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Platform management and early supplier involvement in NPD

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Abstract. Platform strategies reflect a firm's technology policy towards its new product development (NPD) activities. Depending on the technological complexities embedded in the platform, certain degree of interdependence is created between the firm and its suppliers. Firms may decide to what extent the suppliers should be involved in its NPD activities. There has been an increasing interest with issues related to supplier involvement in NPD. Involving suppliers early in NPD can help firms reduce costs, reduce concept-to-customer development time, improve quality, and provide innovative technologies. However, it requires a great effort and many tradeoffs need to be considered.

This paper discusses the implications of early supplier involvement in new product development, specifically regarding to sourcing decisions and NPD processes when new components are designed and incorporated into the new platform. We would like to understand to what extent the NPD collaborates with suppliers, and at which stage of the NPD process suppliers are invited to participate in platform designs. A case study of Oticon, a Danish manufacturer of hearing aids, is presented. We describe how the successful introduction of a new platform of hearing aids is realized as well as how and when Oticon's suppliers were involved during this process.

Key words: Platform management, early supplier involvement, new product development.

1. Introduction

Shorter product life cycles, increasing customization of products, clockspeed competition (Fine, 1998) in addition to supply chain integration (Bagchi & Skjoett-Larsen, 2003; Mouritsen et

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al., 2003) are encouraging many firms to increase outsourcing of various activities, not only in services but also in new product development (NPD) (Chiesa et al., 2004), or to collaborate with suppliers (Bonaccorsi & Lipparini, 1994; Dowlatshahi, 1998). Much of the debate about outsourcing during the 1990s has mainly focused on manufacturing and service issues. Some of the drivers behind outsourcing include, for example, to: accelerate reengineering efforts, access to world-class capabilities, free resources for other purposes, improve company focus, and to reduce operating costs (The Outsourcing Institute, 1998). However, when firms follow a defensive incremental approach to outsourcing decisions, it can initiate a spiral of decline that ultimately leaves firms without the skills and competence they need to compete (Bettis et al., 2001).

With the increasing focus on supply chain integration, many high-tech firms are increasing their outsourcing activities, not only in terms of services and production, but of new product development activities as well. The literature often emphasizes the impact of the initial stages of NPD on the overall performance of the development projects (Khurana & Rosenthal, 1998; Wheelwright & Clark, 1992; Bacon et al., 1994; Ulrich & Eppinger, 2004). The initial stage includes planning, concept development, and system level design. Platform design strategies and related sourcing strategies are often devised during this stage. The extent to which a system can be decomposed with well-specified and standardized interfaces determines whether component outsourcing is a viable strategy (Mikkola & Gassmann, 2003), which has a tremendous impact on when to involve and collaborate with suppliers in NPD (Mikkola, 2003).

Involving suppliers early in NPD can help firms reduce costs, reduce concept-to-customer development time, improve quality, and provide innovative technologies (Handfield et al., 1999). However, it requires a great effort and many tradeoffs need to be considered. Wynstra et al. (2001), for instance, identify four driving factors that can affect the significance of the different management areas: the size and complexity of the organization; the type of production technology employed; the importance of R&D processes; and, the dependence on suppliers.

The challenges with outsourcing are aggravated by the increasing customer demand for product individualization and customization at affordable cost. Many high-tech firms are dealing with this challenge by devising platform strategies to best meet their customer needs while keeping a hold of the firms' core capabilities. Firms have to carefully decide which NPD activities to outsource to suppliers. Depending on the technological complexity of the activity, firms also have to consider what kinds of relationship it should nurture with the selected suppliers. So how are firms dealing with this challenge? How much difference does it make by involving suppliers in NPD of new platforms? What are some of risks? How can a company maintain its platform leadership and integrity? How can the company mitigate the risk of supply disruptions when they are closely related to a sole supplier?

This paper addresses these questions by analyzing the implications of early supplier involvement in new product development, specifically regarding to sourcing decisions and NPD processes when new components are designed and incorporated into the platform and related product architectures. We would like to understand to what extent the NPD collaborates with suppliers, and at which stage of the NPD process suppliers are invited to participate in platform designs. A case

study of Oticon, a Danish manufacturer of hearing aids, is presented. We describe how the successful introduction of a new platform of hearing aids is realized as well as how and when Oticon's suppliers were involved during this process.

