Linking beyond lean: International new product development at Toyota Motor Europe

Keywords

International new product development, R&D subsidiary, Knowledge transfer, Automobile industry, Concurrent engineering

Abstract

Japanese automakers' NPD capability is characterized by integral organizational arrangement among different functional divisions whose tasks are concurrently overlapped and coordinated for problem solving between them, lead by a project manager. Previous researches pointed out that such integral organizational NPD capability, which is well established in Japanese cultural and social contexts, is difficult to apply to Western automakers. In particular, the narrowness of an engineer's job scope, which is related to labor market conditions beyond company control, has been mentioned as a hurdle for the transferring Japanese NPD capability to Western countries. However, these contexts could be bottlenecks for Japanese automakers when they internationalize NPD, and little argument and evidence exists concerning how to transfer the integral NPD capability to foreign subsidiaries.

We will analyze the NPD project of Toyota Motor Europe (TME) focusing on knowledge interaction within TME and with its parent firm. Our findings suggest that the narrowness of engineer's job scope is overcome by recruiting strategies and developing engineers' ability of specialized and enlarged knowledge. Enlarged jobs are also arranged by organizational structure changes, multiple knowledge transfer arrangements, and administration policies to give local engineers opportunities to learn by doing.

1. Introduction

The Japanese automakers' new product development (NPD) competitiveness, recognized as a part of the lean production system, is characterized by its integral organization capability and is explained by its national characteristics in the culture and the system of its origin that influences knowledge accumulation, sharing, and creation patterns (Clark and Fujimoto, 1991; Cusumano and Nobeoka, 1998; Nobeoka and Fujimoto, 2004; Nobeoka, 1996). On the other hand, Japanese automakers have set up offshore R&D subsidiaries and implemented international new product development (INPD). INPD is formed by cross-functional teams bringing personnel from two or more countries to collaborate on NPD, thereby tapping into exercises and resources inherent in multiple countries (Riege and Keeffe, 2007; Sivakumar and Nakata, 2003). The meta-national corporation concept (Doz et al., 2001) which links knowledge diffused among global institutions of research and development (R&D), is important for multi-national enterprises to establish their sustainable competence. However, we treat knowledge linkage in Japanese automakers' INPD in the traditional strategy concept that leverages the competitive superiority of headquarters to offshore subsidiaries, because their global NPD competitiveness relies on their competitive superiority created in Japan to a great extent (Sanbonmatsu, 2006). Our research questions are simple: "What are the bottlenecks and solutions when Japanese automakers transfer their NPD capability to offshore R&D institutions?" and "How do Japanese automakers arrange INPD collaboration for control/authority and task allocation among global institutions?" Previous studies did not pay much attention to these issues. There is a study of Sugiyama and Heller (2004) that discussed the characteristics of product architecture and Japanese automakers' capability. However, they focused more on knowledge interaction and heterogeneity among global NPD units and less on Japanese NPD capability application for offshore managerial conditions.

We will first briefly review the empirical findings and research evolutions related to Japanese automakers' INPD and their capability. Next, we will show an INPD case study of Toyota Motors Europe (TME) and discuss the findings.

2. Literature review

Eppinger et al. (1997) suggests, there are two streams of concurrent engineering research. One is that focus on relatively small projects (with five to ten people) with team integration concept and suggesting small teams are suitable for exposing and resolving technical issues because members work closely and understand each other. Second is that focus on relatively large projects (hundreds of people) composed of many smaller projects or function groups to execute specialized task each. Different tasks involved in such large NPD projects are interrelated mutually and transmitting information among different tasks is essential for the orchestrating different tasks within such large NPD projects.

This paper will focus on the second NPD management research stream to deal with relatively large NPD project with many engineering participants engaging in varieties of different R&D tasks. There are lots of NPD management studies have focused on how automakers integrate and coordinate different engineering tasks and its impact on managerial performances. We will mainly review NPD management of automakers in this section, though there are also studies of automakers' external NPD with component suppliers, such as Clark and Fujimoto (1991), Nishiguchi (1994) and Takeishi (2001).

