“Developing the knowledge value chain: A strategy for knowledge sharing in New Product Development in Multi-national Corporations”

AUTHORS	Bruce Gurd Ayadurai Jothidas

ARTICLE INFO	Bruce Gurd and Ayadurai Jothidas (2009). Developing the knowledge value chain: A strategy for knowledge sharing in New Product Development in Multi-national Corporations. *Problems and Perspectives in Management*, *7*(2)
RELEASED ON	Tuesday, 16 June 2009
JOURNAL	"Problems and Perspectives in Management"
FOUNDER	LLC “Consulting Publishing Company “Business Perspectives”

NUMBER OF REFERENCES
0

NUMBER OF FIGURES
0

NUMBER OF TABLES
0

SECTION 2. Management in firms and organizations

Bruce Gurd (Australia), Ayadurai Jothidas (Singapore)

Developing the knowledge value chain: a strategy for knowledge sharing in new product development in multi-national corporations

Abstract

Our research is at the nexus of two bodies of research knowledge: knowledge sharing in multinational corporations (MNC) and new product development (NPD). We explore the institutional and cultural issues in relation to sharing knowledge in new product development in multi-nationals both within the MNC and across the supply chain. Starting from a simple model of knowledge sharing we use a historical analysis of four new product development cases in one company to develop a richer model of the knowledge value chain to achieve the best outcomes from interdependencies among the partners in the value chain. The article contributes to the literature a tentative model of this knowledge sharing processs. We argue that while knowledge sharing within the organization and among the value chain partners is necessary, sharing of proprietary knowledge needs to be managed such that the competitive position of the firm is not eroded and its survival is not threatened by such knowledge reaching its competitors.

Keywords: knowledge management, multinational corporations, new product development.
JEL Classification: M14, M16.

Introduction

Knowledge is at the centre of the existence of the multinational corporation (MNC) (Gupta and Govindarajan, 2000; Almeida et al., 2002) and is important to new product development (NPD) (Liu et al., 2005). This research advances the literature by linking two areas – knowledge flows in MNCs (Gupta and Govindarajan, 2000; Buckley and Martin, 1999; Adler and Hashai, 2007) and new product development (NPD). In the case of NPD in an MNC there are two forms of knowledge sharing. First, there is a need to share knowledge within the organization across all of its locations and divisions with the problems of who gets the benefit of the knowledge (Cabrera and Cabrera, 2002) and the cross-cultural issues including language (Almeida et al., 2002). Second, there is a need to share knowledge with supply chain partners, which is even more problematic because it can result in a loss of bargaining position and even leakage of knowledge to competitors. Our contribution to theory is to explore both issues in the one study.

We advance the research literature by examining both issues in one research study, using a case study of a single MNC under the pseudonym of Transelectronics. First of all, we build from the literature a model which we call the "knowledge value chain"; a term previously used by Lee and Yang (2000) but we are using it in the conjunction of both ideas – knowledge management and the value chain, rather than looking at internal knowledge flows. The next section explores the literature and arrives at the research model. This is followed by a brief research methods section, which describes the case study approach. The case studies then follow with a discussion section, which draws the themes together and arrives at the model of the knowledge value chain.

1. Prior research

Considerable effort has gone into improving the routines and activities of NPD in a single location (e.g., Clark and Fujimoto, 1991; Cooper, 1994). More attention is being paid to the problems of NPD in companies spanning multiple country markets; knowledge of which often resides in overseas locations (Bartlett and Ghoshal, 1989). Li and Scullion (2006, p. 74) advance the idea of the knowledge holder, "an individual or a collective group of people or an organized body who possess any relevant information, experience and understanding of the business and its market". We define knowledge as per Davenport and Prusak (1998, p. 5):

"Knowledge is a fluid mix of framed experience, values and contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of the knowers. In organizations, it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices and norms".

This definition clearly delineates it from just information because it provides a framework in which information can be evaluated and incorporated. The definition also recognizes the essential tacitness of

Dr. Jothidas died on June 14th 2008 but this work is published posthumously in his honour from his research work.

much knowledge. While the idea of codification and sharing of tacit knowledge is contested, it is recognized by Noordhaven and Harzing (2009) that it is shared, and any codification of tacit knowledge (Nonaka and Takeuchi, 1995; Herschel et al., 2001; Strach and Everett, 2006) increases the likelihood of it being shared outside of the organization (Li and Scullion, 2006).

The importance of local knowledge holders is implicit in the writings of Nonaka (1997) who suggests that global knowledge creation must draw from the local environment through explicit knowledge of products, tacit knowledge of hidden needs, and tacit knowledge of processes (Subramaniam et al., 1998). When the knowledge about different product requirements is tacit, firms employ cross-national product development teams and use overseas subsidiaries as sources of new product concepts (Subramaniam et al., 1998; Mudambi, 2002).

The mechanisms enabling firms to transfer knowledge across borders so as to simultaneously address efficiency and responsiveness have been the subject of several studies in the international business literature (Subramaniam et al., 1998; Mudambi and Navarra, 2004; Li and Scullion, 2006). The key issue facing NPD in an MNC is the sharing of knowledge within the organization. This is particularly heightened in the case of tacit knowledge (Li and Scullion, 2006; Jensen and Szulanski, 2004) that cannot be communicated easily or transmitted in formal, systematic, or codified language (Nonaka, 1994; Polanyi, 1966). Tacit knowledge can exist in understanding local customer requirements (Subramaniam et al., 1998) which is best shared through socialization or interpersonal contact (Kogut and Zander, 1993; Nonaka, 1994).

