user requirements, comments on new product concepts, assistance on development and testing of prototypes, and assistance in diffusion (Biemans 1989). However, it is not well-established whether and when those advantages pay off.

**Manufacturer-Supplier Collaboration**

Manufacturers are increasingly seeking to involve their suppliers in product and process development in an attempt to reduce development cost and time and increase product quality and value (Wynstra 1998). Development costs may be reduced by manufacturers pushing cost and responsibility towards the suppliers and, perhaps more importantly, by suppliers having superior knowledge of the components they supply i.e. specialised product and process technologies (Birou and Fawcett 1993). A range of studies have also shown how this (along with ‘concurrent engineering’ (O’Neal 1993)) may explain shorter development times and also improved quality (see for example Womack *et al* 1990; Clark *et al* 1987; Clark and Fujimoto 1991).

Whereas the potential benefits are therefore plentiful it has been suggested and shown that involvement of suppliers in innovation may not always be advantageous (Birou 1994; Wynstra 1998). This indicates that whereas there are potential benefits of involving suppliers in innovation, companies are also likely to encounter problems.

Håkansson and Eriksson (1993) (partly based on Håkansson 1989) presented four key issues in “getting innovations out of supplier networks”, relating to combining and integrating

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145 It is not entirely clear whether these four activities relate to customer relationships only or whether there are also relevant for managing relationships with other parties such as suppliers and universities.
different supplier relationships: Prioritising, Synchronising, Timing, and Mobilising. Wynstra (1998) later examined the same set of issues, translated them into ‘purchasing activities’, and added another key process: Informing. The problem of timing has been the subject of Bonaccorsi and Lipparini’s work on strategic partnerships in new product development (1994). Their work indicated that different activities may be performed differently at different stages of the innovation project. However, the assumptions that ‘the earlier the better’ is questionable; ‘timely’ involvement may be more appropriate (Wynstra 1998).

Takeuchi and Nonaka (1986) and Imai et al (1985) elaborated on the challenge of learning but also indicated that some (mainly Japanese) companies co-ordinate and manage a large group of both first and second tier supplier during the development process; they argue that suppliers need to be run like a rugby team, maintaining cohesiveness and balance (like the internal development team). Their findings also highlighted the importance of information sharing (similar to Wynstra’s findings 1998), but seemed to place greater emphasis on the role of lateral/horizontal information and knowledge exchange. The findings from the IMVP (Womack et al 1990), concerned many of the same issues as the earlier studies by Takeuchi and Nonaka (1986) and Imai et al (1985). Their findings emphasised the role and importance of assignment of teams of (suppliers’) resident design engineers to car development teams. Their work also showed the significance of establishing a basic contract to ensure the long-term commitment of the parties and to establish ground rules for determining prices and quality assurance, order and delivery, proprietary rights and materials supply; making the parties work together to mutual benefit, and enabling sensitive information and knowledge to be exchanged. Thus three key activities emerged from the IMVP and the studies by Takeuchi and Nonaka (1986) and Imai et al (1985). Firstly the importance of mutual and extensive sharing of information; secondly sharing of knowledge related to both commercial and technical details; thirdly the assignment of guest engineers to development teams; what could be broadly described as exchange of (technical) human resources.

More recently Oliver et al (1999) examined a set of key processes of managing ‘multi-party alliances’, including buyer-supplier relationships and horizontal relationships e.g. across industries, aiming to develop new products or technologies. These processes included network creation (i.e. partner selection/assembly and the original raison d’être of the network), decision making, conflict resolution, information processing, knowledge capture, integration (alignment of objectives and co-ordination of activities), risk and benefit sharing, and motivation. Their findings suggested that a variety of contingencies shape how activities are discharged, but their findings seemed to complement the earlier findings discussed in this section.

As an overall observation on the issue of upstream collaboration for innovation, it seems that although some research findings are contradictory, a variety of managerial models has been suggested to potentially reduce costs, increase product quality and value and reduce time to market by involving supplies in product and technology development.