Clark and Fujimoto (1991), a representative and influential study, initiated a primary approach to compare the NPD management of automakers in the 1980s. This study is categorized as a disciplined problem-solving perspective (Brown and Eisenhardt, 1995). According to Brown and Eisenhardt (1995), this perspective originated from studies of Japanese NPD in the automobile, camera, and copy machine industries. They also noted two other perspectives. One treats NPD as a rational plan whose success stems from a superior product, an attractive market and a rational organization that has little theoretical basis and considers too many variables, but triggered NPD research. Another treats NPD as communication, such as Allen (1977) and Katz and Allen (1982). They argued that successful NPD communication pertains to a method of facilitating internal and external communication by linking people of different sub-units having different knowledge and perspectives.

Clark and Fujimoto (1991) compared the interaction among the function groups in NPD projects and the leadership of the project manager and concluded that the Japanese NPD process under heavy weight project manager is superior to Western examples. In such a process, project managers are committed to comprehensive aspects of NPD and facilitate interaction among engineers of different function groups with their overall responsibility for the design, quality, productivity, profitability, and cost of the project. Japanese NPD project management is also distinctive because it consists of task flows among function groups, and such tasks are partly overlapped with inter-functional coordination (Imai et al., 1985; Takeuchi and Nonaka, 1986). Such a NPD process is called concurrent engineering, which requires less lead time and cost, reflects market needs for product design, and prompts inter-functional learning (Takeuchi and Nonaka 1986).

In the 1990s, the focus of NPD research of the automobile industry shifted from a single project management level to inter-project management level analyzing interaction among NPD projects called multi-project strategy (Cusumano & Nobeoka, 1998; Nobeoka, 1996). Within a multi-project strategy, NPD projects are grouped into subgroups to share core technology, such as the platform, and to achieve economy of scope among different products. For instance, Toyota implemented this strategy in 1996 by grouping its NPD organization into four development centers, to link NPD projects technologically. Within each division, semi-grouped projects were carefully coordinated and arranged by a common project manager and engineers to share technology and components among products.

After the multi-project strategy, two possible directions remain for NPD management at least. First is the joint new product development (JNPD) by means of a strategic alliance (Cusumano and Nobeoka, 1998; Nobeoka, 1996; Ishii, 2008). JNPD is defined as an NPD in conjunction with platform sharing among automakers' products. There are two JNPD types. One is the NPD transferring core components between partners (i.e., Mazda Carol JNPD with Suzuki). The other is the NPD project in which partners jointly participate, and mostly one partner is partially involved in the project of the other, and the product is sold by their brands (i.e., Honda Legend and Rover 600). Reducing NPD costs and lead-time, expanding the product line, and acquiring its partner's knowledge are its general motives for JNPD. Instead of managerial bottlenecks, such as coordination costs and knowledge management difficulties, automakers have aggressively implemented JNPD (Ishii, 2008).

The second direction is INPD to utilize the resource of global R&D institutions for NPD projects. As Japanese automakers increased export and offshore production, they set up and expanded their foreign R&D institutions, which were analyzed by Yoshihara et al. (2000), Sugiyama (2005), and Sugiyama and Heller (2004). However, these previous studies focused more on relatively general aspects of international management, such as the motives of foundation, roles, and localization. Conventional international R&D studies have not focused on the NPD process itself with a tendency for too much generalized discussion (Sugiyama, 2001).

As for Japanese automakers' NPD capabilities, note that their fit with product architecture characteristics has explained their competitiveness (Fujimoto, 1999). Product architecture refers to the design conception regarding how to decompose the product as a system into subsystems and how to define their relationships (Fujimoto, 2001). An automobile is categorized as an integral architecture whose inter-subsystems, such as components, have high interdependency and complex interdependence between product functions and structures (Ulrich, 1995; Fujimoto & Oshika, 2006). Due to such high interdependency and complexity of integral architecture product, interfaces among subsystems need to be coordinated for assembly. Fujimoto (2006) suggests that Japanese manufacturers' endowment of "integrative organizational capability" is suitable for the NPD of integral architecture products because it is based on long-term employment and long-term transaction practices that emphasize teamwork among multi-skilled workforces and integrative organizational manufacturing. He assumes that Japanese automakers had to engage in economically rational long-term transaction/long-term employment due to high economic growth amid shortages of work force, materials and money.