2. Literature review

2.1. *Product Platforms and Product Architectures*

Product platform is a set of subsystems and interfaces that form a common structure from which a stream of derivatives products can be efficiently developed and produced (Meyer & Lehnerd, 1997; Meyer & Dalal, 2002). It encompasses the design and components shared by a set of products. A robust platform is the heart of a successful product family, serving as the foundation for a series of closely related products (Meyer & Utterback, 1993). In order to implement a platform strategy, product architecture strategies (which can range from modular to integral) have to be devised. The purpose of devising modular product architecture designs is to create flexibility and changeability (Erens & Verhulst, 1997). Product architecture can be defined as the arrangement of the functional elements of a product into several building blocks, including the mapping from functional elements to physical components, and the specification of the interfaces among interacting physical components (Ulrich & Eppinger, 2004). According to Robertson and Ulrich (1998), good product development means good platform development, and in order to do so, a firm must carefully align its differentiation plan and its commonality plan through an iterative planning process. This planning process leverages the trade-offs between distinctiveness and commonality in product architectures. At the heart of platform is the organization of components and interfaces making up the product architecture, and the degree of modularity embedded in the product architectures is dependent on the composition of the components, how these components are linked with one another, and substitutability of unique components (Mikkola & Gassmann, 2003).

Platform management is the integration of the building blocks (the core technologies and processes) with common architectures (the shared subsystems and interfaces), with user requirements aggregated into target market segments towards the end of producing value rich products and systems. Product platform has tremendous implications for a firm's product portfolio management, in which set of technologies and products are evaluated in relation to each other (Mikkola, 2001). How platform is planned and configured, in terms of technology composition contained in the sub-systems and respective interfaces linking these sub-systems, has significant impact on trade-offs between the degree of standardization and customization of product families and respective end products. The result of that integration should be product families that serve a spectrum of price and performance for one or more market segments. Furthermore, having platform leadership (Cusumano & Gawer, 2002) allows a company to drive innovation around a particular platform technology at the broad industry level. Platform leaders, however, face three problems (p. 53):

(1) How to maintain the integrity of the platform (the compatibility with complementary products), in the face of future technological innovation and the independent product strategies of other companies
(2) How to let platforms evolve technologically while maintaining compatibility with past complements; and
(3) How to maintain platform leadership.

Depending on the technological complexities embedded in the platform and management decisions as to outsourcing of NPD activities, certain degree of interdependence is created between the firm and its suppliers. Firms may decide whether to what extent the suppliers should be involved in the firm's NPD activities.

2.2. *Early Supplier Involvement*

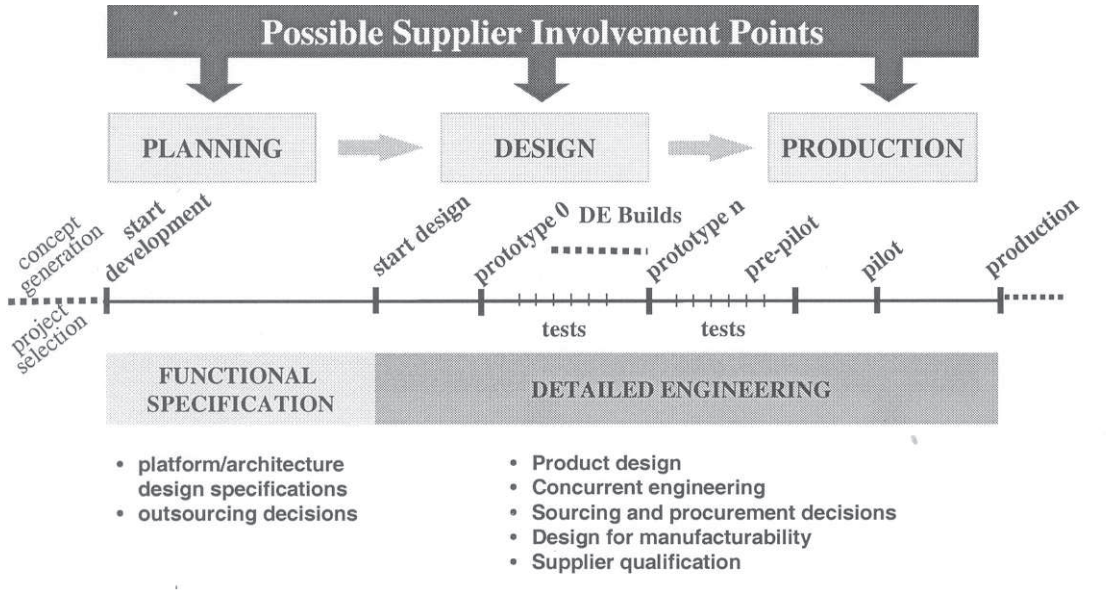
Early supplier involvement (ESI) generally refers to as a form of vertical cooperation in which manufacturers involve supplier at an early state in the product development and/or innovation process (Bidault et al., 1998). ESI is a means of integrating suppliers capabilities in the buying firm's supply chain system and operations (Dawlatshahi, 1998). Some of the benefits for involving suppliers in NPD include reduced development cost (Bonaccorsi & Lipparini, 1994), improved performance (Hsuan, 1999), reduced lead times, and access to supplier's technical expertise and capabilities (Ragatz et al., 2002; Wasti & Liker, 1997). However, studies have shown that, despite the visible benefits of ESI, many firm still experience difficulties in managing this involvement (Wynstra et al., 2001). Some of the difficulties are attributed to lack of communication and trust, supplier's poor technical capabilities (Wasti & Liker, 1997), limited commitment of the suppliers (McCutcheon et al., 1997).

