In Chains?

Automotive suppliers and their product development activities

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Abstract

Our research, based on a survey of 161 Swedish automotive suppliers, investigates whether the level of product development activity by a firm is uniquely determined by its position in the supply chain, or also by its competitive strategy and customer characteristics, in terms of their orientation towards product development collaboration. The results indeed demonstrate that product development activity by suppliers is not solely determined by their position in the chain, but also by their focus on innovation as a competitive strategy.

The distribution of product development activities across the automotive supply chain

In the automotive industry, as in many other industries, suppliers have a growing impact on manufacturers' performance as a growing share of components and systems are being outsourced. In turn, many suppliers too have started to outsource parts of their manufacturing operations. As a result of the concomitant increasing complexity of logistical operations and information flows and increasing consumer demands in terms of reliability and flexibility, practitioners as well as researchers have adopted a supply chain perspective on operations management.

Together with the outsourcing of production activities, however, suppliers have adopted an increasing role in the development of components, assemblies and modules of the final product, the whole car. This has led to various discussions in the literature, about the actual and desired roles of various types of suppliers in terms of product development activities, largely following the same supply chain 'metaphor'. But are development activities indeed organized in 'chains'?; do actors closer to the final assembly firm have a more substantive role in product development than actors that are located more upstream? And do other factors, and in particular the competitive strategy of the supplier and the collaborative orientation of customers, also have an impact on the supplier's role in product development? These questions are addressed in this paper, based on a survey among 161 automotive suppliers in Sweden.

The paper aims to make two main contributions. First, it sets out to develop a more detailed understanding of what drives product development activity for different

suppliers in the automotive supply chain, since we think much of the current understanding of these factors is too 'deterministic'. In other words, we think that it is not solely a firm's position in the supply chain that automatically determines its level of product development activity. Secondly, the paper specifically looks at the European, or more specifically Swedish, automotive sector whereas most research has traditionally focused on their Japanese and North American counterparts.
The paper first takes a look at existing empirical and conceptual research on the topic of supply chain management and supplier involvement in product development. In the following section develops our research hypotheses, after which the design of the empirical study is discussed. Subsequently, the preliminary findings from our survey are presented, and the paper ends with some short conclusions and discussion.

Supply Chain Management and Supply Chains

Supply chain management is defined as the management of flows of information, products and funds between and among stages in a supply chain to maximize total profitability. A supply chain consists of all actors directly or indirectly involved in fulfilling a customer request (Chopra and Meindl 2001; Schary and Skjött-Larsen 1995; Oliver and Webber 1992; Christopher 1992; Lee and Billington 1992).

The supply chain perspective implies that not only the supplier found closest to the customer company, but that all upstream suppliers and their production and transaction activities are being included in managerial decisions regarding the control of the overall goods flow (Slack et al. 1998; Ellram 1991). For example, Mabert and Venkataramanan (1998, p. 538) define supply chain as "the network of facilities and activities that performs the functions of product development, procurement (…..), the movement of materials (…), the manufacturing of products, the distribution (…) and after-market support for sustainment.' By managing the entire supply chain, lower cost, better quality and more flexible and reliable deliveries can be achieved.
Figure 1 depicts a typical supply chain. The supplier in the chain found closest to the customer (OEM) is often called 'tier 1 supplier' and so forth.

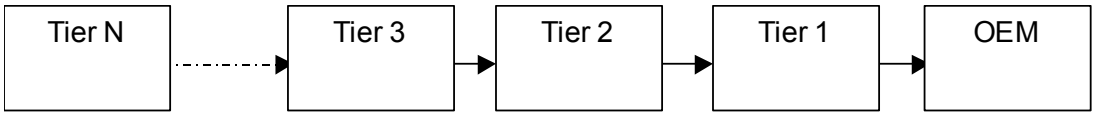

Figure 1. The supply chain model (see e.g. Slack et al. 1998).