According to Nobeoka & Fujimoto (2004), limiting the size of NPD project members is one of the organization conditions of Japanese automakers' NPD capabilities. They indicated the average number of automaker's NPD project engineers: 105 (Japan), 424 (US) and 348 (EU). The width of the job scope of each engineer is one main factor to reduce the number of Japanese NPD project members and efficiently and effectively integrate engineers with different functions by project managers. They pointed out that in Western countries an engineer's job is so professionalized and institutionalized that it is narrowly specialized, divided with others and clearly defined in the labor market. So they assumed that it is difficult for Western automakers to enlarge the jobs of engineers at the corporate level and establish integral NPD organizational capabilities. In this sense, the management span of project managers at Western firms is relatively limited and may result in Western project manager's difficulties in coordinating the whole range of NPD projects (Nobeoka & Fujimoto, 2004).

However, Japanese automakers may also face such problems when they transfer their capability to their foreign R&D subsidiaries, which are mostly located in Western countries. In addition, when utilizing those subsidiaries as NPD units, they have to allocate the control and the tasks of the NPD project. Hence, our research question is: "How Japanese automakers relegate their NPD control and tasks and transfer their integral organizational capabilities to foreign R&D subsidiaries with different social and cultural contexts?" One possible solution is to orchestrate a NPD project by all expatriate engineers at foreign subsidiaries, which is ideal to realize integral organization capability. However, such a posed INPD does not bring sufficient merits of global NPD to utilize local engineers' knowledge and to reduce the cost of expatriates. In addition, it is not ideal to establish local brand images and alleviate trade conflict because it only makes a slight contribution to the local economy. Moreover, it is preconditioned with sufficient domestic R&D resource, which is a difficult condition for Japanese automakers.

Japanese automakers will find difficulty to construct NPD capability by orchestrating international R&D subsidiaries. According to Sugiyama (2009), Japanese auto assemblers have concentrated their resource and control of R&D activities mainly in Japan, which is different from sales or production functions and he suggest such a global strategy (Bartlett and Ghoshal, 1989) to concentrate R&D function at headquarters has supported Japanese auto assemblers' NPD capability. He also points out that NPD functions of Japanese auto assemblers are required to diffuse and globalized toward transnational strategy (Bartlett and Ghoshal, 1989), because they are closely linked with sales and production functions that have globalized in advance and their main customers are in foreign market today. Within this process, Japanese auto assemblers are required to raise their new or expanded foreign NPD organizations to harmonize their global activities. Otherwise, they may face risks to their NPD quality and cost because their NPD capability with overlapped process is realized under the condition that each NPD task is operated with sufficient and similar level of skill and knowledge. Krishnan et al. (1997) pointed out that there are limits to concurrent NPD process because disaggregation and finalization (or preliminary form) of develop information being exchanged among different tasks should be carefully coordinated for the overlapped NPD process. For instance, former NPD task conveys preliminary NPD information to the latter task, and the former task changes the final NPD information from preliminary one, after the later task has been started, the later task has to re-start its task again and the NPD will be delayed if the engineers do not have enough skills at the later task. This is because basic elements of R&D process are tasks that require input information, take to execute and produce decisions or output information for transfer to other tasks (Eppinger et al., 1994). If the later task is operated by a foreign NPD subsidiary with smaller capability than its headquarter with former task operation, its overlapped NPD process will be insufficient and ineffective. Previous studies paid attention less for such capability gap among different tasks, and more for change of NPD process from sequential one to concurrent one (i.e. Eppinger et al, 1994; Krishnan et al, 1997).