Platform strategies reflect a firm's technology policy towards its NPD activities, hence idiosyncratic to a particular firm (Mikkola, 2003). This is one of the reasons why there is very little literature available that proposes a generic and comprehensive framework for implementing ESI, as most of the efforts in this area are proprietary and domain-based in nature (Dawlatshahi, 1998).

The literature often mentions that the type of supplier/customer collaboration in the development of new products is an important source of competitive advantage for firms (cf. Dyer et al., 1998; Lamming, 1993; Wheelwright & Clark, 1992). Timing of involvement and the degree of competition among suppliers are also important dimensions (Bonaccorsi & Lipparini, 1994). The degree of supplier involvement in NPD depends on the complexity of the technology outsourced, which would determine the degree of interdependence shared between the manufacturer and the supplier, as illustrated in Figure 1.

A generic NPD process can be analyzed in three steps: planning, design, and production. In the automotive industry, the planning phase is often referred to as the *functional specification* phase, whereas the design and production steps are often referred to as the *detailed engineering* phase (Clark & Fujimoto, 1991; Lamming, 1993; Womack et al., 1990). The platform/architecture and related outsourcing strategies are often decided during the functional specification stage. Most firms

Figure 1. Possible Supplier Involvement Points in NPD



regard their ability to manage platform designs as their core competences, hence generally not much supplier involvement is observed during this phase (at least with regard to core components). As explained by McCutheon et al. (1997: 274), «[f]irms that tried to be technological leaders in their industry usually spent more to maintain in-house design and development expertise. The key concern of the product designer was to nurture some proprietary skills or knowledge that, if not duplicated by competitors, would provide an avenue for competitive advantage.»

The degree of supplier involvement is also related to how the platform is designed. Before outsourcing decisions can be delegated, product architecture strategies have to be devised. Modular product architectures, for instance, can be used as flexible platforms to leverage a large number of product variations (Robertson & Ulrich, 1998; Meyer et al., 1997), which are related to the way in which a system is decomposed (or integrated). With standardization of interfaces, the decomposed portions of the product architecture (e.g., sub-systems, modules, sub-modules, components, etc.), can be developed independently by different suppliers.

3. Research methodology

This is an explorative as we ask “how” and “why” questions to investigate a contemporary phenomenon within its real life context and use multiple sources of evidence. Therefore, according to Yin (2003), a case study is the most appropriate research methodology.

The study seeks to identify some of the major issues and problems firms face when they col-

laborate with suppliers in NPD. In order to illustrate the implications of early supplier involvement in NPD, we have chosen a leading edge manufacturer of hearing aids for case study. The hearing aids industry is a niche industry, of which three of the largest manufacturers in the world are from Denmark. Furthermore, the production of hearing aids requires an advanced technology and NPD has a very important role to ensure that these firms stay competitive in this market.