Cultural differences have also been found to form barriers for effective knowledge transfer across borders. While a common culture permits interaction and thus the flow of knowledge within a country (or firm), cultural differences across countries restrict the flow of knowledge across borders (Almeida et al., 2002). Numerous studies have suggested cultural conflicts limit sharing of information and learning across countries and firms (Fiol and Lyles, 1985; Parkhe, 1993). Cultural distance may advance a firm's motivation to learn, but it also limits the ability of alliance partners to learn from each other (Almeida et al., 2002).

The richness of a knowledge transfer mechanism depends not only on the technical characteristics of the media but also on the context within which the communication takes place, in particular the social relationships between the communicating individuals (Almeida et al., 1998). Prior research on semiconductor engineers has shown that a movement from one place to another, even across firms, allows engineers to exploit tacit knowledge in new locations (Almeida and Kogut, 1997).

An organization cannot develop within its boundaries all the critical knowledge needed to prosper and grow (Dussauge et al., 1998). The explosive growth of strategic alliances over the years, especially in high-technology industries such as semiconductors and commercial aircraft supports the view of the increasing importance of collaborative agreements in accessing external knowledge (Dyer and Singh, 1998; Mowery et al., 1996). In a globalizing world, alliances offer firms an incentive to share the risks and costs associated with knowledge creation (Almeida et al., 2002). Networks within the value chain as sources of knowledge include vendors (Allen and Cohen, 1969), customers (Von Hippel, 1988) and suppliers (Von Hippel, 1988). Von Hippel argues that a production network with superior knowledge-transfer mechanisms among users (customers), suppliers, and manufacturers will be able to perform much better in their innovation processes (new product and process development) compared to supply chains with less effective knowledge-sharing routines. How this can happen is under-explored in the research literature.

Both Austin (1990) and Leonard-Barton (1995) propose an approach to transferring product development capability to developing nations (low cost sites). On process development and developing new tools, Leonard-Barton (1995) advocates the involvement of users (manufacturing sites) in developing tools and processes. In NPD, transferring such knowledge within a short time across the borders is not always possible, particularly if the product life cycles are short. There is therefore need for further research to understand as to how knowledge existing within the organization can be shared and utilized effectively for NPD. It is not easy to convert tacit knowledge into explicit knowledge or transfer tacit knowledge across borders with different languages and cultures.

These connections are shown in Figure 1.

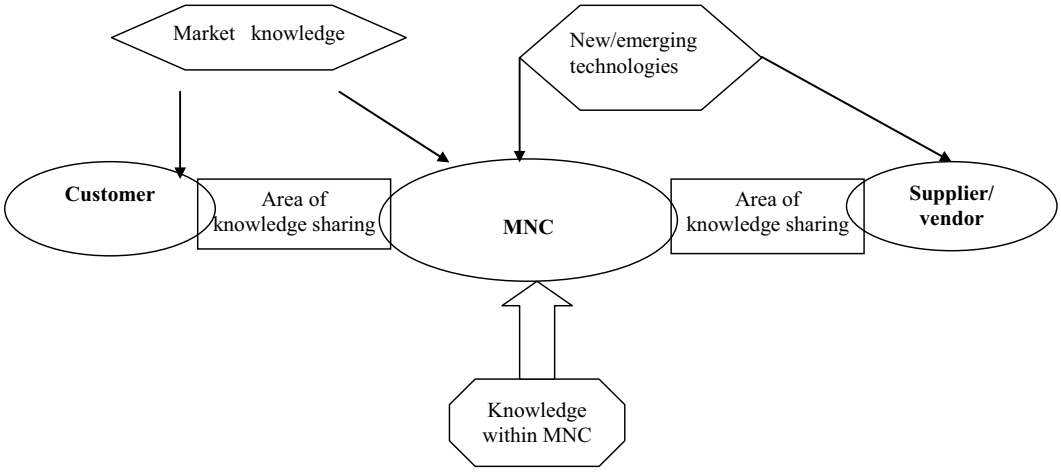

Fig. 1. Knowledge value chain

The customers, on the left-hand side of Figure 1 are the closest to the market and should act as knowledge holders of consumer requirements and apply its own tacit knowledge to conceptualize the products. Although the customer should be a source of market knowledge it can flow to the MNC through other sources as well, hence the market knowledge box on the top right of Figure 1. The suppliers will have specialized knowledge of the manufacture of components and be knowledge holders of both explicit and tacit knowledge relating to design for manufacturability. The MNC needs to determine the amount of knowledge that should not only be shared with its vendors to utilize the vendors' tacit knowledge but also to be shared internally within the organization. Managing knowledge sharing within the organization has emerged as a critical success factor in NPD.

From this literature we elicit the key question: What problems arise with inadequate and excess knowledge sharing in an MNC within the organization across its subsidiaries and within the value chain? This question is anchored within the literature on new product development in MNCs. In particular, we explore the circumstances in which insufficient knowledge sharing occurs and when too much knowledge is shared. We build from this a model which we call the knowledge value chain.