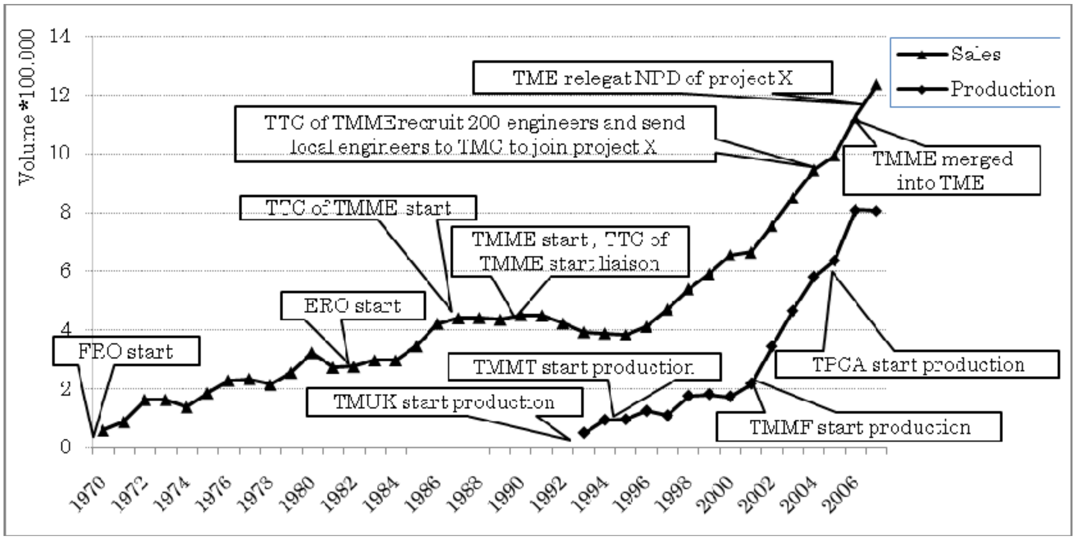
To seek explanations for our research question above, we will analyze the INPD case of Toyota Motor Europe (TME) and its collaboration with headquarter in Japan in the next section. Our case is based on published and internal documents about TME and our interview at TME. We also interviewed 24 people of TME (16 were Japanese and eight were European) in Belgium and Japan. Interviews were semi-structured and ranged from 0.5 to 2.5 hours.

3. International new product development case of Toyota Motor Europe

3.1 Toyota's business history in Europe

Toyota Motor Corporation (TMC) has increased its sales and production volume of automobiles and expanded its R&D operations in Europe, as seen in Figure 1.

Figure 1: Sales and production volume and R&D business operations of Toyota in Europe



Toyota started its European business in 1963 by exporting "Crown" to Denmark and in 1964 set up a European branch in Copenhagen. In 1967, Toyota set up a new European branch in Belgium because its sales had expanded to Western Europe. At that time, the European branch was under the control of the sales company, Toyota Motor Sales Co., Ltd. (TMSL), and it operated R&D activities, such as local homologation and market research. In 1970, the manufacturing company Toyota Motor Co., Ltd. (TMCL) founded a European branch Factory Representative Office (FRO) because such specialized R&D tasks as European (ECE) standard homologation and technology-related research were demanded in Europe. In 1982, these European branches merged into Toyota's European Representative Office (ERO) at the merger of TMCL and TMCL. Then evaluation development, such as testing and experimentation of products and components began at ERO.

In 1987, Toyota Technical Centre (TTC) in charge of the R&D related operations of ERO was set up with about 30 Japanese expatriate engineers, who stayed in Europe for three years in general, and some local secretaries in Belgium. In 1990, ERO became a local subsidiary of TMC called Toyota Motor Europe Marketing and Engineering S.A. (TMME) to cover sales, marketing, and development. In particular, TMME's mission to support Toyota Motors Manufacturing (UK) Ltd. (TMUK), which started production in 1992, was important because it was the first mass production factory for Toyota in Europe. Then TTC became a R&D subsidiary of TMME.

TMUK introduced a new task to TTC, "liaison," to support the coordination between TMC and TMUK and between TMC and local component suppliers. Japanese automaker engineers generally collaborate with people in the production area to solve problems of design development. In particular, the managerial philosophy of "Genchi-genbutsu," which literally means to go and see, is emphasized at Toyota, where even a development engineer has to visit the factory or component suppliers to grasp a problem correctly and solve it by studying changes to the product/component design or improve the production process. During offshore production, since it is much more difficult for Japanese engineers at TMC to recognize problems and collaborate with people in Europe, Japanese TTC expatriates act as coordinators between TMC and the production fields in Europe.

