Summary
The paper reports the preliminary findings of four current case studies on supplier involvement in product development from the respective perspectives of Engineering, Purchasing and Suppliers. The supplier involvement is studied from the viewpoint of how supplier information and knowledge are deployed in the fuzzy front end of product development. The objective of the case studies is twofold. First: to learn more about the conditions under which the search, acquisition and utilization of supplier information and knowledge take place. Second: to explore whether these conditions are affected by tie strength of the information relationships among Engineering, Purchasing, and Suppliers.

Keywords
Product development, supplier knowledge, social ties.
Supplier Involvement in Product Development: a Multidisciplinary Perspective.

Introduction
The research into the supplier involvement in product development (PD) spans approximately three decades (Johnsen, 2009). The frequently cited benefits of supplier integration in PD are improved product quality, reduced costs, speed to market, and access to new manufacturing knowledge (Dowlatshahi, 1997; Wynstra, Van Weele and Axellsson, 1999, Monczka, Handfield, and Scannell, 2000, Wynstra and ten Pierick, 2000, Ragatz, Handfield, and Petersen, 2002; Van der Valk and Wynstra, 2005; Parker, Zsidisin, and Ragatz, 2008; Echtelt, Wynstra, Van Weele, and Duysters, 2008, Song and Thieme. 2009; Wynstra, Von Corswant, and Wetzels, 2010). Parallel to this research, and often intertwined with it, is the research into the role of purchasing as a go-between for suppliers and product development engineers (Burt and Soukup, 1985, Dowlatshahi, 1992; Primo and Admundson, 2002; Di Benedetto, Calantone, Van Allen and Montoya-Weiss, 2003; Wynstra, Weggeman, Van Weele, 2003; Schiele, 2006, 2010). Most research focuses on the outcome and impact of the supplier involvement in PD. Our research has a much narrower focus. We examine the supplier involvement in PD from the viewpoint of supplier information and knowledge deployed in the fuzzy front end of PD. The focus of our research is not the outcome of the supplier involvement but the conditions under which the search, acquisition, and utilization of supplier information and knowledge take place. We study the conditions of knowledge transfer by exploring the information relationships among Purchasing, Engineering, and Suppliers.

The paper is structured as follows: it opens with the conceptual background and research questions. Next, the case study methodology is described, and the three emerging patterns are briefly outlined. The preliminary findings provide tentative suggestions as to the direction of answers to the research questions. The paper concludes with managerial implications, research limitations, and the steps to be undertaken to bring the research to completion.

Conceptual background and research questions
The information relationships are studied in the context of the strength of ties that exist between the firm’s suppliers and the firm’s engineering and purchasing. The ties are seen as mechanisms through which the information relationships are developed and sustained. Central to the studies of ties is the concept of embeddedness (Uzzi, 1996, 1997) which holds that all economic action is embedded in social relations, and that the structure and quality of social ties affects the interaction of information exchanges. The literature on the relational embeddedness of social networks recognizes three types of ties: strong ties, weak ties, and trusted weak ties (Granovetter, 1973, 1983, Hansen, 1999, Levin and Cross, 2004).

Strong ties are defined as interpersonal relationships within a small group of actors (e.g., the engineers in PD teams). Strong ties prefer to engage in the transfer of internal information, i.e. information that is firm-specific (often involving tacit knowledge). Trust among the exchanging parties is taken for granted, and the information relationship is reciprocal. Thus, the relational embeddedness (i.e. the interpersonal relations) is high and the environment of strong ties is conducive to learning. In the long run, however, this learning can be hampered by knowledge redundancy (i.e., overlapping knowledge among the engineers), and the reluctance of strong ties to trust information that comes from outside the firm (The Not Invented Here syndrome).

Weak ties are defined as infrequent interpersonal relationships that lead to novel and diverse (i.e., non-redundant) information. Weak ties have low relational embeddedness, and thus contribute little to learning. Weak ties are less costly to maintain because there are no reciprocal links
between the information provider and information recipient. The information behavior of weak ties is marked by incidental information searches that take place in the environment of uncertainty and risk.

The trusted weak tie is a phenomenon developed by Levin and Cross (2004), and can best be described as a hybrid of weak and strong ties. Trusted weak ties operate in the environment of the benevolence-and-competence based trust, i.e., in the environment in which the external information source is perceived as trustworthy, benevolent and competent. As a result of this additional relational characteristic between the information source and the information recipient, the ensuing information relationship of a trusted weak tie combines the benefits of bringing in new external information while also enabling learning. In other words, a trusted weak tie relationship can, under certain conditions, acquire the properties that have previously only been associated with the information exchange in a strong tie relationship.