2. Research method and case study background

We use a historical analysis of multiple cases in a single organization to explore the issue of knowledge in NPD. Transelectronics, the pseudonym of the Asia Pacific division of a large manufacturer, operated throughout the Asia Pacific region and was managed by a regional CEO/ President (Asia Pacific), with country General Managers and functional Vice Presidents reporting to him directly. Each country was managed as a profit center. The functional Vice Presidents were responsible for their functions across the region and country functional managers reported to them on a "dotted line" and reported on a "straight line" to the respective Country General Manager.

Transelectronics was a manufacturer of electronic components for notebook computers, mobile phones and other electronic devices. These electronic devices use rapidly changing technologies in markets where product life cycles are short and there are discerning consumers who are aware of technological sophistication. Component manufacturers such as Transelectronics who are further away from the ultimate consumer have difficulty accessing the market knowledge. On the other side of the supply chain, component manufacturers depend on vendors with specialized skills for their tools and in some cases even for manufacturing.

Four case studies of NPD undertaken during the period from April 1994 to January 2002 are analyzed. Although the company developed or modified at least sixty products each year, the cases that are included were selected on the basis of their importance to knowledge management. In the industry in which the company operated, technologies were changing rapidly and products and process technologies were becoming obsolete within a short span of time. Data were collected through interviews of key personnel including the Chief Operating Officer of each national office, personal notes and diaries and meeting minutes. Each case was then analyzed to write a historical analysis. These historical analyses were given to the Chief Operating Officer of the Asia Pacific region to review and critically analyze the realism of the interpretation.

3. Case study analysis

3.1. The original NPD system. Transelectronics recognized the need to improve its NPD processes to gain a competitive position. As a first step, in 1994 it implemented a cycle time reduction program to reduce the time to market but it did not achieve time to volume as it encountered process capability prob-

lems to meet market demand. A revised structured approach to NPD was introduced which included screening all new business opportunities to minimize wastage on prototype development and build new information systems to share global knowledge.

There were still several failures of missing new business opportunities due to insufficient market analysis and lack of co-ordination and communication between sales, marketing, engineering and product development teams. Sales teams requested product prototypes from engineering teams based on incomplete understanding of the customers' requirements or poor assessment of market demand. As Leonard-Barton (1995, p. 84) remarks: "When prototypes are used only for testing technical concepts and not as communication vehicles for problem solving across boundaries, developers are overlooking enormous opportunities for creative abrasion-integration".

While engineering teams were encouraged to develop new technologies and processes and rewarded them when they were patented;. Transelectronics filed patent applications at every stage of development of a new product if it involved a new or proprietary technology. However, the length and complexity of litigation, particularly in Asia, meant that if Transelectronics was able to obtain judgment against a competitor who had violated the patent the technology was already superseded. Hence, patents did not offer any real protection of corporate knowledge.

Corporate headquarters did not have any centralized NPD approach but rather the headquarters' engineering team focused on new generic technologies for both product and process development. Historically there was no information system to collect and share all NPD information but a reliance on ad hoc dissemination, with teams across the world working in relative isolation. The company maintained document control units (DCUs), but not in a common database and all in different languages including Chinese and Japanese.

3.2. Case studies 1 and 2: Problems of inadequate knowledge sharing. In 1996, the company invested US$3 million to develop a new product for use in personal computers. The product development teams in Japan and Singapore developed it jointly for customers in both Taiwan and Singapore. The Singapore team sought assistance from the Japan NPD team to help develop molds for the component's plastic housing, a technology only available in Japan in the Asia Pacific region. The Japanese team had to first understand the product requirements and the type of mold required to make the plastic housing from the Singapore team, which was directly working with the customer. In turn they had to explain the requirements of the mold design to the Japanese vendor who had the expertise to develop the mold. In Japan, if the vendor develops the tool such as a mold or die, the vendor expects to produce the parts for the customers. Considerable negotiation was needed to get agreement with a Japanese vendor just to make the tools without making the part.

The vendor was awarded the contract to manufacture the plastic housing with the proviso that the vendor would transfer the mould to the company when required for "in house" manufacturing. Unfortunately, the plastic housings produced had warpage and were non-symmetrical that caused quality problems on the customers' production line. The Singapore team sought assistance from the US mold design engineers who recommended that the molds should be modified. The US team reviewed the vendor's design. An engineer from the Singapore team went to the R&D site in the USA for two weeks, carried out a mold flow analysis and came up with a proposal to modify the mold. The Japanese team instructed the vendor to make the necessary modifications, which still did not solve the problems.

In this case knowledge transfer was not optimized in the supply chain, as the vendor could not utilize its tacit knowledge in mold making without transferring knowledge backwards from the customer to the component manufacturer (Transelectronics) to the vendor. Sharing of knowledge with the component manufacturers by the personal computer (PC) manufacturer would enable the component manufacturers to supply the components to its requirements. Companies like Transelectronics had to supply the component to meet not only the physical and functional specifications of the component but the manufacturing processes including automated supply to a production line. The role of the Japanese team was merely translating the product/process requirements to the vendor but not being actively involved in the knowledge transfer.