Afterwards, liaison engineering at TTC became important as Toyota increased its production volume in Europe with new factories in Turkey (TMMT), France (TMMF), and Czech (TPCA). In the mid 1990s, there were more than 100 engineers at TTC in Europe, more than half of whom were Europeans. TTC expansion was also related to adding R&D functions and institutions in Europe. As for styling design, the first Japanese expatriate was sent to ERO in 1983, TTC's styling institution, Toyota European Office of Creation (EPOC) was created in 1989 with 10 designers, and in 2000 EPOC was transformed into a new design unit called European Design and Development Centre (ED2) with 28 designers as a separate unit from TTC in France. In addition, there used to be some TTC branches and offices out of Belgium, such as in the UK and Germany. However, they were mostly integrated into TTC of TMME in the late 1990s. In 2005, TMME unified with Toyota Motor Europe Manufacturing, the production controlling company, and Toyota Motor Europe, the holding company, into Toyota Motor Europe S.A./N.V. (TME) to link sales, development, and manufacturing. Then TTC of TMME became TME Technical Centre (TMETC), which in 2004, started to recruit 200 engineers for design development and to construct new buildings with new investment of 75 million Euros. In 2006, TMETC had 580 employees (350 engineers), and in 2008, it declared to recruit 250 employees by the new investment plan which starts from 2009.

3.2 International new product development process

3.2.1 Localization of design development

In the mid 2000s, TME started new NPD tasks of design and evaluation development which were relegated from TMC. This NPD relegation was proposed and planned by Japanese expatriates in collaboration with local managers at TME in the mid 2000s. Some of these Japanese engineers had had long careers at TME and INPD experiences in the US.

The first reason for NPD relegation was to develop local market oriented products. By localizing NPD to seize customer demands in Europe, Toyota tried to increase its local sales. The second was to complement NPD resource scarcity at TMC, which was caused by an increase of product variety, global sales and production, and development of new technologies. Although Toyota introduced Computer Aided Design (CAD) system and out-sourced some engineering tasks to improve productivity, the demand for R&D tasks has drastically increased. The third reason is the marketing and political aspirations to be a local manufacturer. European customers and governments recognize Toyota as a local manufacturer by localizing its production and engineering. It increases Toyota's local sales and prevents political trade conflicts. The fourth is to motivate local engineers by localizing engineering tasks.

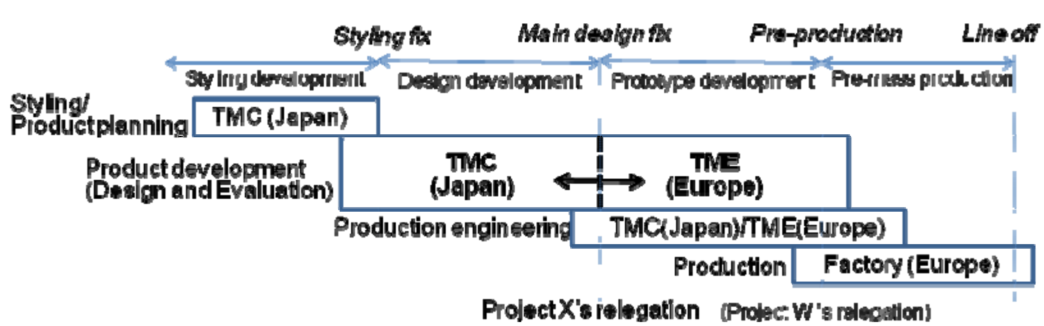
Skeptical views could be found at TMC about NPD relegation to TME. So, the top managers at TME explained the NPD relegation plan to managers at TMC. The first concern was the failure of NPD relegation, which might increase TMC's load to cover it if there were some problems caused by the NPD relegation. Second was related to the organizational structure change caused by NPD relegation, which strengthened the link between the design and evaluation development engineers for concurrent engineering. One possibility was that the evaluation development engineers might compromise their reports about product/component designs, if they always worked closely with the design development engineers. Actually, it did not happen because the European engineers performed their given tasks of evaluation development even in the circumstance of their close collaboration with engineers of design development.

3.2.2 Implementing international new project development project

In this section, we will analyze the INPD case of project X collaborated between TME and TMC implemented in mid 2000s. It should be noted that project W existed with little NPD relegation scale prior to project X. In addition, project W had a mother project in Japan that shared a main product design. By contrast, the product design of project X was originally created without tracing other products. Hence, TME was seriously underway of NPD relegation from project X.