The research on trusted weak ties is still relatively recent (Abrams, Cross, Lesser and Levin, 2003, Levin, Whitener and Cross, 2006, Gubbins and MacCurtain, 2008; Levin, Kurtzberg and Philips, 2010). In our research we surmise that the information relationship between the firm’s suppliers and the firm’s purchasing and engineers could contain elements of a trusted weak tie relationship. To explore this possibility, the case studies address the following research questions:

- **RQ 1**: What part does the information relationship play in the firm’s overall relationship with suppliers?
- **RQ 2**: What is the perception of supplier information and knowledge among Engineering, Purchasing and Suppliers?
- **RQ 3**: How does supplier knowledge manifest itself in the fuzzy front of product development?

**Case study methodology**

The research design is an explanatory embedded multiple case study. The embedded research design allows exploring the information relationships at different level of analysis (individual, inter-groups, and inter-firms). The unit of analysis is the information relationship between the suppliers and the firm’s engineering and purchasing. There were four focal firms selected. They come from four different manufacturing industries:

- aerospace
- automotive
- industrial automation, and
- aeronautical equipment.

The firms are first tier and second tier suppliers. The product development projects at the four firms were selected in cooperation with the firms’ representatives. Among the respondents were Management, Purchasing and Engineering. Later the snowballing sampling technique was applied in order to recruit more informants. In selecting the projects a particular attention was given to the richness of interaction within the projects (among the projects participants including suppliers and customers), so that each project represents multiple relationships involving purchasing, engineering, suppliers, R&D, and customers.

The data collection followed a two step procedure: a questionnaire and a semi-structured audio taped interview. The project documentation, corporate websites, and occasional participation at the firm’s meetings complete the triangulation of data. At the time of writing this paper, the data collection phase has been completed. In all, thirty-two interviews were conducted, varying in length from of 60 - 90 minutes. The transcripts have been sent to the informants for validation.
The average transcript length is 14 pages. The data analysis is currently underway using the computer software Atlas-ti 6.2. As analytic techniques are used: pattern matching, memoing, within-case analysis, cross-case synthesis (Yin, 2003; Creswell, 2007), and descriptive partially ordered meta-matrices for the presentation of data (Miles and Huberman, 1994). Given the fact that the data analysis has not yet been completed, the issues raised in this paper are contingent on further research and analysis.

**Emerging patterns**
During the transcribing of the thirty-two interviews, the following three emerging patterns have been identified:

*Dyad versus triad*
The information relationships under study involve three parties (engineering, purchasing, and suppliers), and could therefore be said to represent a triad. Instead, our case study has consistently found a set of three sets of dyadic relationships. There is the purchasing/engineering dyad, the purchasing/supplier dyad, and the engineering/supplier dyad. In the firms of our case study the three parties almost never found themselves sitting at the same table. When questioned on this point, the reply invariably was that although tripartite meetings did occasionally happen, they were rare. Concern was mooted about including suppliers in PD meetings.

*Supplier development*
In the literature (Krause and Ellram, 1997, Krause, Handfield and Tyler, 2007, Modi and Mabert, 2007) the concept of supplier development (i.e., the firm assists its suppliers to reach and maintain the desired level of performance) is advocated as a means to transfer knowledge between the firm and its suppliers. In our case study only one firm had a supplier development engineer on its staff. Interestingly, in this particular firm, the origin of the job of supplier development engineer dates back to the times when the firm was a subsidiary of an American company. In the other three firms, supplier development remains limited to checking and demanding that the suppliers meet the industry quality certification standards. The participation of product development engineers in supplier audits (in addition to Purchasing and Quality Engineers) is on the increase.

*Single sourcing*
Although all firms in our study professed to adhere to the policy of multiple sourcing (i.e. buying a particular product component from multiple suppliers), single sourcing was surprisingly commonplace. Our data would suggest that this is a very contentious issue. It is in this area that we expect to find evidence of trusted weak ties.