Each supplier in the chain performs some activities. These activities can be different types of production activities, but also activities concerned with quality inspection, transportation etc. By analysing what value is created by each one of these activities, different categories of activities can be distinguished (see e.g. Womack and Jones, 1996). Some activities directly add value to a product (e.g. a machining operation or painting). Some other activities do not add value in a direct way, but are necessary for the realization of the product (e.g. transportation). Finally, some activities do not add any value at all to the product (e.g. rework) and are considered to be waste. By focusing on the value adding activities only and trying to eliminate waste, cost savings can be achieved throughout the activity chain (see Hines et al. 2000). Obviously, the activities performed along the supply chain need to be coordinated in different ways. For instance, many activities need to be performed in a certain

sequence (e.g. a welding operation that has to be done before painting), or a certain amount of products need to be produced to achieve certain economies of scale across the chain (see Dubois, 1994). Thus, supply chain management can be regarded as the co-ordination of a number of interlinked activities. By regarding the whole chain of activities, not only a part of it, the overall performance of the whole chain can be improved – rather than just some local suboptimisation in one part of the chain.

Surveying the literature on supply chain management, one could draw the tentative conclusion that whereas this stream of research started out with a focus on the management processes required for coordinating flow of information and goods across various stages of connected actors, an increasing amount of literature has tended to 'reify' supply chains; in others, they are being considered as some sort of physical entity – the basic building block for any sort of collection of firms and/ or industries that physically exchange goods and/or services with each other.
As we will demonstrate below, the supply chain has also been studied as a sort of 'structural background' for studies on the distribution of product development activities among firms. This brings us to the question whether supply chains indeed do exist, or whether they are (merely) an abstraction of a much more complex reality.

Do supply chains really exist?
Despite its remarkable popularity, many authors have more or less explicitly criticized the concepts of supply chains and supply chain management (Normann and Ramirez 1994). More specifically, various groups of authors both from operations management (Lamming et al. 2000; Brown et al. 2000) and from purchasing and supply management (Gadde and Håkansson, 2001; Axelsson and Wynstra 2002) have argued that in reality, supply chains do not exist. In fact, "It may be more accurate to use the terms supply network or supply web to describe the structure of most supply chains" (Chopra and Meindl 2001, p. 5).
The first, most important reason is that chains, or 'strings', of firms working together towards one particular final product nearly always are interwoven with other chains, leading to the existence of 'networks', in which all sorts of indirect and direct relations exist between different firms (Axelsson and Easton 1992; Håkansson 1982).
The second reason is that firms may have very different sets of actors they collaborate with for the different main business processes. In other words, firms may deploy supply chains or networks, next to innovation networks, learning networks etc.
One could conclude that supply chain management as a process is still important and possible to implement, but that supply chains as such do not exist: they are an abstraction from reality. In reality, (most) relations between firms have much more aspects to them than just production and logistics, and they are much more interwoven than a set of interconnected 'shackles' or 'pipeline-segments'.
However, while bearing these criticisms in mind, it may still be relevant and interesting to take the supply chain metaphor – and especially their main (stereotyped) actors - as a starting point for any discussion on the division and integration of activities among firms, since currently much of both academically and practice oriented research takes the supply chain as something that does really exist.
In the following section on the automotive supply chain in particular, we address some of the comments targeted at an overly simplified conception of this chain, incorporating those comments in the further development of the research hypotheses.

The automotive supply chain

The pervasive trend towards more outsourcing in the automotive industry has increased the interest among vehicle manufacturers for effectively controlling and managing their supply situation (Mercer 1995). With inspiration from Japan, the increased focus on supply chain management has resulted in a restructuring of US and European auto manufacturers' supplier bases. According to Clark and Fujimoto (1991), US and European auto manufacturers have traditionally relied on a broad supplier base with a large number of suppliers that to a limited extent participate in technical development (see Figure 2).