Key Activities of Managing Collaborative Technological Innovation

The examination of some of the main contributions and frameworks that have been provided within the areas of (vertical) collaboration reveals a range of different activities that would seem to be critical to the management of collaborative innovation. None of the existing frameworks, however, are totally comprehensive; the various IMP-related projects capture some of the main activities and have done so from an interaction rather than a static focal
network implication on managing collaborative innovation

the examination of the literature in the previous section revealed a range of activities that companies, who seek to innovate in partnership with suppliers and customers, may be advised to apply to manage their relationships effectively. the problem with the majority of the existing frameworks, however, is that, at the specific level, they seem to fail to fully understand the implications of networks on the performance of specific collaboration activities. the imp group has devoted a great deal of effort to the study of buyer-supplier relationships (e.g. håkansson ed. 1982) and the embeddedness of these in networks (e.g. håkansson and snehota 1995). core to the imp work is the actor-activity-resources model of networks (håkansson 1987) which conceptualised the ‘connectedness’ of individual actors and their activities and resources in relation to other actors, activities and resources. this connectedness implies that what happens in one relationship affects - positively or negatively - what happens in other relationships within the network (blankenburg and johanson 1990). thus, any actor and any dyadic relationship within a network is affected by the actions of other actors and thus has to cope with these (håkansson and snehota 1995). thus the process of innovation is both constrained and enabled by the network in which it is embedded (håkansson 1987).

network as constraint

any innovation has to merge into a large network before it can be marketed. not only complementary assets and technologies need to be available within the network for an innovation to be developed and eventually produced (or at least they need to co-emerge) (håkansson 1987; teece 1986, teece et al 1997), but a distribution network needs to exist or evolve so that the technology can be supplied to customers in a meaningful manner and generate a competitive advantage for the company. such dependencies may obstruct the process of innovation and even prevent some apparently technologically superior (systemic) innovations from becoming successful e.g. apple computers and beta videos (rosenbloom and cusumano 1987; chesbrough and teece 1996; tidd et al 1997; lundgren 1995). four common types of dependency, which may each have a negative bearing on innovation if they do not pre-exist or if they are not developed along with the innovation, has been identified: technical dependencies, knowledge dependencies, social dependencies, and logistic or administrative dependencies (håkansson 1987).

developing innovations in networks also implies that the process becomes ‘sticky’ as relationships are built up over a period of time and thus become difficult and costly to dissolve i.e. what economists call ‘path dependency’. the significance of this is that as
companies invest in relationships over long periods of time it becomes both difficult and costly to determinate existing relationships in favour of new ones. Relationships become ‘resource heavy’ (Håkansson and Ford 2000).

Finally, inter-connectedness in networks means that sensitive knowledge may be lost to third parties, including competitors, for instance, through common suppliers. Firms are faced with the dilemma that one the one hand they wish to learn from their partners, however, on the other hand they want to retain their own core proprietary assets and thus prevent leakage of critical know-how (Kale et al 2000). This may constrain the process of collaboration by limiting, for example, the extent of information and knowledge transferred and shared within partnerships, thereby hindering the interaction of different bodies of knowledge which generate innovation in the first place. This may be particularly important as companies increasingly compete on knowledge and competencies as they risk losing their competitive advantage. Bower and Keogh (1997) showed how technology leader firms limited their contributions when they were obliged to enter into close partnerships where there was a potential for knowledge flows to exceed what they deemed desirable, thereby creating barriers to innovation within those alliances. They observed that many of these dangers were not recognised by the firms involved and concluded that firms sharing leading-edge technology may act in ways detrimental to the industrial network as a whole if they perceived there to be any conflicts of interest.

**Network as enabler**

On the positive side dyadic relationships may provide ‘conduit’ or access to other relationships (Easton 1992). As the abilities of any collaboration ‘partner’ to effectively contribute to the development of a new innovation, depends on their other network relationships it may be useful to understand this broader picture. An understanding of this could not only lead to avoidance of conflicts, but also potential synergies.

Bower (1993) showed how a small group of bio-tech and pharmaceutical companies derived benefits from the pool of resources accessible through the wide network, particularly critical resources (including contacts) possessed by the small parties. These cases showed the importance of networking as a way of gaining access to technologies possessed by both immediate and immediate relationships. This ‘networking’ was of a fairly emergent and coincidental nature rather than following any organised pattern.

The research carried out by Takeuchi and Nonaka (1986), Imai et al (1985) Womack et al (1990), Lamming (1993), and Nishiguchi (1994), indicated that certain companies appeared to be able to explore and exploit the capabilities of not only individual suppliers but also a large part of the supply network as a whole. The practices described by these authors appeared to be much more organised and intentional than simply ‘networking’. The studies by Takeuchi and Nonaka (1986) and Imai et al (1985), discussed in the previous section showed how a whole group of suppliers apparently worked for, and were committed to, one lead manufacturer. Their study revealed how suppliers were ‘rationally’ divided into so-called ‘primary’ and ‘secondary’ subcontractors, equivalent to what has also been termed 1st and 2nd tier suppliers (see for example Nishiguchi 1994). According to their study it was this detailed division of labour and tasks, which allowed the process of innovation to speed up; subcontractors were able to respond very quickly to special requests and adapt to changes in the environment. The IMVP study (Womack et al 1990) elaborated on the division and coordination of work in automotive supply chains. Womack et al described how lean Japanese car assemblers assigned the design and development of whole modules to a group of 1st tier
suppliers who in turn usually utilised a team of 2nd tier suppliers, conducting the detailed development and engineering. However, within lean Japanese car assemblers not only groups of suppliers at different tiers were involved in the process; car dealers played an important role. They formed an integral part of the whole production system and even the development team, providing frequent customer information. As a consequence they had very good knowledge about the products they sold which in turn meant that they were in a strong position to feed into the development process. Also Lamming (1993) showed how lean car assemblers apparently benefited from delegating and co-ordinating responsibilities in their supply networks.