Figure 2 indicates the INPD process of project X.

Figure 2: International new product development process of project X



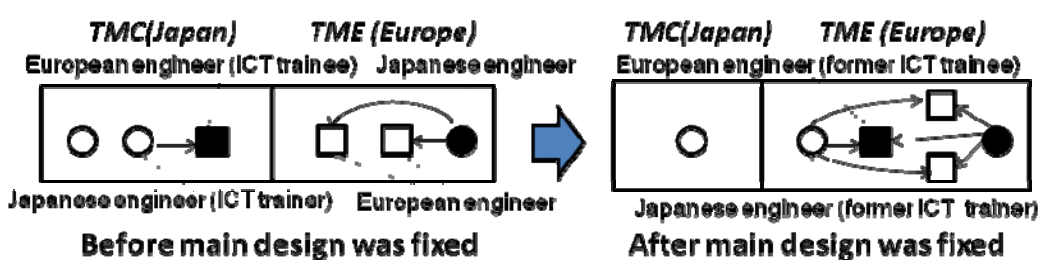
In project X, the responsibility and control of NPD was handed over from TMC to TME when the main design was fixed. The engineering tasks relegated to TME were the design development, which had responsibility for drawing the product design, and the evaluation development, which was in charge of the technical reports of products. About 20-30% of the total engineering manpower of project X was relegated from TMC to TME to finalize the product and component design by reflecting the product engineering requirements. At the relegation point between TMC and TME in the product development, the engineers of these institutions collaborated and coordinated by joint meetings and participation in mutual tasks. In addition to those cross-over activities, design and evaluation development were implemented in close coordination with the styling development of TMC, the product engineering of TMC and TME, and the factories and component suppliers in Europe.

Although most of local engineers engaged in project X, about 250 people were recent university graduates, there were some experienced engineers and a few of them had difficulty adapting to Toyota's NPD which is different from that of European manufactures. In addition, since the main mission of TMETC was transformed from liaison engineering to design development, some new local managers were promoted, but a few local managers were demoted too. Engaging design development of project X at TMETC accompanied these organization changes. At the same time, TMETC should construct capability by transferring new knowledge and organization system of NPD from TMC at this stage of NPD relegation from its headquarter.

3.2.4 International cross-over knowledge interaction

Within project X, T multiple knowledge transfer routes were arranged among TMC and TME engineers, as seen in Figure 3, to cultivate local engineers' abilities at TME and to bridge the international NPD tasks.

Figure 3: Cross-participation of TMC and TME engineers in project X



The left side of Figure 3 indicates the knowledge interaction among TME and TMC engineers before the main design was fixed. The arrows indicate knowledge transfer among engineers. At this stage, product development was operated at TMC under its control and responsibility. TME sent 35 local engineers to TMC as trainees to join project X for 1-2 years under a human resource development program, called Inter Company Transferee (ICT) program. In the ICT program, local employees of foreign subsidiaries are dispatched to TMC. Toyota started the program to cultivate foreign manufacturing subsidiaries' fast-track bureaucrats in the mid 1990s and applied it to the sales and R&D areas later. Apart from the project X oriented ICT program, a few local TME engineers worked at TMC on programs for fast-track bureaucrat cultivation purposes since the 1990s. Almost all of these ICT trainees were newly recruited engineers and sent to TMC after being engaged at TME for 6-12 months. They were from the design and evaluation development divisions of TME and paired with Japanese trainers at TMC. Their engineering task assignment at TMC is based on their requests as well as those of their TME managers. By participating in NPD operations at TMC, European engineers gained specialized knowledge, especially about the Toyota production system, and established networks with Japanese engineers. At this stage, the other local engineers who do not join the ICT program are trained by Japanese expatriates at TME.

The right side of Figure Y indicates the knowledge interaction among engineers after the main design fix stage. Here, project X was operated at TME under its control and responsibility, and European engineers being trained at TMC returned to TME and lead NPD using their project knowledge. Some Japanese trainers at TMC also stayed at TME for 1 to 2 years as advisers for three to five local engineers each in the body design and chassis design development groups. Knowledge transfer also occurred from the Japanese expatriates to the local engineers at TME.