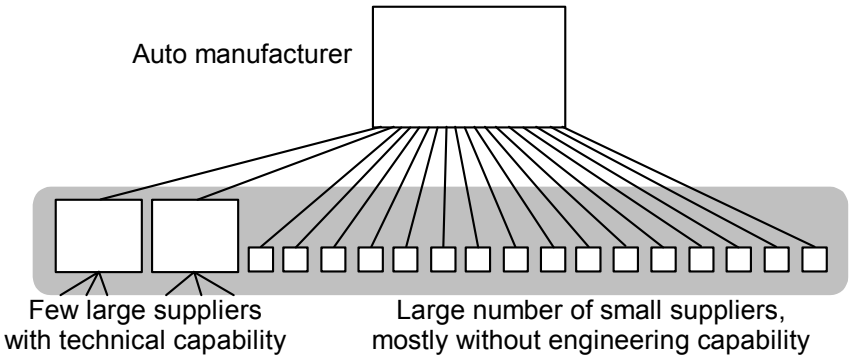

Figure 2. US and European supplier structure (Clark and Fujimoto 1991, p.139).

In contrast to this, Japanese auto manufacturers instead emphasizes a tiered structure based on fewer long-term relationships (e.g. Lamming 1990; Lamming 1993). First-tier suppliers[1] provide the auto manufacturer with sub-assembled units (e.g. complete seats or instrument panels) based on components from lower-tier suppliers (see figure 3). First, second and third-and-below tier suppliers tend to differ significantly in terms of size, technological capabilities and the type and content of their customer relations (Fujimoto 2001, pp. 10-11).

This tier structure simplifies communication between customers and suppliers as *"first-tier suppliers coordinate the activities of the second tier and so on down the hierarchy, allowing customers to focus scarce communication resources on the top tier"* (Kamath and Liker, 1994). The auto manufacturer guarantees a long-term relation with the suppliers but demand that they take a significant responsibility in return. This mutual dependence between suppliers and auto manufacturers motivates close coordination and communication (Clark and Fujimoto, 1991).

[1] Typically, a Japanese automaker has about 100 to 200 first-tier suppliers (Kamath and Liker 1994)

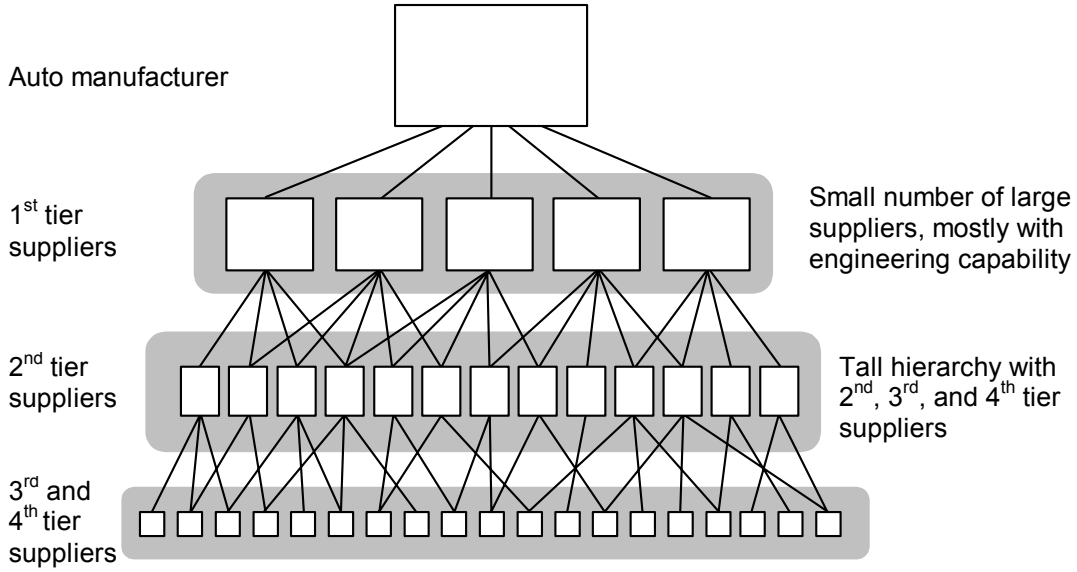

Figure 3. Japanese supplier structure (Clark and Fujimoto 1991, p. 139).