Nor did Transelectronics used the knowledge within its own organization especially the US product development team. Neither the Japanese team nor the Singapore team made an effort to utilize the knowledge within the organization until the teams ran into difficulties and it was too late. There was lack of knowledge integration within the organization. Secondly, Transelectronics did not gain sufficient knowledge of its customers' requirements. Even the knowledge it had acquired from the customers through the interaction of its teams in Singapore and Taiwan was not effectively transferred to the team in Japan, which was working with the vendor in developing the molds.

The management of Transelectronics addressed the lack of global integration. It planned to move the product engineering organization from the responsibility of the country General Manager to that of the Vice President for engineering. This change was designed to create more effective communication between the regional engineering teams and the engineering teams at the headquarters responsible for generic technologies. Regional product engineering teams would then work closely with the country manufacturing/process engineering teams to ensure that new products developed were manufacturable in volumes to meet the market demand. It was also expected that moving the product engineering organization from the country management to a regional organization would improve the communication and knowledge sharing within the region as well as among the three regions. Although this organizational change might not have produced the level of "global knowledge integration" required, it was expected to improve the knowledge transfer within the organization.

The company was developing multiple sources for making molds and expected to reduce its dependence on a single vendor. The company had also started discussions with its customers to link its design centers with the customers' design/CAD engineering to move to concurrent engineering. Concurrent engineering would provide real time feedback on incompatibility of the component with the final product so that corrective action could be taken during the design stage, but would not result in the transfer of all of the tacit knowledge of the customer. Optimizing the knowledge transfer between the customer and Transelectronics was necessary. Although the customer would not be willing to transfer all of its knowledge, knowledge transfer had to be sufficient to enable Transelectronics to understand the customer's product and process requirements.

3.3. Mobile phones case: Component connector for mobile phones. In June 1999, one of the world's largest makers of mobile phones, Korelectronics, approached the company to develop a component for its new mobile phone. Initially it did not know exactly what it required in terms of the components' dimensions or functional performance neither did the product marketing team in Korea. Management instructed the Taiwan product development team to work directly with the customer together with the Korean sales team. Several meetings were held between the customer's engineering team and the Taiwan engineering team in July and August 1999.

The first sample was submitted in October 1999 but was rejected. A month later a second set of samples was submitted based on Korelectronics feedback. Not only did they again reject it but also they came up with new requirements for the component, which meant that it had to be completely redesigned. The Taiwan NPD was having a difficulty in translating the customers' requirements into clearly defined product specifications because there was a lack of information from the customer as to the implications of 3G technology and an inability of Transelectronic's staff to make sense of the needs.

Further meetings were held between Korelectronics engineers, the Taiwan NPD team and the Korean marketing team between December 1999 and July 2000. In Europe, Transelectronics had experience in developing similar components for mobile phone makers, such as Nokia and Ericsson, but the teams in Taiwan and Korea did not benefit from the knowledge of the European team. Korelectronics' engineers made several visits to the Transelectronics R&D and manufacturing facility in Taiwan in December 2000 and January 2001. In spite of all these efforts and after spending nearly US$ 800,000 there was no final solution in sight after nearly two years. The global product group manager and corporate management at headquarters insisted that the teams in Korea and Taiwan stop this project and inform Korelectronics. The Korean team, the Taiwan team as well as the Asia Pacific management team wanted to continue as the company would be the sole source for this component if it succeeded in meeting Korelectronics' requirements. The Korean team became very emotional as they tended to take group responsibility (Steers and Sanchez-Runde, 2002) and were adamant that they continue. The management agreed to give the team a maximum of three more months to resolve all the issues, a means of providing an outlet for the emotions (Trompenaars, 1994; Trompenaars and Hampden-Turner, 1998). The teams reached an agreement in April 2001 and commenced supply in commercial volumes in August. Transelectronics expanded sales to customers in Taiwan as well as in Europe to use this component for other applications such as PDAs.

3.4. Case studies 3 and 4: Problems of too much knowledge sharing. Case study 3 was a PCMCIA cardbus development for a notebook computer. In this case, Transelectronics outsourced the NPD and manufacturing to a well-known vendor in Japan who had the manufacturing capability to get the product quickly to the market. Transelectronics developed and patented the technology for the eject mechanism and asked their Japan team to meet the vendor's team at the vendor's corporate headquarters in Furukawa city in Tokyo and arrive at an initial draft agreement. This draft was forwarded to the company's counsel, and patent attor-

ney, at corporate headquarters in the USA. He reviewed the clauses relating to intellectual property rights while the Japan team was anxious to finalize the agreement to avoid missing the window of opportunity. The corporate counsel raised the question of ownership of the process technology and the drawings but the Japan team felt that the vendor would not agree to any changes to the agreed draft. The Japan team felt that management did not understand the Japanese culture of mutual trust in working relationships between customers and vendors. The contract was signed by the corporate HQ.

Although the product development was outsourced, the process of product development was fully managed by the company's team. The company patented the technology for the product and the vendor developed the product and the processes including the tools required to manufacture the products. Transelectronics paid for all the cost of investment made by the vendor.

The vendor commenced the product and process development immediately, completing this in June 1997 with first shipments to customers in the next month. The vendor insisted on patenting the processes for the manufacture and since Transelectronics did not have the resources or process technology it reluctantly agreed with a much larger company.