**Preliminary findings**
Before addressing the three research questions, we need to clarify our understanding of the terms ‘information’ and ‘knowledge’ (Davenport and Prusak, 2000). We understand information to be factual, codifiable, and easily transferable. Information is easy to capture because it resides in printed and digital documents. In the context of our case study, supplier information pertains to prices, logistics data (e.g. delivery times), and required performance (e.g. quality certification standards). The term knowledge, on the other hand, refers to the experience and skills, the know-how of human beings. It originates and is applied in the mind of knowers. In the context of our research supplier knowledge pertains to manufacturing processes and material technology.
**Research Question 1**

*What part does the information relationship play in the firm’s overall relationship with suppliers?*

Based on our preliminary findings we visualize (Figure 1) the firm’s information relationship with its supplier as a block of two inverted parts: supplier information and supplier knowledge. The supplier information is the domain of the firm’s Project Management and is applied in decisions concerning project financing and supplier selection. By contrast, supplier knowledge is the domain of the firm’s Engineering, and is used to resolve the issues of manufacturability, or to explore the feasibility of new technology applications. It is at this level that effective transfer of knowledge takes place. The inverted relation between supplier information and supplier knowledge reflects our finding that, by and large, Project Managers perceive the contribution of supplier knowledge to the manufacturability of products as a third order issue. Whereas the Engineers view the knowledge exchange with the suppliers as essential to their work. The awareness that costs savings could be achieved through effective use of supplier knowledge has been sighted only once or twice during the case study. The division between the domains of supplier information and supplier knowledge is not static and can be influenced or facilitated by Purchasing. Our findings suggest that a Purchaser with technical education background has better relationship with engineering and suppliers than a purchaser with business education background. In the former case, the room for supplier knowledge in Figure 1 would increase.

![PROJECT MANAGEMENT (focus: risk and costs)](image)

![ENGINEERING (focus: technology)](image)

**Figure 1: Information relationship block.**

**Research Question 2**

*What is the perception of supplier information and knowledge among Engineering, Purchasing and Suppliers?*

We make a first attempt to answer this question by presenting in Table 1 the single case comparison of how Engineering, Purchasing and Suppliers view the concept of ‘preferred suppliers’. The partially ordered matrix in Table 1 shows that even within a single firm, the views on what constitutes a preferred supplier vary widely. The supplier wants to compete on knowledge, skills, and creativity, not on costs. When contacting a firm for the first time, the
Table 1: Partially ordered matrix on Preferred Suppliers

<table>
<thead>
<tr>
<th>Informants within one firm</th>
<th>Preferred suppliers viewpoints</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Definition</strong></td>
</tr>
<tr>
<td>Project Manager (Engineer)</td>
<td>We don’t have ‘preferred suppliers’. It’s not a terminology we use very often. Rather, we have a list of technologies and a list of firms with which we do business.</td>
</tr>
<tr>
<td>Engineers (product development)</td>
<td>The Engineers’ view on preferred suppliers differs from that of Purchasing. Personally, I prefer a supplier whose PPM (parts per million) defect rate is not so good, but who can provide me with useful information, and contribute ideas. Of course, if his defect rate is really bad, then his information is also no good. But there is a grey area in-between. I don’t need a supplier with a perfect PPM rate but who cannot give me the information I need.</td>
</tr>
</tbody>
</table>
| Purchasing | Per each product group there is one preferred supplier. In total, we have 70 suppliers of which 10 are preferred. The ten preferred suppliers represent our major technologies. They also deliver the greatest part of our components. We often ask them to take part in product development. Most of our suppliers are abroad. We have a long relationship with | When we need a new technology, then it is better that the Engineers and R&D do the initial search for potential suppliers themselves. As a Purchaser I would not know where to start. For the initial stages of development a supplier nearby may suffice, but later you need to scan the market, | We develop new products, but often the components that we need are derivatives of the components that we buy already. The price level of those products is our starting point. When we do benchmarks, we rarely find sharper prices than those of our long standing suppliers. The length of the relation-


our preferred suppliers. As Purchasing we visit them at least once a year. We know their technical capabilities.

know who the market leaders are, and that’s my job. Dropping a supplier is difficult because of the product release procedures. We need a permission of our customer, and also our customer’s customers.

ship is just as important as the purchased volume.

**Supplier**

My business model is that I don’t want to be a supplier who can only compete on price, because then I will always lose. So I am avoiding that, and am trying to get back in. I want to bring in an added value, and make the added value so high that I can get a better price, and survive. So this is how we fight. We try to show that we present solutions, and that we are very highly skilled, in a specific market. We don’t say we can do anything. We try to reach the design team. We try to avoid the management and the purchase channel. I am not selling any product. We earn our money by products, but in fact we are selling knowledge. So I cannot advertise for the product.