3.2.5. Local engineers' specialized ability development

Developing local engineers' specialized skill and knowledge is emphasized at TME for NPD relegation because most are recent graduates. Each local engineer's assignment, confirmed in TME's human resource cultivation policy, is carefully designed to be suitable for his/her ability in addition to his/her preferences and background. For instance, new engineers at the design development division are generally assigned to relatively simple tasks under their own responsibility to gain experience to complete their tasks. At the same time, they are also assigned to tasks accompanying frequent interaction with other engineers to provide many chances to receive advice from others and to expand their knowledge. Afterwards, they are gradually assigned to more complicated and specialized tasks as they accumulate experience.

Moreover, a newly recruited design development engineer at TME is only allowed to draft on blueprints by hand, not by the three-dimensional CAD system. To draft by hand on a two-dimensional blueprint, an engineer needs to imagine the object from a particular angle and what part of it is focused. Then, engineers can cultivate their creative design ability in three-dimensions by hand drafting, which is difficult by using a CAD system because they can describe three-dimensioned drawings by computer. In addition, it is difficult for young engineers to learn from other engineers on CAD drafting because CAD's design information is complicated. On the other hand, designing by hand describes the object design simply in two-dimensions so that engineers can easily exchange ideas. Although design development by CAD system is more efficient than by hand, prioritizing the development of young engineers' abilities to draft by hand is also observed at other Toyota R&D institutions (Lyker and Meier, 2007).

Finally, the development of the local engineers' abilities by their own experience is prioritized at TME. Some Japanese and local managers mentioned that fostering the patience to let their subordinates finalize allocated tasks is quite difficult. Although they can relatively easily help or take over such tasks to solve problems, their subordinates need opportunities to learn by doing. Therefore, TME managers emphasize that they are expected to support their subordinates who are local engineers to learn their jobs by carefully designing job allocation and ability development. Cultivation of local engineers' ability may sacrifice NPD efficiency to some extent. However, it is recognized as a fundamental element of NPD capability at TME.

3.2.6. Inter-functional integration: job scope, organization structure, and knowledge

The job scope of each TME engineer is based on that of TMC, which is wider compared to Western automakers. However, such an enlarged job has been generally accepted by local engineers except for a few engineers who had worked at European firms and had difficulty adapting at the beginning. The recruiting policy for new engineers, which focused on recent graduates, contributed to assigning enlarged jobs for engineers at TME.

Here, the job scope of each engineer is not only conditioned by a particular description but also by TME's organization structure, knowledge, and awareness. The organization structure of TMETC was changed in 2003 to prepare for NPD relegation. Specifically, the design and evaluation development divisions were integrated into units of body, chassis, power train, and electric components to develop similar components or systems. Toyota started R&D activity with a small group of engineers in Europe, and each functional division has become bigger and separately operated at different locations. Within that gradation, TMETC's organization was structured as TMC's because the functions of liaison engineering are directly linked to each functional division of TMC.

However, when TME began its new mission of design and evaluation development, collaboration among these functions was important to exert Toyota's integral NPD capability. At the NPD stage after the main design fix of project X, collaboration between the design and evaluation development engineers to study product/component design changes and production process improvements is indispensable. In addition, this linkage is also enforced in a more physical way by collocation based on the units of the development group in the same office sitting side by side.

By strengthening inter-functional linkages, local engineers get chances to obtain broad knowledge and views beyond their assigned jobs. This is emphasized as well as cultivating specialized abilities at TME. For example, design development engineers are required to be able to design drawings by considering methods and contents of evaluation development. On the other hand, evaluation development engineers are required to propose constructive ideas for design changes by enhancing their comprehension levels for blueprints designed by design development engineers. It is too early to evaluate such cross-functional collaboration at knowledge or awareness levels. However, some positive indications, such as joint visits by the design and evaluation development engineers to component suppliers have become a daily occurrence that infrequently occurred before at TME. In addition, their communication based on daily interaction has become more efficient and effective.

Interestingly, some Japanese expatriates claim such inter-functional links at TME are stronger than those of TMC where each specialized division is operated relatively independently. Some also said that such strong inter-functional links resembled those of previous times when TMC's organization scale was smaller. Although such inter-functional links at TME may also be strengthened by its compact organizational scale, which has about 20 times less manpower, TME seems to be tracing TMC's capability roots.