Unfortunately, the result was unsatisfactory. The product revenue was about 15% of Transelectronics revenue in the Asia Pacific region. The main customers in Taiwan and China were constantly demanding lower prices. Transelectronics' dominant market share was eroded because it could not get the vendor to reduce their price and therefore could not meet these price demands. Its customers moved to lower cost manufacturers. Transelectronics requested the drawings and details on the manufacturing processes, which the vendor refused to supply to Transelectronics.

The NPD involved the vendor handling the entire NPD, supervised by the company personnel. Although the company had patented the technology, it allowed the vendor access to the technology. As the vendor was doing the manufacture it developed the manufacturing processes, which it patented and Transelectronics was denied access to the process technology. When the company entered into the agreement with the vendor, there was a window of opportunity to secure ownership of the process technology. A year later, in 1998, the company lost a legal battle against a competitor who infringed the company's patent registered for the PCMCIA mechanism. This loss in litigation further weakened the position of Transelectronics vis-à-vis the vendor.

Case study 4 relates to a component for mobile computers. The company was approached by an ODM (original design manufacturer) in May 2001 to develop a mechanism for Dell notebooks in which the smart PC card is pre-inserted into the PCMCIA mechanism, a feature desired by at least 70% of the customers, according to a market survey. Having been chosen as the first supplier, Transelectronics anticipated a substantial share of the market and moved quickly in eight weeks to produce workable samples to be submitted and tested with the notebook that was being developed by the ODM.

Within a few weeks of submission Transelectronics found out that one of its major competitors had submitted an identical sample to the ODM. The company carried out a detailed investigation of its own employees who were involved in the NPD. Taiwan management team interviewed all employees associated with the NPD and attempted to verify all the evidence. Transelectronics believed its employees were not responsible for the leakage and raised its concern with the customer, the management of the ODM company. The management of the ODM agreed to investigate and found that one of its engineers had been leaking the information to Transelectronic's competitor. This not only posed a threat to Transelectronics but also to the ODM and the OEM as the information could have been leaked to other ODMs and to their respective OEMs.

3.5. Summary of cases. Transelectronics made significant improvements to its NPD processes and systems in the eight years from April 1994 to January 2002, but it still faced several issues including the best approach to sharing knowledge with vendors, lack of an accessible centralized database with drawings and specifications of all products, the inability to share both explicit and tacit knowledge as well as the centrally developed generic technologies.

Cultural and language barriers exist across the Asian region but they were pronounced in the Japanese operation with the Japanese tending to hold back information from people outside of Japan. This is sometimes attributed to their politeness (Mead and Jones, 2002) and their inadequacies in communication skills. There was also a view among the Asian people that knowledge whether it is explicit or tacit is proprietary to the individual. The company had chosen not to invest in its own resources and so relied on external vendors, which were often small or medium sized companies that depended on the individual toolmaker's expertise to support customers' requirements. Knowledge resides with the vendor and the toolmaker, which may be unwilling to share this knowledge with their customers. Even if they were

willing, understanding their knowledge and translating it into explicit one pose a major challenge.

Discussion

In the PC case, Transelectronics learnt three key lessons. First, there were ownership problems when the site handling the NPD either did not manufacture the product or it was not its customer. Second, there was a problem of knowledge sharing, for both the Singapore team and the Japanese team that did not seek the assistance of the US team, which had extensive capability to build computer models for molded parts, until they faced the problem on the housing. The Singapore team wanted to respond quickly to the market but did not explore existing knowledge in Transelectronics. Third, the absence of a structured approach to product and process development left Transelectronics exposed as there was no review at each stage of the product and process development.

In the second case, mobile connectors, the case study also reinforces the need for a clearly defined knowledge value chain to link the knowledge of the customer, component manufacturer, and vendor. Desirably, the customer who is the closest to the market and the consumer should have a good knowledge of what is required by the consumer and apply its own tacit knowledge to conceptualize the product. However, in this case mobile phone technology was evolving including 3G, but Korelectronics was not clear as to the strategy to move towards the new technology. Evolving technologies create an issue of what can be offered to the consumer in the short run.Secondly, language and cultural barriers made the sharing of knowledge with the Taiwanese NPD team more difficult. The Korean field sales staff and product-marketing manager could not handle the technical aspects and the customer's engineers had to communicate directly with the Taiwanese team. The frequent visits to Taiwan and the opportunity to socialize with the product development team contributed to the customer's engineers gaining trust and confidence in the team in Taiwan. Although verbal communication was limited to few words in the common language, English, by physically working together and with the help of body language, the Koreans were able to transfer their tacit knowledge to the Taiwan team.

The Taiwanese team was working with Taiwanese vendors, so knowledge transfer did not cause any major problems. However, with several local competitors in Taiwan, there was a risk of the vendor using the knowledge to support Transelectronics' competitors. The Taiwanese team had to, therefore, limit the knowledge transfer to what was required to make the tools.