Some of the contributions discussed in this section suggest that certain companies manage a large portfolio of not only direct supplier relationships, but also - through different co-ordination strategies - indirect relationships; this appears to have a positive effect on their innovation processes. The question is whether these companies operate in a very specific set of circumstances which allows them to exercise a high degree of control of their supplier network, and hence manage part of it very effectively. Also, given the circumstances exist to enable this type of strategy, is it always appropriate for firms to try to exert control over its network through different co-ordination strategies?

**An Exploratory Study**

The purpose of the study was to explore how companies, who seek to innovate in close collaboration (or ‘partnerships’) with external parties, manage their network of business relationships and how the management of these may be constrained and/or enabled by the collaboration operating in a complex network. It also aimed to explore how this differed in different circumstances.

A conceptual model provided a theoretical frame for the enquiry. This model had three foundations. Firstly, the so-called IDEF0 model of transformation processes used in operations management (ICAM 1981; Godwin *et al* 1989), which distinguishes inputs, processes, and outputs, as well as constraints and enablers of the processes. Secondly, the set of key activities of managing collaborative innovation. Thirdly, the IMP model of networks which identifies the three network building blocks: actors, activities, and resources (Håkansson 1987). Combining these three models, the framework provided a way to capture the positive and negative effects of networks on the process of managing collaborative innovation through the performance of critical collaboration activities. The framework is illustrated in Figure 1:
As shown in Figure 1, three types of technology provide the input in the model: product, process and marketing technologies. The set activities is at the centre of the model and provides the means by which these technologies are converted into successful innovations. ‘Network as enabler’ and ‘network as constraint’ refer to the dialectic role of the network i.e. that the network simultaneously may enable and constrain innovation projects. This duality also implies that two strategies - or at least behaviours - of managing collaborative innovation in networks can be distinguished: an ‘intentional’ pro-active behaviour in which companies deliberately capitalise on their network to gain access to complementary technologies, and a ‘coping’ re-active behaviour in which the actions of companies are shaped and even restricted by the actions of other actors in the network.

Methodology
Each interview focused on a specific product or technology development project and the role of each collaboration activity during or related to that particular project. Current or recent projects of particular importance to the companies were chosen to reduce the risk of biased responses (such as post-project rationalisation). Although all activities were effectively conducted within dyadic relationships the network perspective implied that the particular focus was on the inter-connectedness of each activity. The significance of this ‘inter-connectedness’ was operationalised by the notion of ‘3rd party relationships’. The activity of ‘co-ordinating’ specifically sought to capture the extent to which efforts were made to coordinate activities beyond one-to-one dyadic relationships i.e. to bring a wider group of actors together for the development project and utilise all their individual technologies and capabilities.
Given the exploratory nature of the study it was decided to focus on two industries: automotive and bio-tech/pharmaceutical. These industries were chosen because of their relative importance to British industry and because existing research from which the collaboration activities had been identified often include these two industries, but have not fully considered the problems and opportunities offered by the surrounding network. ‘Best practice’ of managing collaborative ventures could therefore be expected in these two industries. An attempt, however, was made to include both large influential firms, who might be expected to behave ‘intentionally’ and possible seek to exert control over the network, and relatively smaller firms whose behaviour in contrast might be expected to be one of ‘coping’.

The interviews were semi-structured i.e. with a list of specific questions around which a discussion took place. Mapping (i.e. drawing) of the network was used as a technique to assist and focus discussions.\textsuperscript{146} The position of the respondents included a Chief Design Engineer, a Purchasing Director, a Business Development Manager, a Supplier Development Manager and a Logistics Manager (one interviewee per interview). Two consequences of the nature of the respondents are worth-while emphasising. Firstly, the wide spread of people being interviewed helped to obtain a useful understanding of the type of business functions that are likely to be concerned with the problem of relationships being embedded within a complex network. Secondly, the negative consequence of the wide spread of the background and perspectives of respondents, is an unavoidable loss of consistency. However, to minimise this, efforts were made to ensure that all interviewees had had particular involvement in the chosen new product development project.