Face-to-face and semi-structured interviews (with open-ended as well as descriptive questions) were performed with two respondents from Oticon (our case company): the project manager and the integrated circuit (IC) designer. The respondents have been personally involved in the NPD processes of the SUMO platform design (the focus of our case study), from the very beginning. The interviews were followed up by telephone conversations and e-mails. An interview narrative was also sent to the respondents for corrections and final approval.

4. A case study of Oticon

Oticon, located near Copenhagen, Denmark, is one of the Hearing Aids business units of The William Demant Group (the other one is Bernafon), which manufacturers and sells products and equipment designed to aid the hearing and communication of individuals. Oticon's goal is to supply the most sophisticated technology and audiology based on the needs and wishes of the hearing impaired and to offer a full range of the best hearing aids and fitting systems on the market. Its products are sold through subsidiaries in 20 countries and some 80 independent distributors worldwide.

Oticon has the capacity to master a wide spectrum of technologies, including the design of ICs for advanced processing of sound signals, the development of fitting software, the design of micro-amplifiers, and the development of micro-mechanical components. Oticon also collaborates with experts with in-depth knowledge of their particular fields and through interaction between the company, the users and the hearing-care professional.

NPD at Oticon is organized in Project Groups within the Team Business. The Team Business Development Group is consisted of competence managers, project managers, and the Team Management. Oticon holds "development group" meetings every six weeks, when new ideas are brought up. The ideas are presented in the form of "project applications", but not all project applications get accepted. Only projects considered for further development move to the next stage, the Pre-Investigation Phase, in which market investigation, technology feasibility, and target specifications take place. The product managers contact the sister companies, dispensers and clinics to test the market reactions of new product ideas. Schematics are not generated at this stage yet, however. It is seldom that the suppliers get involved at this stage of the product development process. The Pre-Investigation Phase typically ends with a "milestone meeting". If approved, the project moves on to the Concept Phase, in which priorities between projects and resource demand are evaluated.

Suppliers visit Oticon once or twice per year when new ideas are presented by the supplier and discussed. Oticon does not inform the suppliers about its upcoming products or ideas, unless

an actual collaboration is initiated. In such case, new suppliers are approved by a supplier committee. Some evaluation criteria include economics, investments, quality, delivery certainty, certificates, procedures, etc. Visits at the supplier's premises are done prior to approval, and regularly after the approval. There exists a number of ways to protect new joint developments between a supplier and Oticon. These include patents and exclusivity arrangements, for example. However, in the long run, Oticon cannot prevent their competitors from copying its good ideas. Reverse engineering is a common practice in this industry, thus every time a hearing aids manufacturer launches a new product, instruments are ordered by competitors for analysis.

There are two types of platforms at Oticon: extension of existing platform, and new platforms. The existing platforms are expanded with new variants up to a few times per year. As the concept evolves, simulations are performed in order to minimize the risks of failure and to verify that the ideas are technically feasible. The SUMO project, described below, is an example of how new platforms can be realized at Oticon.

4.1. *The SUMO project*

SUMO is a BTE (behind-the-ear), hearing aid that is developed based on a new mechanical platform and a new IC platform. The development lead time of SUMO (from concept generation to final production) took a little over three years involving all competence areas of Oticon. It has been in production since 2002. A picture of SUMO is illustrated in Figure 2.