In the third case, PCMCIA, the company had placed itself in a disadvantageous position by sharing complete knowledge of the product technology with the vendor. This was a combination of their employee's partially coded tacit knowledge and the explicit knowledge well documented. Uncoded tacit knowledge of the employee who invented the technology was still available to the company internally through socialization (Nonaka and Takeuchi, 1995). In retrospect, access to the coded tacit knowledge of the individual employee should be restricted to a few employees as long as the lack of such knowledge did not hinder the NPD process. Access to the product technology by the vendor should have been limited by co-developing the product with the vendor.

This case study provides a classic example for the need to try and establish equilibrium in knowledge sharing where there is co-dependence for knowledge, even when true equilibrium is unlikely. In these two case studies, if Transelectronics had only transferred the new product technology partially to the vendor, it could have avoided the vendor becoming a potential competitor. If Transelectronics had pursued this approach and the vendor had retained its proprietary knowledge on process technology, there would have been "equilibrium". We include this later in the paper in the knowledge value chain model as to how the MNC can shift its position from the "equilibrium" to place itself in a position of strength.

In the fourth case, mobile computers, the leakage of the product knowledge to the competitor through the customer's engineer was again caused by the lack of management of knowledge flow in the knowledge value chain. This case study demonstrated the risk of coding the tacit knowledge of the individual or group of employees. The customer's engineer had gained information including documentation of the product specification as well as the process specification. The problem that Transelectronics faced raised a new issue, which the company did not encounter in the other three case studies.

In Figure 2 we illustrate how the flow of knowledge should work in an MNC.

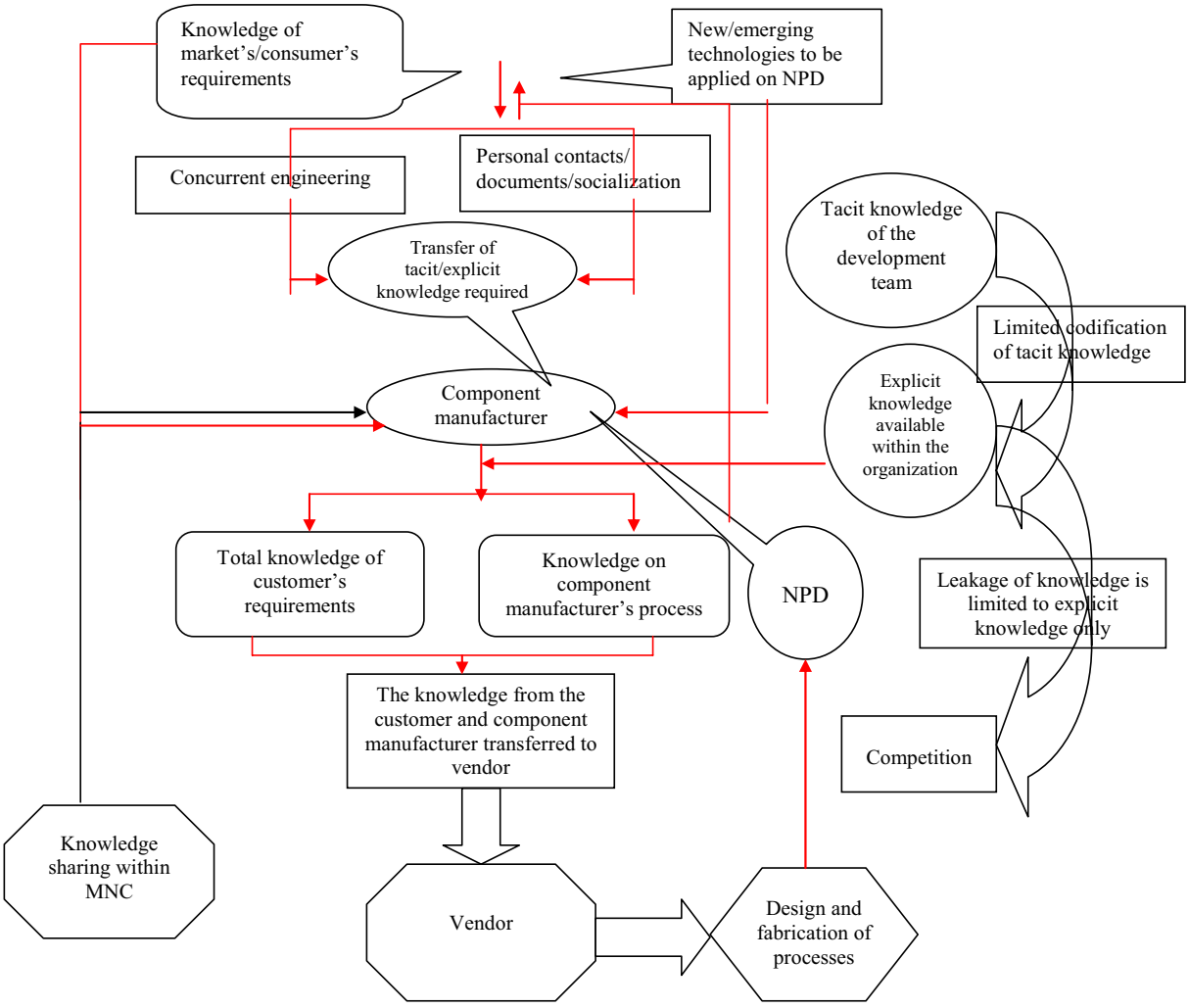

Fig. 2. A generic model for knowledge value chain

The knowledge flows recommended in the model address all the issues in knowledge sharing recorded in the case studies:

- both customer and the components supplier acquire knowledge of market/consumers' requirements and new and emerging technologies to be applied on NPD;
- transfer of required knowledge by customer to the MNC through concurrent engineering, personal contacts, documents, meetings and socialization;
- codification of proprietary knowledge/tacit knowledge only what is required and hence leakage through employees, vendors and customers is limited to codified/explicit knowledge. This approach will also eliminate the problems faced in case studies 3 and 4, where too much of proprietary knowledge was transferred to the vendor;
- knowledge sharing within the organization to respond to local market responsiveness, global integration and facilitate worldwide learning.