Each interview lasted app. two hours and was structured around the following headlines:

1) Company background
2) Identifying appropriate technology
3) Mapping/drawing network pool of technologies and identifying collaboration partners (upstream, downstream, and others)
4) Management of collaboration activities within the network (as drawn)

The interviews were all carried out as confidential. This was necessary given the sensitivity of the subject, especially as some of the projects in focus were still in development. All (but one) interviews have been taped and transcribed, or at least thoroughly summarised, and returned to respondents for comments and corrections. In this connection efforts were made to establish the possibility of referring to company names, which was successful in a few cases. The five companies involved in the study and the new product development projects in focus, therefore, were:\textsuperscript{147}

1) TVR Engineering (British sports car manufacturer): Development of sports car engine
2) CarPartComp: Development of new exhaust system
3) ‘Vehicle Manufacturer’: Development of new car
4) ‘Bio-Pharm’: Development of new drug
5) ‘Pharma’: Development of new drug

\textsuperscript{146} The mapping identified actors as nodes (most often companies but also individuals) and the their technologies and components.

\textsuperscript{147} All names, except TVR Engineering that was subsequently happy for the information to be disclosed to third parties, has been disguised for confidentiality reasons.
Findings
Table 1 provides an overview of the nature of each collaboration activity across all five companies interviewed and the relevance or significance of collaboration operating being embedded in a complex network:
<table>
<thead>
<tr>
<th>Companies Activities</th>
<th>TVR (Small Car Manufacturer): Engineering Perspective</th>
<th>CarPartComp (Large Auto Supplier): Supplier Dev. Perspective</th>
<th>VM (Large Car Assembler): Logistics Perspective</th>
<th>Bio-Pharm (Small R&amp;D Comp.): Bus. Dev. Perspective</th>
<th>Pharma: (Large Pharmaceutical): Purchasing Perspective</th>
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<tr>
<td><strong>Identifying/Selecting</strong></td>
<td>Emergent and informal process: companies ‘accidentally’ come together</td>
<td>Historical suppliers involved in project - set of selection criteria e.g. cost, technology, quality, service: different factors qualify different suppliers</td>
<td>Structured supplier nomination process: long term partners (suppliers) become preferred choice at nomination stage - but FC also wants some competition</td>
<td>A process of going out, trying to make parties interested</td>
<td>FC sourcing team identify suitable suppliers for new projects through a model of suppliers’ competencies, providing structured mechanisms and criteria: almost all strategic suppliers used to be raw material suppliers</td>
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<td></td>
<td>Main route of identifying suppliers is through suppliers and (technical) consultants suggesting suppliers. May also get better quote through other suppliers (1st tier) having long rels. with (2nd tier) suppliers</td>
<td>Process probably not hindered by 3rd party rels. Process probably enabled by suppliers believing they would get additional business</td>
<td>Supplier selection related to long term strategy and wish to maintain local supply base: 3rd party constraints not visible</td>
<td>Few constraints due to 3rd party rels., but conflicts of interest when selecting consultants (and occasionally clinicians) as they may be working for competitors</td>
<td>Process not constrained by suppliers having other rels., as long as they can allocate sufficient resource and responsiveness. FC encourage suppliers to have other rels. as this is a source of knowledge</td>
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<td>Process often hindered by 3rd party rels., when suspecting that FC components/technologies would be offered to competitors</td>
<td>Process enabled by supplier’s other rels., as client list is reference of experience and capability</td>
<td>Process enabled by supplier’s other rels., as client list is reference of experience and capability</td>
<td>Clinicians, universities and consultants, become involved because they have interacted with other people - by reputation or word of mouth.</td>
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<td><strong>Timing</strong></td>
<td>No formal framework, but large no. of actors involved early. Process not affected by 3rd party rels.: in or out. Some suppliers involved later as FC learn about them through other suppliers.</td>
<td>Suppliers became involved during detail engineering 3rd party rels. would not have influenced timing</td>
<td>Different suppliers get involved at different stages: no hard rules</td>
<td>Corporate partner/customer gets involved later on, when FC has developed basic technology</td>
<td>Suppliers become involved as early as possible: Phase 1 or 2 regardless of 3rd parties. Timing affected by time and regulatory constraints.</td>
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<td><strong>Mobilising</strong></td>
<td>Process enabled by FC’s reputation and when FC’s business is large part of suppliers’ total business.</td>
<td>Some partners involved in FC’s 10 to zero (improvement) programme, others became involved as</td>
<td>Majority of suppliers existing suppliers for other products: incremental business</td>