With inspiration from Japan, US and European auto manufacturers have recently begun to restructure their supply base, shifting from a large number of direct supplier relationships to a few close relationships (Womack *et al*. 1990; Bidault *et al.* 1998, p. 18). However, the Japanese structure is still different in that Japanese auto manufacturers own large shares of equity in their largest suppliers (Dyer 1996a, p. 56; Lamming 1993, p. 186). Further, It should be noted that not all Japanese first-tier suppliers are regarded as 'partners': *"In fact, [Japanese auto manufacturers] typically regard only a handful as partners and assign more limited roles to the rest. […] Only an elite corps of about a dozen first-tier suppliers enjoy full-blown partnership with their customers"* (Kamath and Liker 1994).

The increased focus on structuring the supplier base and creating long-term supplier relationships has resulted in stronger horizontal as well as vertical relationships (Lamming, 1990). It is the ambition to improve these vertical relationships that is often termed supply chain management (e.g. Hayes and Wheelwright 1984; Harland 1996; Harland *et al.* 1999; Spekman *et al.* 1998).

It should be pointed out, however, that in reality, the automotive supply chain (and the tier structure) looks much more complicated (Nishiguchi 1986; Brown et al. 2001, pp. 137-8). Lamming (1993, pp. 186-190) makes some important comments on this view of strictly organised tiers of suppliers. First of all, suppliers may in fact deliver components to various customers at different levels in the supply chain. In other words, they could operate as, for example, first and second tier suppliers simultaneously. Secondly, pointing to the original meaning of tiers in the Japanese 'Keiretsu' system, Lamming emphasises the necessary element of organisational 'alignment' between customer and suppliers to be able to speak of tier structures. In conclusion, Fujimoto (2001, p. 10), however, states:

> "Although the real transaction network is far from a simple hierarchy, such a classification is possible according to the *main stream* of transactions. " (emphasis added)

Finally, Lamming (1993, p. 187) argues that some suppliers may indeed supply their products indirectly to the OEM, but at the same have direct technical contacts with

these final assembly firms to discuss the design and development of their component (cf. Wynstra 1998). This brings us to the issue of the role of the different tiers in product development.

Supplier involvement in product development: supply chain position and competitive strategy

Traditionally, most product development has been performed internally at the auto manufacturers. Based on detailed technical specifications (drawings etc.) suppliers were then contracted to produce the products. This means that the auto manufacturers used to have full control over the technical development of the product, while (a considerable part of) the production activities was performed by suppliers. In other words, production was to some extent performed externally, while product development was mainly internalised. However, as the pace of technology development and customer demands increase, product development cost has increased. Therefore, many auto manufacturers have been forced to seek new ways to perform product development. Since suppliers have valuable production skills and, in many cases, also product development capabilities, collaboration with suppliers in product development has been increasingly regarded a viable option (Dröge et al. 2000; Wasti and Liker 1999, 1997; Kamath and Liker 1994; Clark and Fujimoto 1991; Clark 1989). Thereby, better product quality, shorter development lead-time and reduced product and development cost can be achieved, and possibly also better long-term alignment of technology strategies (Wynstra et al. 2002, 1999). One should note, however, that in Japan, this supplier involvement in product development has already traditionally been much more widespread than in the US and Europe (Liker, Ettle and Campbell 1995; Clark and Fujimoto 1991; Clark 1989; Helper 1991; Nishiguchi 1995), although the differences seem to be time-dependent and to be converging recently (Sobrero and Roberts 2002; Dyer 2000; Liker et al. 1995).