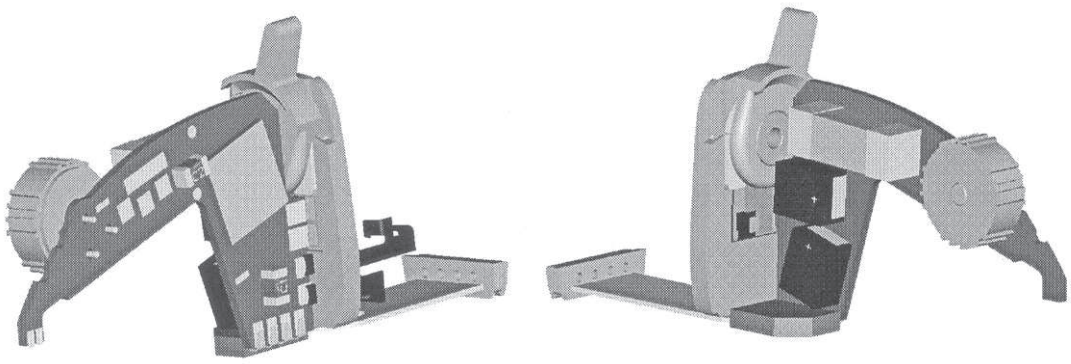
Figure 2. The SUMO hearing aid

Although SUMO is a mid-range product, it is the most powerful hearing instrument in the world. Its product life cycle is estimated to be between 10 to 15 years, complemented with new versions from once a year to every 18 months. The product life cycle of powerful hearing aids is usually very long, because it takes a long time for the user to get acquainted with the sound pattern from the hearing aids. Therefore, the user tends to be conservative and stick to the same instrument for as long as possible. Some users are still wearing 30-year-old hearing instruments, as it takes a long time for the brain to adapt to new sound pictures provided by new instruments for users with profound hearing losses.

SUMO is a powerful instrument based on analogue design (in contrast to digital design). It is probably the last analogue product from Oticon to be brought to the market. SUMO has better power performance than other products in the market. This is especially important for one niche of Hearing Instrument customers: the users that cannot get enough power, that is, people with profound hearing loss. The trend in hearing aids, however, is changing from analogue hearing aids to digital.

The SUMO product architecture is comprised of the following key components: housing, volume control, microphone, receiver, battery wall, switch, connecting element, and PCB where the customized IC is placed. There are about 25 components in SUMO, of which all are unique, with the exception of volume control and the microphone. It is interesting to note that although the volume control is a unique component for Oticon, it is made from a library of combinations from the supplier, hence considered a standard component, of which the technique is also standard for the supplier. The product architecture of SUMO is shown in Figure 3.

Figure 3. Product Architecture of SUMO



Although there are no black-box components in SUMO (Oticon wants to have the control of its design), many of the unique components are, in varying degrees, developed in cooperation with the suppliers. For instance, the design of switch and IC were carried out in-house, but the manufacturing (and assembly of the switch) was delegated to the suppliers. The receiver and the connecting element, on the other hand, are the only components that suppliers were actively involved to jointly solve technical problems. Development costs were also split between the suppliers.

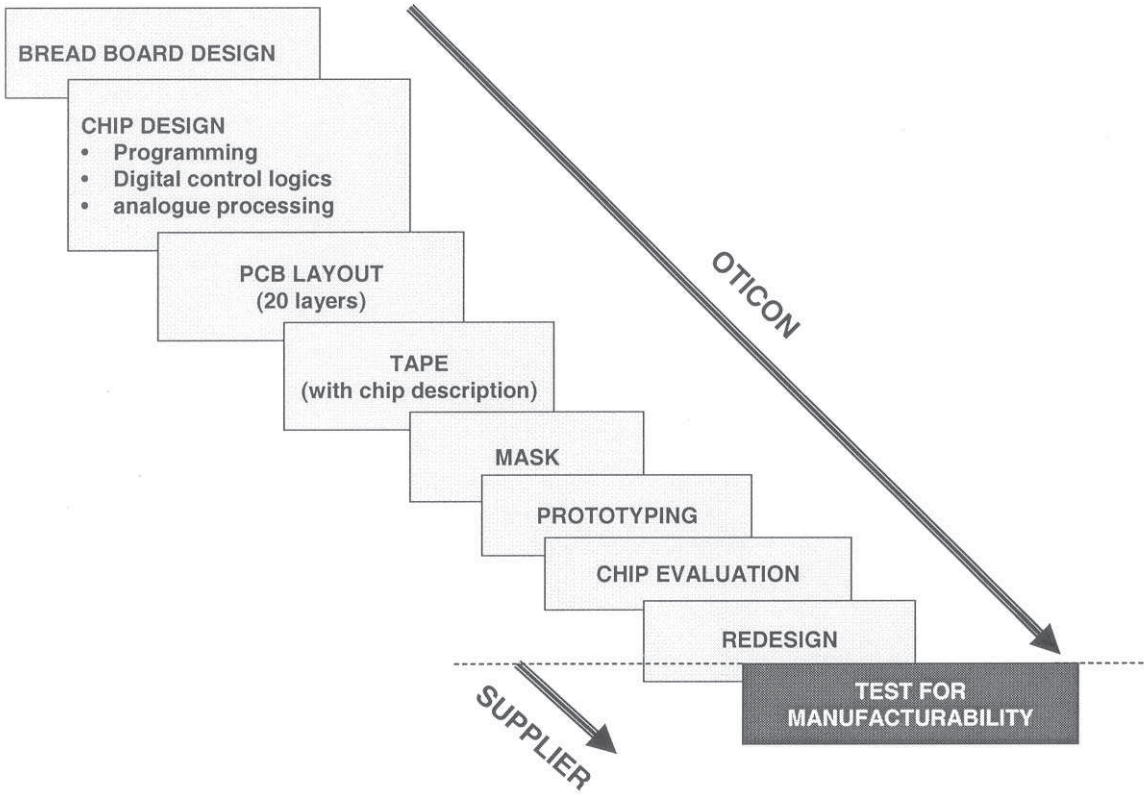
The receiver is supplied by a sole supplier. Oticon is in a small business area making very small components, which means it depends on the suppliers to deliver prototypes as well as in relatively small quantities. In order to reach the highest possible level of quality and performance, Oticon, in some cases, involves the suppliers into joint development of components. Sometimes this results in a high degree of dependency of the supplier. For instance, there is only one supplier (out of a total of two possible suppliers worldwide), that is currently capable of developing the receiver used in SUMO. The development of the receiver started in parallel with the supplier. Engineers were actively "running" to and from both places. Oticon generally balances the use of the two suppliers in order to ensure that they are both active in all areas, thus avoiding having only one supplier. By doing this Oticon also ensures that the technical level of the suppliers is kept high. Although Oticon involves suppliers in its NPD processes, and also helps its suppliers to improve their processes. Oticon owns all the tooling (especially for plastic moulding) to ease second sourcing as much as possible if needed. Oticon is giving more responsibilities to its system suppliers, who are responsible for assembling subsystems, such as parts of the switch. Oticon has video conferences with their global suppliers for 1-2 hours per week when drawings and other information are exchanged.