<td>Corporate partner and regulatory authorities mobilised by getting through to their highest</td>
<td>FC apply risk &amp; benefit sharing arrangements once process is fixed. FC generally ensure</td>
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<td>Assigning</td>
<td>Informing</td>
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<td>Limited and informal: FC likes to keep everything under control and close to the company. Some suppliers allowed to use FC’s testing equipment on site - even if for another company, because FC will benefit eventually.</td>
<td>Informal process: mostly phone, e-mail and meetings (some suppliers want written documents, but FC don’t like). Race car customers lease engines and provide feedback on problems and improvements (data logging). Loss of sensitive knowledge and info. a big concern when technology can be copied by competitors: mostly</td>
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<td>Would have been a person or team of [supplier] people allocated to project. Doubt the process would be constrained by 3rd party rels.</td>
<td>Clear communication through 10 to zero process i.e. Gantt charts, time scales, milestones, and KPIs. Info. and knowledge constrained by suppliers’ agreements with other customers - parties would keep knowledge separate and respect confidentiality. Contracts widely used.</td>
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<td>Resident engineers brought in. No perception of difficulties due to 3rd party rels., but security videos and security discussions at conferences.</td>
<td>One-to-one communication between key supplier and FC people + supplier conferences, logistics focused workshops and other programmes. FC guidelines on security e.g. re. leaving parts exposed or info. on notice boards. (videos and security conferences). Suppliers informed on ‘need to know basis’.</td>
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<td>Limited, some on development side: e.g. academics may come in for short time or vice versa (contract basis). Also regular meetings and discussions. Confidentiality agreements help to keep knowledge segmented.</td>
<td>Confidentiality agreements help to keep info. and knowledge segmented. Communication of forecast info. with corporate partner.</td>
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<td>Extensive during validation: team spend 1 month with suppliers ensuring manu. processes are OK. Suppliers may transfer people to FC when developing novel innovation. Not constrained by 3rd party rels.: controlled by trust and secrecy agreements.</td>
<td>Little leakage of knowledge: industry a fairly closely knit community. May be a problem when dealing with countries that have limited regard to IPR.</td>
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<td><strong>Synchronising</strong></td>
<td>Very limited Suppliers may have to synchronise amongst themselves</td>
<td>Synchronisation of EDI and e-mail systems, data transfer, technical specs, paletisation, and possibly transport: would be sorted out at this stage (before production) Would (probably) not have been constrained by 3rd party rels.</td>
<td>Milestones synchronised and suppliers required to perform to various standards e.g. EDI, ISO9000 and technical standards Different EDI standards for different automotive companies (e.g. multi-national suppliers): standards have to conform to FC</td>
<td>Agreed processes and work undertaken to agreed time tables for certain stages and milestones have to be synchronised. Contracts establishing IPR Conflicts of interest as people work for different people at the same time: different priorities</td>
<td>Systems are synchronised. Not imposed by FC, but suppliers increasingly adopt similar standards e.g. SAP or e-mail FC encourage suppliers to adopt similar principles rather than mechanisms as suppliers have many customers</td>
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<td><strong>Co-ordinating</strong></td>
<td>No formal co-ordination structure: FC get ball rolling and rely on suppliers to get together themselves (suppliers tend to know each other very well anyway) FC do not rely on modular suppliers: believe design becomes conservative. Only viewed as relevant for [proprietary] suppliers</td>
<td>FC would encourage suppliers to get together as a group across chains and tiers - unsure about FC’s specific role, but FC try to bring 1st tier suppliers together to ensure parts fit together</td>
<td>Suppliers encouraged to come together when involved in same mechanisms/systems. Modular suppliers responsible for co-ordination 1st tier suppliers left to co-ordinate across tiers (only exceptionally specified by FC)</td>
<td>FC’s role is to manage all rels.. Some ‘round tables’ with several partners. Problem of divorcing discussions: possible to discuss one thing with a person at one meeting, which cannot be used at other meetings with same person: controlled by confidentiality agreements</td>
<td>Strategic suppliers generally supply all FC sites, hence co-ordination is important to avoid overlapping: team responsibility</td>
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Observations on Collaboration Activities
Looking across the five mini-cases, it is clear that the focus of the discussions - and therefore data consistency - varies significantly. This is an unavoidable consequence of the exploratory nature of the study (i.e. lack of operationalisation) and thus a constraint on the data. However, it also provides a useful basis for identifying (cross-functional) issues of importance within each activity.