In the light of the growing role of automotive suppliers in product development, however, there is increasing realisation that not all suppliers should and/or can be involved in the same way (Sobrero and Roberts 2002; Sobrero and Roberts 2001; Sobrero and Toulan 2000; Wynstra and Ten Pierick 2000; Bidault et al. 1998) Supplier involvement is not without cost, time and effort and should thus be applied selectively and efficiently.
In most of the literature, a supplier's level of desired responsibility or activity in product development is closely connected to the product being produced. Kamath and Liker (1994), for example, distinguish between Partner suppliers, that have up to concept-definition responsibilities for entire subsystems; Mature suppliers that develop the critical specifications of complex assemblies; Child suppliers that develop the detailed specs of simple assemblies together with the manufacturer; and finally, Contractual suppliers that have no development responsibility to speak for the simple parts they deliver. This would suggest that first tier suppliers are more active in product development than second tier suppliers, who are more active than third tier suppliers etc. Also Fujimoto (2001, pp. 10-11) indicates that first tier suppliers are much more likely to have their own engineering responsibilities than second tier suppliers, whereas third suppliers fully rely on the engineering activities of their buyers (customers).

Besides the respective supply chain position of a supplier, we also expect the supplier's competitive strategy to have an impact on its involvement – or level of activity – in product development. Many suppliers nowadays have an explicit strategy to become more involved in product development, and this not only holds for first tier suppliers (Anderson *et al*. 2001). Even suppliers at more upstream tiers, with less complex products, may try to differentiate themselves from their competitors, by means of product development.

Finally, apart from the competitive strategy of the supplier and its position in the supply chain, we also expect the customer's purchasing strategy to have an impact on the supplier's involvement – or level of activity – in product development.

Customers' purchasing strategy

In the literature on purchasing and supply management, a broad distinction is made between transaction-oriented and relation-oriented purchasing (Axelsson and Wynstra 2002, pp. 213-236). Transaction-oriented purchasing is geared towards creating competition between suppliers, which are kept at arm's-length, in order to get the most advantageous offerings, whereas the relation-oriented approach is more focused on creating advantageous exchanges with suppliers through intensive, close collaboration with a limited number of partners (Axelsson and Wynstra 2002; Gadde and Håkansson 2001; Dyer 2000; Araujo *et al*. 1999). Some of the most notable differences are listed in Table 1.

Table 1: Transactional vs. relational purchasing approach

Transactional approach	**Relational approach**
Many alternatives	One or few alternatives
Every deal is a new business, no-one should benefit from past performances	A deal is part of a relationship and the relationship is part of a network context
Exploit the potential of competition	Exploit the potential of co-operation
Short-term; arm's length distance, avoid coming too close	Long-term with tough demands and joint development
Renewal and effectiveness by change of partner, choose the most efficient supplier at any time	Renewal and effectiveness by collaboration and "team effects", combine resources and knowledge
Buying "products"	Buying "capabilities"
→ Price-orientation, strong in achieving favourable prices in well-specified products	→ Cost- and value-orientation, strong in achieving low total costs of supply and developing new value

Source: Axelsson and Wynstra 2002, p. 214.

Regarding the automotive industry, various studies have characterised the traditional practices adopted by the Japanese OEMs as more relational based, and especially the US practices as more transactional-oriented. However, as among others Dyer (1996b;

2000) points out, important differences among US OEMs exist as well: in the 1990s, especially Chrysler has adopted a much more relational approach and has benefited significantly from this both in terms of static (product costs etc) and dynamic (product development speed etc.) efficiency.
An important element in this 'collaborative' approach is joint product development; customers that have a relational-oriented approach towards their suppliers are much more focused on product development collaboration than transactional-oriented buyers (f.e. Araujo et al. 1999). One could even argue that a collaborative approach is necessary for joint product development to take place, since ".. the use of collaborative arrangements allowing for mutual access to internal processes will facilitate both the development and the transfer of tacit knowledge. " (Sobrero and Roberts 2002, p. 161; see also Gulati, 1998) Equally, for those suppliers that are facing such 'collaborative' customers it makes much more sense to engage in joint product development activities since it is much more likely that such activities will be rewarded economically in the future; collaboration extends 'the shadow of the future' (Heide and Miner 1992).
Hence, we argue that another important determinant besides the supplier's 'intended' strategy regarding product development, the actual interest from customers in product development assistance from their supplier – as reflected in their general purchasing strategy - will also impact the supplier's actually 'realised' strategy (Mintzberg and Waters 1985).