The receiver is an example where Oticon had a very close cooperation with the suppliers in NPD. One of the problems was with the plastic and the parts that go into it, specifically with mechanical components that were moving inside the receiver. There were two suppliers involved (not simultaneously), in this project: an American and a Danish supplier. The first supplier was an American company who was selected primarily from evaluating technical vibrational patterns of the existing receivers from this company. In the end the performance goal could not be met and it proved to be necessary to switch to the alternate supplier to reach the goal. Although the American supplier lost the order with Oticon, it was able to use the hearing aid knowledge learned from Oticon in its other businesses. Hence the continued collaboration with this supplier remained non-affected.

The development of the IC platform, on the other hand, involved very little supplier participation. The design of the chip, including the chip layout, is performed entirely in-house. The IC development process is shown in Figure 4.

The development of the IC started with the bread board design (in which only standard components were used), and ended at the test for manufacturability (prior to full production), with all in-between activities. Suppliers only became involved at the test for manufacturability stage, at which point suppliers were evaluated based on test time and price.

Figure 4. The NPD process of the IC development



5. Some managerial implications

The case illustrates the dilemma a firm may face regarding early supplier involvement in NPD. One the one hand, Oticon wants to keep control of the development of platforms and core components. On the other hand, a few suppliers have the control of the sophisticated technology, which is necessary to produce competitive products. There are only two relevant suppliers in the world, who are currently capable of producing the receiver used in SUMO. To some extent, these suppliers also share knowledge and technology with Oticon's fiercest competitors. Therefore, there is an obvious risk that proprietary knowledge is leaked to the competitors. There exists a number of ways to protect joint NPD between Oticon and a supplier including patents and exclusivity arrangements. However, in the long run, Oticon cannot prevent competitors from copying their good ideas. Reverse engineering is common in this industry, thus every time a hearing aids manufacturer launches a new product, instruments are ordered by competitors for analysis. Another issue related to the use of sole suppliers for core components is the risk of disruptions in the sup-

plies, caused by e.g. bankruptcy, acquisition of the supplier by a competitor, plant fire or strikes. If such events happen, Oticon will not, in the short run, be able to replace the supplier with an alternative source. Oticon is very conscious about the potential problems of disruptions. Therefore, it balances the risk by working with the two receiver suppliers in order to ensure that they are both active in all areas. Such policy also ensures that the technical level of the suppliers is kept high.