The model addresses the challenge faced by the companies in accelerating the NPD processes from the perspective of knowledge management. As companies have to respond to local market needs in terms of NPD, they have to draw from the knowledge available internally and at the same time share the knowledge with their partners in the supply chain to speed up their NPD processes. As we have seen in the case studies, both the aspects of knowledge sharing, internally within the organization and externally with the partners in the supply chain are critical for companies to gain competitive advantage through NPD.

This model makes a major contribution to understanding knowledge sharing within the value chain and within an MNC.

First, as new technologies emerge, companies, which serve the end user markets, have to apply them in their NPD and assess both market demands and the consumer preferences in terms of the new technology. Secondly, the customer must transfer its knowledge, both tacit and explicit, to the component

manufacturer, for it to be able to supply the component ready for production. Transfer of knowledge by the customer was a key issue in all the case studies. In terms of internal knowledge, there are three key issues that the model addresses:

1) integrating of knowledge gained by responding to a local market requirement;
2) using the knowledge existing within the organization to respond to local market needs;
3) managing the level of tacit knowledge converted into explicit knowledge, as it is well recognized that the codification of tacit knowledge will increase leakage of proprietary knowledge (Li and Scullion, 2006).

Transfer of knowledge to a vendor can be very important to ensure that the vendors' knowledge, predominantly tacit, is fully utilized in the development of processes and tools, but with a danger of knowledge leakage. In sharing knowledge back with the customer, the model prescribes that only a limited knowledge in the form of product and process information needs to be transferred back to the customer.

Conclusion

A company operating in an industry where product life cycles are short can gain competitive advantage by shortening the time taken for NPD by reducing the time to volume and manufacturing the product close to the customer and/or at the lowest cost site to maximize profitability. Optimizing knowledge sharing both within the organization and among the partners in the supply chain is key to developing this competitive advantage. Not only must companies be able to shorten the time to volume, they must be able to manufacture the first incremental volume of production (after product development) at the site, which yields maximum revenue, highest gross margins. In high technology industries, first entrants can command better prices as the new technology attracts greater prices and the lack of competition means that demand exceeds supply.

The knowledge value chain model was developed in a single organization in a particular time-frame. The next development in the model is to test and refine it in other organizations. It is possible that some of the issues of trust are heightened in the Asian environment and would be less important in other national cultural contexts.

The research demonstrates that managing knowledge and knowledge sharing is one of the key prerequisites to improve a company's ability to shorten time to market and gain competitive advantage in terms of its NPD. Developing the knowledge value chain becomes a key strategy to succeed in such a business environment.

Reference

1. Adler, N. & Hashai, N. (2007). Knowledge flows and the modelling of the multinational enterprise, *Journal of International Business Studies*, 38, 639-657.
2. Allen, T.J. & Cohen, S. (1969). Information flow in research and development laboratories, *Administrative Science Quarterly*, 14, pp. 12-19.
3. Almeida, P. & Kogut, B. (1997). The exploration of technological diversity and geographic localization of innovation, *Small Business Economics*, pp. 9, 21.
4. Almeida, P., Grant, R. & Phene, A. (2002). Knowledge acquisition through alliances: Opportunities and challenges, in M. J. Gannon & K.L Newman (eds.). *The Blackwell handbook on cross-cultural management*, Blackwell Publishers Ltd, UK.
5. Almeida, P. Grant, R. & Song, J. (1998). The role of international corporations in cross-border knowledge transfer in the semiconductor industry, in M.A. Hitt, J.E.R. Costa & R.D. Nixon (eds.) *Managing strategically in an interconnected world*., John Wiley& Sons, Chichester.
6. Almeida, P. Grant, R & Song, J. (2002). Are firms superior to alliances and markets? An empirical test of cross-border knowledge building, *Organization Science*, 13, pp. 147-161.
7. Austin, J.E. (1990). *Managing in developing nations: Strategic analysis and operating techniques*, Free Press, New York.
8. Bartlett, C. & Ghoshal, S. (1989). *Managing across borders*. Harvard Business School Press, Boston, MA.
9. Buckley, P.J. & Carter, M.J. (1999). Managing cross-border complementary knowledge, *International Studies of Management and Organization*, 29 (1), pp. 80-104.
10. Cabrera, A. and Cabrera, E. (2002). Knowledge sharing dilemmas, *Organization Studies*, 23 (5), pp. 687-710.
11. Ching, C. & Yang, J. (2000). Knowledge value chain, *Journal of Management Development*, 19(9), pp. 783-794.
12. Clark, K.B. & Fujimoto, T. (1991) Product development performance: Strategy, organization, and management in the world auto industry, Harvard Business School Press, Boston, MA.
13. Cooper, R.G. (1994). Third generation new product process, *Journal of Product Innovation Management*, pp. 11, 3-14.
14. Davenport,T.H. & Prusak,L. (1998). Working Knowledge: How Organizations Manage What they Know, Harvard Business School Press, Boston, MA.
15. Dussauge, P., Garrette, B. & Mitchell, W. (1998). Acquiring partners: Capabilities: Outcomes of scale and link alliances between competitors, in M.A. Hitt., J.E.R. Costa & R.D. Nixon (eds.). *Managing strategically in an interconnected world*, Chichester: John Wiley & Sons.
16. Dyer, J.H. & Singh, H. (1998). The relational view: Cooperative strategy and sources of interorganizational competitive advantage, *Academy of Management Review*, 23(4), pp. 660-669.