Hypotheses development

Based on the literature discussed so far, we now develop our research hypotheses and measurements, subsequently for the concepts of product development activity, the supplier's position in the supply chain, its own (competitive) strategy and the customers' purchasing strategy.

Product development activity

We distinguish between four dimensions of a supplier's level of activity in product development processes: the *influence* the supplier has on the specifications of its products, the quantitative *share* in total product development regarding the supplier's set of products, the *phase* of product development activity the supplier is active in, and finally the *type* of development activities. These are respectively measured by questions 26, 27, 29 and 30 (Appendix A).

Position in the supply chain

Based on the discussions above, we hypothesise that the further downstream towards the OEM a supplier operates, the more active it is in product development.
First of all, therefore, we will look at which tier in the supply chain the supplier is operating. However, as we have seen earlier, important differences may exist between first tier suppliers in terms of the product they deliver. Specifically, one important group of first-tier suppliers delivers complete modules to the OEM whereas another important group delivers very simple components, such as fasteners. These suppliers can be expected to have a completely different profile regarding product development, since a supplier's involvement in product development has much to do with the kind of product it delivers to its customer. Therefore, we will rank the different types of

suppliers in the following order of operating increasingly down-stream: raw material suppliers; third-tier suppliers; second tier suppliers; direct suppliers; module suppliers. However, we also want to include the possibility of second tier and third tier suppliers selling part of their products directly to OEM's. In other words, in our operationalisation of the concept of 'downstream position' we will explicitly include and measure any direct sales going to the OEM, even for non-first tier suppliers. Thus, we hypothesise:

> *H1: The further downstream in the supply chain a supplier is located, the more active it is in its customers' product development process.*

Items for these constructs are question 19 and 20.
Based on the earlier discussions, we additionally hypothesise:

> *H2: The more a supplier's strategy focuses on 'innovation' rather than on 'efficiency', the more active it is in its customers' product development process.*
>
> *H3: The more a supplier's customers focus on a relation-oriented purchasing strategy, as opposed to a transaction-oriented strategy, the more active the supplier is in its customers' product development process.*
> *H3: The more a supplier's customers stimulate product development capabilities in their suppliers, the more active the supplier is in its customers' product development process.*

The corresponding items are included in questions 5 and 22.

Empirical study

The research underlying this paper consists of a survey among companies with manufacturing activities in the Swedish automotive industry.

Questionnaire development
Based on our literature review, we generated items and questions for the constructs discussed in the previous section. A pre-test was conducted, first with a number of academics in the field of industrial networks / purchasing management and product development, and then with representatives of ten supplier firms. This resulted in some minor adjustments to the questionnaire. The resulting items (translated from the Swedish original) are listed in Appendix A.

Data collection
Firms were selected with the help of the four largest Swedish passenger car and truck manufacturers' supplier registers, the Swedish Vehicle Component Association, Statistics Sweden and other public registers. The manufacturers' data was very useful since it was based on actual purchase volumes, and therefore ensured that all important suppliers (in terms of purchase value) were included in the sample.
In February 1999, the questionnaire was sent to 601 companies. In fact, this includes all the automotive suppliers in Sweden. Fax and letter reminders were sent out at several occasions, and once by telephone. By December 1999, a total of 242 companies had answered the survey resulting in a response rate of 40,3%. Of these, 81 were component factories owned by car or truck manufacturers or suppliers of

products for the aftermarket, and were therefore not included in the analyses presented in this paper, resulting in a net response of 161 companies (suppliers of production material to car and truck manufacturers) (27 %). Among the companies that declined to respond to the questionnaire a group of 20 companies were selected to analyse any non-response bias. Moreover, a large number of companies in the total sample were known to the researchers from previous studies. No evidence was found indicating structural differences between companies that did respond and those who did not. The sample of responding companies was also compared with the total population regarding the representation of companies in each part of the value chain, which yielded no significant differences. The sample used for the research in this paper is therefore regarded as an accurate representation of automotive suppliers in Sweden.