In order to reduce the risk of disruptions, Oticon is very carefully with the supplier approval process. New suppliers are approved by a supplier committee. Evaluation criteria include financial issues, investments, quality, delivery reliability, certificates, and procedures. Several visits, both at Oticon's and at the supplier's premises, also take place prior to approval, and regularly after approval.

6. Conclusions and future research

During the last decade, there has been an increasing interest with issues related to supplier involvement in NPD. Major drivers include rapid technological development, short product life cycle, global competition and core competency focus by companies. By involving suppliers at an early stage of NPD, the focal company can get access to suppliers' technology and capabilities, reduce time-to-market lead time, and share development costs.

This paper discussed some of the problems a company may face when involving suppliers in NPD processes, specifically when new components are designed and integrated into platforms and related product architectures. How can a company maintain its platform leadership and integrity? How can the company mitigate the risk of supply disruptions when they are closely related to a sole supplier?

We have illustrated these challenges with a case study of a platform development of a behind-the-ear instrument called SUMO from Oticon, a Danish company in the hearing aids industry who has a leading-edge technology in acoustics. SUMO is a hearing instrument designed for people with severe hearing loss problems. During the NPD process of SUMO, the suppliers were not involved in the design of platform and product architecture. There were no black-box components and most of the unique components were produced in-house. The receiver and the connecting element were the only components that were developed jointly with two suppliers. Oticon balanced the use to the two suppliers, thus avoiding being dependent only on one supplier. The development of the IC platform involved only supplier participation at the test for manufacturability stage. All the previous stages were performed in-house.

One conclusion drawn from the Oticon case is that it is very difficult to protect proprietary knowledge over a long period of time. Competitors can do reverse engineering to disclose technical innovations and are able to copy them within a relatively short time. Therefore, NPD performance and time-to-market is becoming increasingly important. Only by being a few steps ahead of the competitors, in terms of technological innovations, can the company survive. Therefore, R&D is essential for this industry, not mentioning the accessibility to complementary capabilities at the

suppliers market. The delicate balance is how and when to involve the suppliers during the early stage of the development process without getting too dependent on sole suppliers. The Oticon case illustrates how the company deals with such challenge. However, more case studies from different industries and environments are necessary in order to explain with more certainty the factors that influence the nature and extent of supplier involvement in NPD.

Supply chain management links a firm with its customers, suppliers, distributors, and other intermediaries. In this paper, we have focused on the buyer-supplier relationships, and especially on the early supplier involvement in NPD. However, it is also important to study the integration between NPD, operations, outbound logistics, and customer service. What challenges are companies facing when they are trying to achieve integration with internal and external partners in the supply chain, and how are companies overcoming these challenges?

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Resumo. A estratégia de plataforma reflecte os planos tecnológicos das empresas em relação às actividades do desenvolvimento de produtos novos (NPD). Dependendo das complexidades que existem na tecnologia, certo grau de interdependência é formado entre as empresas e suas fornece-

dores. Empresas decidem como e quando os fornecedores devem ser envolvidos em NPD. Recentemente o mundo académico está cada vez mais interessado com o envolvimento inicial dos fornecedor (ESI) em NPD. O ESI em NPD pode assistir as empresas em reduzir custos, reduzir o período de conceito-para-consumidor, melhorar a qualidade, e fornecer tecnologias inovadoras. Porém, isso exige um esforço extenso e muitas considerações precisam ser avaliadas. Este artigo examina as implicações de ESI em NPD, particularmente a respeito de decisões de fornecimento e processos de NPD, especialmente quando os componentes inovadores são desenhados, construídos e incorporados na plataforma nova. A discussão teorética é avaliada através de um estudo de caso da Oticon, uma empresa dinamarquesa que manufactura aparelhos auditivos. A narração explica como a Oticon, com muito sucesso, introduziu uma plataforma nova de aparelhos auditivos. Além disso, a narração revela como e quando os fornecedores da Oticon foram convidados para participar na ESI em NPD.
Palavras-chave: Gerência de plataforma, envolvimento inicial dos fornecedores, desenvolvimento de novos produtos.