17. Fiol, M. & Lyles, M.A. (1985). Organizational learning', *Academy of Management Review*, 10(4), pp. 803-813.
18. Galbraith, J.R. (1977). *Organization design*, Addison-Wesley, Reading, MA.
19. Gupta, A.K. & Govindarajan, V. (2000). Knowledge flows within multinational corporations, *Strategic Management Journal*, 21, pp. 473-496.
20. Herschel, R. Nemati, H. and Steiger, D. (2001). Tacit to explicit knowledge conversion: knowledge exchange protocols', *Journal of Knowledge Management*, 5, pp. 107-115.
21. Kogut, B. & Zander, U. (1993). Knowledge of the firm and the evolutionary theory of the multinational corporation, *Journal of International Business Studies*, 4, pp. 625-645.
22. Jensen, R. and Szulanski, G. (2004). Stickiness and the adaptation of organizational practices in cross-border knowledge transfers, *Journal of International Business Studies*, 35, pp. 508-523.
23. Lee, C.C. and Yang, J. (2000). Knowledge Value Chain, *Journal of Management Development*, 19 (9), pp. 783-794
24. Leonard-Barton, D. (1995). *Wellsprings of knowledge: Building and sustaining the sources of innovation*, Harvard Business School Press, Boston.
25. Li, S. and H. Scullion (2006). Bridging the distance: managing cross-border knowledge holders, *Asia Pacific Journal of Management*, 23, pp. 71-92.
26. Liu, P.-L., Chen, W.-C., Tsai, C.-H. (2005). An empirical study on the correlation between knowledge management method and new product development strategy on product performance in Taiwan's industries, *Technovation*, 25, pp. 637-644.
27. Mowery, D.C. Oxley, J.E. & Silverman, B.S. (1996). Strategic alliances and interfirm knowledge transfer, *Strategic Management Journal*, 17, 77-91.
28. Mudambi, R. (2002). Knowledge management in multinational firms, *Journal of International Management*, 8, pp. 1-9.
29. Mudambi, R. and Navarra, P. (2004). Is knowledge power? Knowledge flows, subsidiary power and rent-seeking within MNCs, *Journal of International Business Studies*, 35, pp. 385-406.
30. Nonaka, I. (1994). A dynamic theory of organizational knowledge creation, *Organization Science*, 5 (1), pp. 14-37.
31. _____ (1997). Knowledge creation and sustainable competitiveness of the firm. Paper presented at a seminar organized by LIFIM (the Finnish Institute of Management) on Organisational Knowledge Creation, 23 March, reported by Veijo Sahiluoma, Kauppalehti, 1 April 1997.
32. Nonaka, I. & Takeuchi, H. (1995). *The knowledge-creating company,* Oxford University Press, New York.
33. Noordehaven, N. and Harzing, A.-W., (2009). Knowledge-sharing and social interaction within MNEs', *Journal of International Business Studies*, pp. 1-23.
34. Parkhe, A. (1993). Interfirm diversity, organizational learning and longevity in global strategic alliances, *Journal of International Business Studies*, 22, pp. 579-601.
35. Polanyi, M. (1966). *The Tacit Dimension*, Doubleday, New York.
36. Porter, M. (1986). *Competition in global industries*, Harvard Business School Press, Boston MA.
37. Strach, P. & Everett, A.M. (2006). Knowledge transfer within Japanese multinationals: building a theory, *Journal of Knowledge Management*, 10 (1), pp. 55-68.
38. Subramaniam, M. Rosenthal, S.R. & Hatten, K.J. (1998, November). Global new product development processes: preliminary findings and research propositions, *Journal of Management Studies*, 35 (6), 773-796.
39. Trompenaars, F. (1994). *Riding the waves of culture: Understanding cultural diversity in business*, Nicholas Brealey Publishing, London.
40. Trompenaars, F. & Hampden-Turner, C. (1998). *Riding the waves of culture: Understanding diversity in global business*, 2nd edition, Irwin, Chicago.
41. Von Hippel, E. (1988). The Sources of Innovation. New York: Oxford University Press.
42. _____ (1994). Sticky information" and the locus of problem solving: implications for innovation', *Management Science,* 40 (4), pp. 429-39.
43. Zander, U. & Kogut, B. (1995). Knowledge and the speed of the transfer and imitation or organizational capabilities, *Organization Science*, 6 (1), pp. 76-92.