The questionnaire, in Swedish, was sent to either the general manager or the plant manager. In some cases, it was then delegated to the marketing manager or the information manager. We expect no significant differences between the different types of respondents; we see our respondents as *informants* on the situation at their respective firms – the questions are not on an individual level.
Although the questionnaire actually covered more topics besides the issues raised in this paper, the main focus was on issues concerning product development. As many supplier firms in the industry strive to increase product development capabilities, some exaggeration regarding these issues may be expected ('socially desirable answers'). For this reason, we checked all cases manually for any inconsistencies. So, for example, a supplier that receives detailed specifications from the customer and does not have its own CAD-system is highly unlikely to perform any internal product development. Any inconsistent cases were dropped from the sample. Of the 161 respondents, 23 firms could be classified as 3rd tier suppliers, 69 as 2nd tier, 58 as 'direct' suppliers and 11 as module suppliers.

Preliminary results and discussion

Using Multiple Linear Regression analysis, we evaluated how well the measures of supply chain position, innovation strategy and customer collaboration (in general and specifically related to product development) predicted product development activity. The regression equation with all three predictors was significantly related to the level of product development activity: R^2= . 28, adjusted R^2= . 26, F (4, 131)= 12.71, p = .000. However, examining the standardized weights (Beta) for each of the predictors reveals that only supply chain position and innovation strategy are significantly correlated with product development activity (resp. ß =. 35, p =. 000 and ß =. 32, p =. 000).
The results seem to demonstrate that product development activity by suppliers is not solely determined by their position in the chain, but also by their focus on innovation as a competitive strategy. Surprisingly, the collaborative orientation of customers does not seem to play any significant, additional role. A possible explanation could be that customers still differentiate in their collaborative orientation towards various suppliers, but do so according to a distinction based on product characteristics and/or

supply chain position. If the various automotive customers do so in a comparable way, it would mean that supply chain position captures a large share of the variation in product development activity.
Still, our findings imply that in research on supplier involvement in product development, a more differentiated understanding of supplier roles needs to be developed. For practice, the findings underline that even though a particular supply chain position may be given for a specific supplier, it still has a choice in terms of its focus on innovation and product development as a competitive strategy.
Obviously, the factors included in our analysis here, can only explain just a share of the variation in product development activity. For example, apart from strategy, differences in internal resource endowments (skills and capabilities, laboratories etc.) could provide additional explanations.

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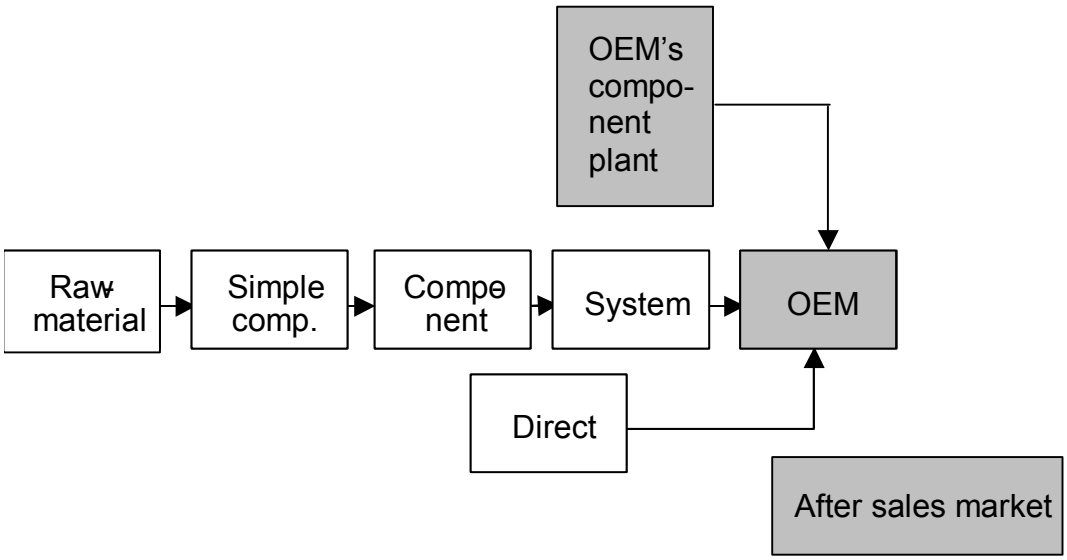
Appendix A: Selected questionnaire items