Identifying/Selecting:
The degree of formality varied significantly across the five cases from the one extreme of companies ‘coming together’ more or less accidentally, to a very structured and ‘rational’ nomination process. The history of supplier relationships seemed to be important in most cases. Only TVR expressed a concern that 3rd party relationships might constrain the process of selecting suppliers i.e. when suspecting that TVR’s technologies would be offered to competitors. 3rd party relationships, mainly in terms of a list of other clients, often influenced the selection process by providing a reference point of experience and capability. Relationships with consultants illustrated the paradoxical nature of relationships: on the one hand it caused a concern that consultants might transfer knowledge to competitors; on the other hand it was generally recognised that they possessed (and therefore offered) their knowledge as a result of having worked for (or still work for) other clients.

Timing:
The timing i.e. moment of involvement of supplies did not appear to be influenced by 3rd party relationships. In one case, ‘Bio-Pharm’, the corporate partner, which is essentially the main customer that is to license the product, became involved at a later point, as the technology had to reach a certain stage before any customer can be approached. The fact that this was a customer relationship seemed to cause the difference in this case.

Mobilising:
Due to lack of size, TVR appeared to be the only company with problems of motivating suppliers to supply them, despite the reputation of the company. In another two cases, ‘VM’ and ‘Pharma’, the incremental/historical nature of the relationships provided a major incentive for suppliers. These two large companies seemed to have few problems mobilising their suppliers, presumably due to the value of their business. Again, ‘Bio-Pharm’s situation was very different, as their involvement was mainly downstream or horizontal i.e. they were positioned further upstream than the other companies in the study. Mobilising to them was therefore a process of identifying the right individuals and convincing them of the potential of the technology being developed.

Assigning (human resources):
There was evidence of some form of assignment or sharing of human resources in all the cases, however, this seemed to be less extensive in the cases of TVR’s and ‘Bio-Pharm’ (the two small companies). The three large companies were involved in fairly extensive arrangement of short-term exchange of people with suppliers, such as resident engineers. All the companies were concerned about confidentiality risks, but seemed to manage this by high levels of trust and confidentiality agreements.
**Informing**
The risk of loss of sensitive knowledge seemed to be a concern in all cases except perhaps ‘Pharma’. The companies had different means of handling the risks, but efforts to segment knowledge and inform people on a ‘need to know basis’ seemed to be the common way these companies coped with the risk. It seemed that the companies were reasonably confident that confidentiality would be respected.

**Synchronising:**
All cases except TVR had made substantial efforts to synchronise systems (such as EDI or e-mail), milestones and timetables, and also technical or quality standards such as ISO9000. TVR recognised that this was probably a limitation. TVR’s lack of size and influence may explain their seemingly relaxed reliance on suppliers to synchronise amongst themselves.

**Co-ordinating:**
The companies made various efforts to try to co-ordinate their suppliers, but some largely left this to their 1st tier suppliers. As TVR explained: “These people tend to know each other better than we do”. Others however, and most evidently VM, tried to formally co-ordinate suppliers through suppliers conferences, workshops etc.

Looking across all five cases and considering all the activities, a theme that emerged in most collaboration activities was the distinctiveness of the TVR case in terms of the highly unplanned, almost chaotic, yet extensive ‘networking’. A more detailed examination of this case is therefore appropriate.

**TVR: The case of an innovative sports car manufacturer**
TVR is a small car manufacturer currently employing between 500 and 600 employees (and thus the largest of the remaining independent UK vehicle assemblers). Around 1994 TVR decided to set out on a seemingly impossible task: to develop an engine on its own; the AJP8. This engine was successfully completed and launched in the ‘Cerbera’ in 1997.

For TVR the risk of loss of knowledge and technology to competitors via common suppliers presented a real problem. As a consequence TVR avoided dealing with large suppliers because they often work for its competitors. Also, the Chief Design Engineer, explained how 3rd party relationships sometimes constrain technical development:

*One example is some new material on crankshafts, where because we are in this unique situation that we don’t need very many we can’t afford high cost tooling. So we’re always looking for ways to make better products with lower cost tooling. So we have looked at doing a different type of castings, which really started in America on high volume stuff. They developed a newer type of cast iron with better properties. So we started working on that, but no one else in the UK was using it at the time. We started to work with a company that was doing the heat treatment process for us which is the key to the technology. They were very interested. So this was a bit of a partnership were both parties gained. They gave us a lot of help and experimented a lot with the heat treatment. They gained from the knowledge. At the end it went a little bit wrong because [a large vehicle manufacturer] became involved in wanting to*
develop this for their crankshafts and they knew this company was doing it in the UK. A conflict of interest developed because we didn’t want to divulge too much information that we had learned from the mechanical design to make the casting heat treatment properly. The heat treatment company obviously wanted to work for them and wanted to help them as much as possible. So we had gone along really well, but came to this point where another manufacturer became involved and we started to become a bit reserved as to what we told them, because we knew they were dealing with a competitor of ours. From previous dealings with [the large vehicle manufacturer] we knew they had copied things from us after having come round our factory.