We like to go back to the basics. Mostly, we are not involved in the early stages of development. Most of the time, the development has moved on. That means that choices have already been made, and the development has already taken a certain direction. So we try to go back a little bit. And we ask: ‘What was your intention? What did you mean by that choice?’ And most of the time (and that’s why we do it), we discover that they made the choices because they lacked the knowledge. They didn’t know any other way. So they made choices in a certain direction, and we tell them that there are other possibilities, that things can be done differently.

We are looking for an efficient way to transfer the knowledge. In general, we prefer to go to the customer, because the problem is there, and the knowledge about the problem is there. If the customers come here, they can only see our factory, and see samples of our work. So I always try to make an appointment at the customer’s site, because if we make an appointment here, then the customer starts to be efficient, and sends just one or two guys to us, and that’s mostly not enough. That way you cannot get enough people to think about the idea at the same time. And then you are depending on someone who is not a specialist to bring the information back, and then, as you know, there is always some information lost, and design alternatives may get lost as well. Our experience is that it’s better to hold the meetings where the problem is. There isn’t an attitude to involve suppliers at the beginning. It just doesn’t happen. What you see is that early development is done within the customer’s factory.

technical capabilities.

supplier prefers to approach the Engineers rather than the Purchaser, who is the traditional entry point for suppliers. Within the firm, the supplier is evaluated at two levels: costs and knowledge. Our data suggest that the length of relationship between the firm and the supplier may be a decisive factor in assigning the status of preferred supplier.
Research Question 3: How does supplier knowledge manifests itself in the fuzzy front of product development?

During our interviews we came across three types of situation in which supplier knowledge helped dispel the fuzziness of product development. The situations could be categorized as:

- project-based
- technology-based, and
- troubleshooting-based.

The project-based situation concerned approved and budgetted projects in which the involvement of supplier knowledge centered round the need to resolve the ‘fuzziness’ in compliance, i.e. aligning the supplier products to design requirements. The technology-based situation usually involved testing the feasibility of a new technology application. There was no specific project, but both engineers and suppliers were interested to pursue new technological development. The ‘fuzzy’ potential of new application was explored during technical meetings which the engineers often held with multiple suppliers. During this exploratory time, with no commitments on either side, both new technologies and engineering/supplier relationships had time to mature. The troubleshooting situations in which supplier knowledge was made use of were related to product defects at the site of the customer’s customer. The suppliers considered themselves not responsible for the defects, the cause of which was often unclear (fuzzy), but for which a quick solution was required. The suppliers stepped into the breach because they valued the relationship with their customer.

Conclusion

Managerial implications

Often new technology needs to mature before it brings value. The same can be said about information relationships in the PD projects. The building of trust requires time and continuity in management. The informants in our case studies have often pointed out that each time a new management threw old agreements with suppliers overboard, the trust building process was derailed. Our data suggest that appointing technically trained people to purchasing would help smooth the communication process. For the engineers and suppliers the trust building starts with their common quest for optimal manufacturing. Unfortunately, management tends to view manufacturability as a third order problem. The first and second order problems being the PD project financing, and the selection of suppliers. The preliminary findings of our case studies indicate that the manufacturing improvements proposed by suppliers can not only lead to better products but can also reduce manufacturing costs. Management should be more aware that the path to the tangible benefits of increased productivity, reduced costs, and improved product quality leads via the intangible benefits of information relationships between suppliers and the engineers at the operational level of PD projects.

Research limitations

Of course, our research has limitations. First of all, the selection of participating firms was not random but was largely guided by convenience. The network contacts of our department played a great role. We feel that this fact did not adversely affect the initial character of our research, nor did it influence this work-in-progress paper. In the follow-up studies, however, we should enlist the cooperation of more firms.
Next steps in research
In line with this work-in-progress, the following actions will be undertaken. In the coming months we will be completing the coding of the thirty-two interview transcripts. The next step will be the within-case analysis and writing up the single case reports. This will be followed by a cross-case analysis and the interpreting of findings. During the coming period we also intend to take part in several more meetings between engineers and suppliers as observers. The research project will conclude with a workshop for the case study participants, with the presentation of the research results.

REFERENCES