5. A firm can choose to compete through different means. The scales below describe some of these different means. To the left you should indicate your firm's focus on each of the means; to the right you indicate how your firm rates against competitors.

Firm's focus						Strength compared to competitors				
No emphasis				Strong Emphasis		Much worse				Much better
1	2	3	4	5	**Low Prices**	1	2	3	4	5
1	2	3	4	5	**Swift productchanges or fast product introduction**	1	2	3	4	5
1	2	3	4	5	**Swift volume changes**	1	2	3	4	5
1	2	3	4	5	**Stable and reliable product quality**	1	2	3	4	5
1	2	3	4	5	**Product performance**	1	2	3	4	5
1	2	3	4	5	**Short delivery cycles**	1	2	3	4	5
1	2	3	4	5	**Reliable delivery**	1	2	3	4	5
1	2	3	4	5	**Broad product offering**	1	2	3	4	5
1	2	3	4	5	**Customisation of products**	1	2	3	4	5

19. Indicate in the following figure which box best describes your firm's position in the supply chain. If you are operating in different parts of the supply chain, please indicate the position for the product (family) you referred to in Question X.



(*Note: gray boxes indicates actors not included for analyses in this paper*)

21. Indicate your relative shares of sales to different customers:

Directly to the automotive final assembly firm	___ %
To the assemly firm's internal component factory	___ %
To direct/module suppliers	___ %
Spare parts/after-sales	___ %
Other automotive	___ %
Sales outside automotive industry	___ %
Total	100 %

22. How do the following statements apply to the relations with your customers? *(customers inlcude those firms that have a large share in your firm's sales)*

	Fully disagree		Neither disagree nor agree		Fully agree
Our customers prioritise a long-term relationship.	❑	❑	❑	❑	❑
Our customers play suppliers against each other to achieve lowest possible prices.	❑	❑	❑	❑	❑
Our customers have an explicit strategy how collaboration with their suppliers should function.	❑	❑	❑	❑	❑
Our customers value product development competencies in its suppliers.	❑	❑	❑	❑	❑
Our customers pay (in the unit-price or directly) for the product development costs our firm incurs.	❑	❑	❑	❑	❑

26. To what extent do you manufacture products on customer specification, or develop them yourself?

Develop totally on customer specifications		**50/50 on specification / own development**		**Develop totally on own initiative**
☐	☐	☐	☐	☐

27. Which parties participate in the development of the products that your firm manufactures/delivers?

Share in total development time		
Own firm	___	%
Suppliers to your firm	___	%
Customers to your firm	___	%
Consultants	___	%
Other	___	%

29. In which of the following phases does your firm actively participate in the product development process?

- ❑ Basic research (development new materials etc.)
- ❑ Advanced development (future concepts that are not yet aimed at particular products)
- ❑ Concept phase (development of prototypes, models etc for different alternative design solutions)
- ❑ Engineering phase (development of a concrete product, execution of drawings, testing, verification etc.)
- ❑ Product changes (smaller adjustments to fit a particular production system)

30. Which alternative best describes the product development processes that occur within your firm?

- ❑ Smaller changes in existing product (f.e. to make products easier to produce)
- ❑ Redesigns of existing components/sub-assemblies (f.e. windscreenwiper, windowlift)
- ❑ Development of completely new components/sub-assemblies
- ❑ Redesigns of existing systems
- ❑ Development of completely new systems