Mutual trust was key to TVR’s relationships with its suppliers. Therefore if TVR felt that a supplier was betraying the trust and transferring knowledge and technologies gained from TVR to one of TVR’s competitors the relationship was brought to an end. However, if there was no conflict of interest i.e. when the 3rd party was not a competitor TVR was happy that knowledge and technology were transferred as it appreciated that this is the way suppliers (and indeed consultants) develop their skills in the first place:

[Supplier A] is a one man company specialising in low volume race car technology e.g. pistons for most F1 teams. This relationship was tied in with [Supplier B]. TVR went to [Supplier B] and said they wanted the piston, which [Supplier A] had developed, produced in higher volumes. They developed the tooling for this and we tested it further and this went into series production. They were then later acquired by [Supplier C]. A spin-off from [Supplier A] was some super-bike work he had done for [an innovative motorcycle manufacturer]. We had both been developing pistons along our own routes, but had ended up with similar designs. [Supplier A] suggested a piston design developed with [the innovative motorcycle manufacturer]. And [Supplier A] came up with the tooling design himself. So you learn from each other even though there is no direct link, but through a 3rd party.

These quotes illustrate the dialectic nature of partnerships. On the one hand TVR had serious concerns about dealings with companies who supplied competitors and may be expected to transfer knowledge and technologies to these companies. On the other hand TVR appreciated that these companies had their expertise because they supplied other companies; TVR also ‘networked’ with its suppliers to identify new contacts.

TVR’s technological development was by no means a case of strategic or controlled ‘network management’. The management took place within dyadic relationships and resources and technologies in the wider network were accessed through extensive networking. It seemed to be more of a ‘coping’ approach than a case of ‘strategic’ network management and judging from the recent success of the company and the AJP8 engine it appeared to be successful.

There was certainly no evidence of any ‘network management’ or even sub-network management. The management that did take place took place at the relationship level, although activities extended beyond the single relationship. However, it was clearly more of a ‘coping’ approach rather than ‘strategic’ or ‘rational’ management. Two questions thus emerge from this case:
• Why were TVR so apparently reluctant to engage in any formal relationship (not to mention network) management - does this approach suit innovative companies like TVR?
• As TVR seemed to be more concerned about losing sensitive knowledge and technology to 3rd parties, what are the situations in which companies are - or should be? Is it the nature of their technologies, products, the size of the company?

Methodological and Theoretical Lessons from Pilot Study
Several lessons can be drawn from this pilot study of which the most important will be briefly discussed in this section.

As a reflection on the discussions of the collaboration activities across the five interviews, it should be clear that all cases focused primarily on supplier relationships, leaving few discussions of customer relationships. The nature of the chosen companies i.e. mostly ‘assemblers’ in one form or another (except from CarPartComp and Bio-Pharm) and also the type of respondent, implied that the discussions focused upstream. This is a natural consequence as the majority of the actual technological development takes place between ‘suppliers’ of different types. Therefore, although the activities were effectively designed as generically relevant for all types of external relationship i.e. both upstream, downstream and horizontal relationships, they were in fact mostly relevant to relationships with suppliers. Activities with customers central to innovation, such as testing or forecasting of market potential, emerged during interviews and were considered subsequently as part of other activities (primarily informing). It also became clear that the nature of some of the activities, most notably informing, identifying/selecting, and ‘assigning’, was largely one-directional i.e. the perspective was too much on the actions of the focal firm rather than on the interactions. Furthermore, it seemed important to distinguish pure information from knowledge exchange. Therefore, these lessons have led to a reformulation of the activities as:— prioritising, timing, mobilising, communicating, exchanging knowledge, exchanging human resources, synchronising, and co-ordinating. This revised set of activities provides a useful basis for further examination.

The ambiguity of some of the concepts used during data collection, such as ‘core technologies’, ‘product technologies’, and ‘marketing technologies’, caused some problems during data collection, as the meaning, including practical examples of these concepts. Reflecting on the cases, this was probably at least partially a result of the choice of cases i.e. all manufacturers positioned relatively centrally in their supply chains. This meant that all the cases, except from ‘Bio-Pharm’, effectively focused on ‘products’ rather than technologies. It seems likely that cases of product and process technologies rather than products are more likely to be identified further upstream.

The survey also indicated the importance of consistency of the nature of relationships in focus as this has serious effects on the performance of activities and the importance of network effects. For future research it is planned to build on existing relationship portfolio models (e.g. Kraljik 1983; Cousins 1999; Chesbrough and Teece 1996) to ensure that the relationships to be examined exhibit similar characteristics. The survey

148 Ways of operationalising the activities have also emerged from the interviews.
also indicated that other contextual factors, such as stage of development and company size, need to be included in the conceptual framework as external factors that may affect the process of collaborative innovation.