4. Discussion and conclusion

Although our findings are obtained from one case study and their generality will be scrutinized in future research, they include important implications about NPD capability transfer for multi-national companies.

TME introduced a concurrent NPD process from its headquarter TMC by changing its organization structure and developing the local engineers' abilities. In the cultivation of local engineers' knowledge and awareness at TME, both specialized tasks and closely related tasks outside their own job on concurrent NPD processes were stressed. To develop such local engineers' abilities, including skills, knowledge and awareness, organization changes and varieties of knowledge flow were arranged at TME. The job scope of each engineer at

TME, which is relatively wide and is based on that of TMC, has been highlighted as a Japanese manufacturers' job allocation characteristic and a fundamental aspect of integral organizational NPD capability. Interestingly, enlarged jobs are generally accepted and performed by local engineers at TME except for a few cases. One reason of the relatively smooth introduction of enlarged job for local engineers at TME may be that its recruitment strategy in Europe focusing on recent university graduates without an experience at European manufacturers. It could have been implemented by improving Toyota's market position and strengthening its networks with local engineering universities in Europe. Allocating relatively enlarged jobs since Toyota started R&D activity in Europe may also be another factor. Hence, for the next research step, it is necessary to explore to what extent Japanese NPD organization capability and engineer job scope arrangement are applicable to other Western countries. Allocation of engineers' enlarged jobs at TME may have been possible due to its location in Belgium. Our case also suggests that the job scope of engineers is not the only factor for integral NPD organization capability establishment.

Off course, it is too early to judge whether TME has successfully introduced an integral NPD organization capability. However, TME's managers recognize that the combination of the job scope, the knowledge, and the awareness of local engineers are the keys to establish NPD capability of TME. Though previous studies focused solely on the job scope of engineers, knowledge and awareness exceeding the assigned job scope are also emphasized at TME for its capability construction. It may be because previous studies have identified that engineers obtain knowledge and awareness within the range of their allocated job scope.

Our findings also suggest that Western automakers have possibilities to introduce integral NPD organizational capability by rebuilding their organizational structures, arranging opportunities for engineers to obtain a broad range of knowledge and skills, and recognizing multi-functional values for NPD by combining an enlarged engineer's job scope; implementation, however, may not be easy, European automakers still have opportunities because the number of engineer-engaged NPD projects are between Japan and the US (Nobeoka and Fujimoto, 2004); this also means that the European engineer's job scope is between Japan and the US. To explore this argument, it is necessary to consider the circumstances of our case TME is located in Belgium which has not been argued much in previous research of R&D management. Previous studies, such as Fujimoto and Nobeoka (2004) and Cusumano and Nobeoka (1998) argued NPD capability of European auto assemblers from German or French manufacturers' perspectives because most of their R&D institutions are located in these countries. Hence, the special condition of our case of TME, located in Belgium, should be carefully scrutinized by reviewing its employment conditions and industrial evolutions (Ruysseveldt and Visser, 1996) and comparing with cases of

European auto assemblers located in other European countries in future study. Then, we can explain and discuss to what extent European manufacturers have chances to introduce integral NPD organizational capabilities from the aspects of their social circumstances.

As for the implications for NPD capability transfer from headquarters to foreign subsidiaries, our case suggests that arranging the receptivity of the subsidiary side is very important. At TME, the link between the design and evaluation development divisions was stronger than that of TMC, implying that foreign R&D subsidiaries require sufficient receptiveness by arranging advanced organization systems and the abilities of members than headquarters to absorb the essence of capability. Moreover, top managers at TME recognize that without an advanced and original capability at TME, its raison d'etre as part of Toyota's global R&D network is not enough, so its role must exceed the complements of headquarters. If it were realized, Toyota may proceed to the next step of its global strategy to integrate global R&D institutions' distinctive capability networks after the stage of mother-daughter capability transfer. Toyota has expended such a severe effort because it takes time and manpower to establish its integral organization capability at TME. To build a long-term capability in global networks at a multi-national firm, such seeding and growing aspects at foreign subsidiaries are crucial.

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