A practical methodological outcome of the study concerns the nature of the respondent. Whereas it was useful to interview people from a variety of organisational functions to gain an initial understanding of the differences in their perspectives and responsibilities related to a specific new product development project, an unavoidable side effect was that some respondents were not ideally positioned to discuss the project in focus and/or did not appreciate the concerns and/or opportunities of operating in complex business networks. It is likely that the risks of bias were significant as a result of this diversity. From this experience it may be possible to conclude that the commercial function of Purchasing (and presumably Marketing although not included in the pilot study), and also Engineering/Technical are more likely to appreciate and understand the subject matter than e.g. Logistics or Supplier Development, although it is doubtless that some of these functions (and depending on the type of technology focus i.e. product, process, or marketing) are essential to include in an in-depth case study to understand the wider picture of overall technological innovation in a company.

The following research questions emerge from the exploratory interviews:

1) **On the network as enabler: capitalising on networks through the performance of key collaboration activities:**
   - *Which activities can companies apply to exploit individual dyadic relationships and gain access to resources and technologies available in the wider network?*
   - *Do the nature and performance of activities differ according to whether they are performed upstream, downstream or horizontally?*
   - *How can companies co-ordinate activities within the wider network?*
   - *What are the situations in which companies are most likely to be able to gain access to and co-ordinate resources and technologies in the wider network?*
   - *Are ‘controlled’ networks likely to result in a particular degree of innovation?*

2. **On the network as constraint: coping within networks when performing key collaboration activities:**
   - *In what ways does network collaboration result in loss of control of technology and knowledge to other parties in the network?*
   - *How is the performance of key collaboration activities constrained by the potential loss of control of technology and knowledge?*
   - *What are the situations in which the performance of the activities is most likely to be constrained?*
   - *Which mechanisms can companies apply to cope with these network constraints?*

**Conclusions and Future Avenues of Research**

This paper examined the existing literature related to collaborative innovation and highlighted a number of reasons why companies should partner with customers and
suppliers for innovation. The main reasons can be summarised as the development of more marketable products through customer collaboration, and reduction of development cost and time and improved quality and value through supplier collaboration. The literature also revealed a variety of activities which companies are advised to apply when managing supplier-customer collaborations. As all of the existing activity frameworks are more or less partial we combined the most significant ones and derived a more comprehensive set of collaboration activities. These were: identifying/selecting, mobilising, timing, assigning (human resources), informing, synchronising, and co-ordinating.

The problem with any framework for managing collaborative innovation is that dyadic collaborations need to been seen and understood in the context of the complex network in which they are embedded. There are two consequences of a network view of collaborative innovation. One is the problem side of networks which is that activities performed by individual actors in a network may be constrained by the network. We highlighted different types of dependency on other actors and the risk of loosing sensitive information and knowledge to third parties. The other is the positive side of operating in networks which is that the network may serve as an enabler of the process of innovation by providing conduit to other relationships in the network. Indeed it has been suggested that companies may be able to co-ordinate and delegate activities within a pool of relationships rather than individual relationships thereby fully exploiting a large part of the network. This aspect of networks has traditionally been neglected by the IMP group and the authors argue that there is a need to address this positive effect of networks.

A conceptual framework was presented, which had the set of key activities of managing collaborative innovation (identified in the literature review), at the centre. These activities were conceptualised as ways of transforming the technologies, possessed by actors in the network, into innovation. Furthermore, the framework provided an illustration of the positive and negative effects of the network on the performance of collaboration activities. This framework provided the basis for an empirical exploration of how each collaboration activity may be enabled and/or constrained by the network. Five interviews illustrated how the characteristics of the activities differed across different settings; the duality of networks was illustrated particularly in the case of TVR, the British car manufacturer, who seemed to make the most of their network on a fairly informal and ‘emergent’ basis. Some of the other cases illustrated a much more ‘managed’ way of performing each of the activities, albeit not necessarily leading to a more innovative result.

Various theoretical and methodological lessons emerged from the study. Perhaps most importantly, lessons from the survey resulted in a set of revised activities: These were:- prioritising, timing, mobilising, communicating, exchanging knowledge, exchanging human resources, synchronising, and co-ordinating. Finally, a set of research questions that emerged from the exploratory survey was outlined at the end of the paper.

The next step of the research is to examine the research questions outlined at the end of the paper through a small number of in-depth case studies to gain a thorough understanding of how each of the collaboration activities identified in this paper is
affected by the surrounding network, and how these effects may differ in different circumstances.

References:


