ARTICLES

Exploring the Role of Customer Interface Process in Oversea Markets: Lessons from Japanese Mobile Phone Handset Manufacturers in US

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This study attempts to explore how a firm successfully exploits its accumulated technologies and product development capabilities in relationships with more than a few customer firms within and beyond borders. Close relationships with a few specific customer firms enhance the exploration of distinguished/novel product technologies and development capabilities. Yet, growing customer/market diversity in the era of globalization requires firms to develop products effectively assimilating knowledge specific to each of customer firms in both local and offshore markets.

Drawing on the case of Japanese mobile handset manufacturers in US, the study argues that customer interface process confined to upstream product development stages helps a firm manage close relationships with more than a few customer firms even across borders. In product development process, the contrived customer interface process contributes to the effective selection and combination of specifications/technologies according to both domestic and oversea customer firms. The findings reveal that the effective knowledge transfer from offshore customer firms in product development could enhance the exploitation of a firm's technologies and product development capabilities. The knowledge integration process across borders is explicated by knowledge/problem-solving perspectives.

INTRODUCTION

Collaborative interfirm relationships are vehicles of the exploration of distinguished/novel technologies and capabilities. Studies on automobile development elucidate that collaborative relationships between firms enhance the knowledge exchange/sharing for exploratory problem-solving in product development process (Clark and Fujimoto 1991, Dyer and Singh 1998, Takeishi, 2002).

However, in the line of studies, critical knowledge is assumed to be bound to collaborative relationships between specific firms (Dyer and Singh 1998, Wasti and Liker 1999). Thus, a firm in closed relationships with a few specific customer firms is likely to have difficulties when attempting to cope with other firms outside the existing relationships.

In the era of globalization, the transfer and deployment of knowledge, particularly location-specific know-how, technologies, and customer/market requirements, across borders are critical, though difficult, for many of firms (Kogut and Zander 1993, Subramanian and Venkatraman 2001). As collaborative interfirm relationships are effective vehicles to assimilate the knowledge (Dyer and Singh 1998, von Hippel 1988), a firm would attempt to cope with multiple customer firms beyond closed, in many case local, interfirm relationships. The situation witnesses the necessity of the effective "exploitation" of accumulated technologies and product development capabilities in cooperation with multiple customer firms within and beyond borders.

Globalization requires many of firms to develop products, "transnational products," which have features responsive to diverse customer/market-specific requirements as well as features standardized across customers/markets (Bartlett and Ghoshal 1989, Prahalad and Doz 1987). A firm could exploit its knowledge, technologies and capabilities, emphasizing on both the similarities and differences of local customer/market knowledge among markets.

The importance of the effective exploitation of technologies and capabilities (Yasumoto and Fujimoto 2005a) is suggested in terms of the modularity/modularization of product design and engineering activities (Baldwin and Clark 1997, Cusumano and Nobeoka 1998). The standardized design and engineering activities may provide cost efficiency with a firm competing across markets.

On the other hand, the effective application of accumulated technologies and capabilities to multiple customer firms relies on customer relation process as a vehicle of knowledge transfer and deployment (Day 2000, Fujimoto 2004). Effective cross-national product development requires firms to assimilate customer/market specific knowledge, particularly tacit knowledge, across borders (Subramanian and Venkatraman 2001). Close relationships with customer firms may enhance the customer knowledge transfer and deployment across borders.

Yet, insofar, how a firm assimilates and exploits its knowledge in collaborative interfirm product development within and beyond borders is not sufficiently examined. Whereas the conditions (*e.g.,* cross-national team, international communication and experience) within a firm are outlined, the knowledge transfer and deployment "process" in product development in interfirm relationships across borders is still blurred.

The study attempts to explore the integration process of a firm's knowledge with customer firms' knowledge. Drawing on the anecdotal case of Japanese mobile phone handset manufacturers in US, the article addresses the question how customer interface process encourages the effective exploitation of accumulated technologies and capabilities in product development projects. The attempt would contribute to elucidating the knowledge integration process in product development across borders.

At first, the article reviews the determinants of interfirm relationships drawing on knowledge/problem-solving perspectives, and thereby points out the role of interfirm knowledge exchange/sharing at upstream product development stages. Second, the article attempts to cultivate the concept of customer interface process in product planning process. On the basis of the proposed perspective, the anecdotal case of Japanese mobile handset manufacturers in US is described. At last, the article summarizes findings, and thereby draws some implications for international manufacturers.

LOCUS OF PROBLEM-SOLVING AND INTERFIRM RELATIONSHIPS

Interfirm relationships are associated with architectural interdependencies between the components of a product system (Brusoni and Prenicipe 2001a, 2001b, Fujimoto 2004, Sturgeon 2002, Sturgeon 2002, Takeishi 2002, Ulrich 1995). In the line of studies, firms are presumed to benefit either of two alternative types of interfirm relationships, "closed" or "open", according to the level of interdependencies between the subsystems of the products concerned: integral/modular architecture.

The attributes of interfirm relationships is further envisaged in terms of the concept of the transferability of knowledge within and between firms (Kogut and Zander 1992, 1993). The transferability explicates how the locus of problem-solving in product development is partitioned between related firms (von Hippel 1994, 1998). The necessity of closed relationships between specific firms is attributed to the tendency that knowledge required for problem-solving is dispersed across firms (Brusoni and Prenicipe 2001b, Clark and Fujimoto 1991, Takeishi 2002). The locus of problem-solving calls upon the iteration among the multiple sites of specific knowledge (*e.g.,* sticky information, von Hippel

1994). The iteration would result in close relationships between a few firms, which each possess related specific knowledge.

Drawing on the knowledge partitioning in automobile development projects, Takeishi (2002) finds the factor to enhance the knowledge exchange/sharing between partner firms. When an automobile project includes the development of components based on new technologies, the fluidity of the boundaries of knowledge calls for overlapping problem-solving process across firm boundaries (*e.g.*, design-in activities). The exchange/sharing of specific knowledge in the process bears closed manufacturer-supplier relationships.

On the contrary, if the knowledge required is partitioned by clear-cut boundaries between related firms, the firms may rely on open interfirm relationships, such as modular production networks of firms (Sturgeon 2002). Problem-solving activities are partitioned into each of subsystem engineering/design activities when related knowledge is localized within each subsystem development group.

In the line of studies, interfirm relationships is characterized with knowledge exchange/sharing at design/engineering stages. However, closed interfirm relationships at design/engineering stages are at best one of the options to satisfy customer firms' needs.

If partitioned by clear-cut firm boundaries, most of design/engineering knowledge is held at each of specialized firms (*e.g.*, modularity, Baldwin and Clark 1997). In the case, a supplier will attempt to respond to customers' requirements assimilating customer-specific knowledge within the limit of confined development activities such as product concept/specification planning.

The limited locus of knowledge exchange/sharing will allow the supplier to restrict iterative, thus overlapping, problem-solving process with customers to the range of fluid knowledge boundaries at upstream stages. The limitation of the range of overlapping problem-solving may reduce knowledge exchange/sharing costs relevant to task interdependencies between these firms. Thus, the supplier may expand the scope of customers, to which manufacturers' technologies and development capabilities are applicable.

The logic makes us infer that the necessity of specific knowledge exchange/sharing between firms does not necessarily result in "closed" relationships between a few firms (See Fig. 1). Even in the relationships relatively open to more than a few specific customer firms, a firm could assimilate customer-specific requirements into products. In reality, several Japanese electronic firms (*e.g.*, Denso, Omron, Roam) are reported to be dexterous at customizing products for multiple customers without changing their technological bases (Fujimoto 2004).

The characteristics of interfirm relationships depend

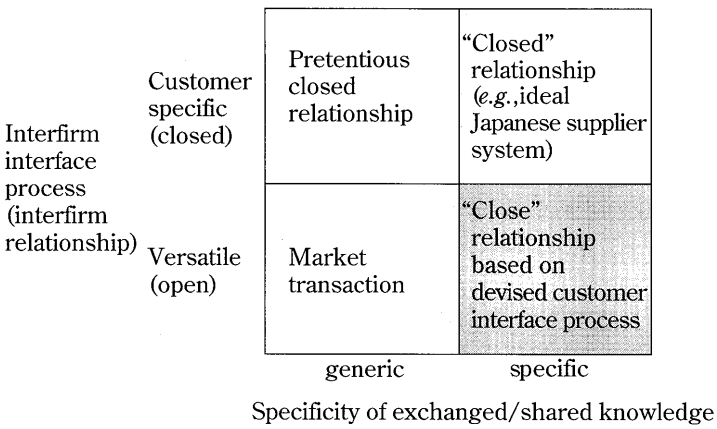

Figure 1 Interfirm interface and knowledge specificity

upon interfirm interface process. The interface process will enhance the exchange/sharing of specific knowledge between a few firms. In the line of automobile development studies, interfirm interface process, such as "absorptive capacity (Dyer and Singh 1998)," is presumed to be idiosyncratic to a closed interfirm relationship stretched over design/engineering or entire development process.

Yet, interfirm interface process, particularly a supplier's customer interface process, could be versatile. The process would encourage the collaborative iteration confined to focused stages, particularly upstream stages, to the extent that the supplier could benefit "close", not closed, relationships with multiple customer firms even across borders.

CUSTOMER INTERFACE PROCESS FOR EXPLOITATION

On the base of the above discussion, the article posits that the attributes of customer interface process conditions how a firm could exploit the technologies and capabilities in close relationships with more than a few customer firms. The exploitation process demands coordination between the firm and knowledge boundaries when the range of required knowledge spreads over customer firms (Herstadtt and von Hippel 1992, Lilien et al. 2002, Ogawa 2000, von Hippel 1988). Thus, in the exploitation process, a firm attempts to coordinate its own accumulated technologies and capabilities and customers' requirements (Brusoni and Prenicipe 2001b, Day 2000).

The coordination demands the assimilation of the knowledge on customer firms in the process aligned with the corresponding process of customer firms (Day 2000). As for product development, two strategies to exploit specific knowledge on customers' requirements, "the lead user approach" and "the customer-based mass-customization approach," are proposed in terms of knowledge/problem-solving perspectives.

Drawing on the cases of industrial machineries, network systems, test equipments, and so on, the former approach shows that customer-specific knowledge, such as sticky information on the needs and solutions of a few lead users, helps a firm create new product concepts, and/or drives product/technology innovations (Herstadtt and von Hippel 1992, Lilien et al. 2002, Ogawa 2000, von Hippel 1988). Iterative problem-solving with a few lead users is presumed to foster the exploration of novel products/technologies.

On the contrary, the user-based mass-customization (von Hippel 1998) approach focuses on the localization of problem-solving within customer firms. The case of application specific semiconductor demonstrates that a supplier firm leaves customization tasks to customer firms so that the customer firms could process the knowledge on their own needs. Whereas the user-based mass-customization enables a firm to cope with more than a few customer firms, customer firms in many industries often do not have sufficient design/ engineering knowledge.

The specialization of design/engineering process still leaves knowledge boundaries overlapped between firms within confined stages. A firm could be sufficiently responsive to the requirements from several customers when the collaboration is restricted within relatively limited locus. In the case, iterations across firms could succeed mostly within upstream stages, concept generation and product planning processes, until firms find the satisfactory combinations of technologies and specifications.

Knowledge exchanged/shared at the stages does not range over design/engineering knowledge, but could be limited to the knowledge for product concept/ specification planning. Customer interface process for the exploitation of technologies and capabilities is expected to encourage the exchange/sharing of knowledge with customer firms to meet the requirements at a relatively low cost.

The cost of the full-customization for a single customer firm, which means the integration of design/technology knowledge with local customer knowledge, is likely to be higher. The cost may urge the firm to sacrifice the responsiveness to other prospective customers/markets. The cost of interfirm collaboration makes a firm face the difficulties to be adept at multiple customers/ markets.

On the other hand, the enrollment of customer firms at product planning stages may restrict the collaboration process for the search and selection of eligible combinations of technologies and specifications coupled with customers' requirements and strategies (Herstadtt and von Hippel 1992, Lilien et al. 2002, Ogawa 2000). The contrived customer interface process confined to product planning stages will enable the enrollment of more than a few customer firms in product development. The principle of the contrived customer interface process is to transfer customer knowledge and thereby deploy the accumulated technologies and capabilities involving multiple customer firms in product development process.

RESEARCH DIRECTION AND DATA COLLECTION

The article focuses on the customer interface process of two Japanese handset manufacturers in US in the early 2000s. The saturation of the domestic market and the international standardization of mobile telecommunication technologies toward the 3G (third generation: CDMA and WCDMA) (1) have encouraged Japanese manufacturers to advance to oversea markets since the end of the 1990s.

Yet, Japanese manufacturers are positioned far behind top manufacturers, such as Nokia, Samsung, Motorola, LG, Sony-Ericsson, in terms of the market share in the world. Whereas leading the evolution of handsets in accordance with advanced mobile telecommunication services, Japanese manufacturers' performances are not necessarily prominent in the global mobile phone industries.

Japanese manufacturers have enjoyed the success in the exploration of advanced product technologies and handset development capabilities (2). However, the local mobile service provider-manufacturer relationship as well as the telecommunication technology difference between Japan and other markets hinders the exploitation of their technologies and capabilities (Funk 2002).

In recent years, the rise of several Japanese mobile handset manufacturers, nevertheless, is reported in US. The case of these Japanese manufacturers in US casts doubt on the concept of knowledge transfer and close relationships between specific firms.

The original data on the sample handset development process was collected from 2001 to 2005 both in US and Japan. Eight Japanese handset manufacturers and four non-Japanese handset manufacturers were involved in the study. The study conducted semi-structured interview researches based on a questionnaire sheet on "platform/base-model" handset development process, which includes knowledge exchange/sharing process with major customer service providers.

Respondents were product planning managers and/ or handset development project leaders, who were mostly engineering section managers. The business/ corporate information was gathered from publications on mobile phone industry, handset business, and handset manufacturers.

Five Japanese and non-Japanese manufacturers provided the information on the handset development for both the US and Japanese markets. After examining the collected data, the study focuses on two Japanese manufacturers, which were relatively successful in both the US and Japanese markets (3). Technological factors would be controlled to some extent since both develop handset business based on the CDMA technology in both US and Japan (4).

JAPANESE MOBILE HANDSET MANUFACTURERS IN US

In recent years, several manufacturers, LG, Samsung, Motorola, Kyocera, and Sanyo, have soared in US as the handsets meet the demand for high-specification models in the market (5). Korean and Japanese manufacturers particularly account 40% of the market share in 2004. It is reported that the demand for high-specification handsets, which have been already diffused in the Japanese market, has grown even in the US market.

Particularly the growth of the CDMA handset market raises these manufacturers. The total market share of Sanyo and Kyocera in US amount to about 10 % in 2005 (6).

A customer satisfaction index has also ranked Sanyo, LG, and Samsung as top three manufacturers in recent years (7). The ranking is explicated by the high-end features of the manufacturers' handsets. Kyocera is not ranked as the top manufactures, but is evaluated higher than several major manufacturers.

In the ranking, the manufacturers continuously excel major manufactures from 2001 to 2004 (*e.g.*, Nokia and Motorola). Since the late 1990s, these manufacturers have fallen behind Korean and Japanese manufacturers in developing high-specification models in terms of the features: color display, digital camera, MPEG player, shell style design, and so on. These features are closely related to advanced mobile telecommunication services such as contents download, graphical data transmission, and user-friendly graphical interfaces.

These data shows that two CDMA manufacturers, Sanyo and Kyocera, particularly flourish among Japanese manufacturers.

Sanyo is the top vendor of KDDI, which is the only CDMA provider, the second largest provider in Japan. Sanyo also provides the handsets for NTT DoCoMo (WCDMA handsets) and Vodafone. Sanyo has devoted the handsets to Sprint PCS (8), the second largest CDMA provider, in US since 1998. In recent years, Sanyo competes with Samsung for the position of the top vendor of Sprint PCS. As one of the top vendors of Sprint PCS, Sanyo had grown the sales 40% annually until 2004.

On the other hand, Kyocera has been one of the leading vendors of KDDI. Whereas the handsets are mostly for KDDI in Japan, Kyocera provides the handsets for several providers including Verizon Wireless (9), the largest CDMA provider in US. Kyocera succeeded the handset business in US from Qualcomm, the dominant CDMA baseband chip vendor. The background would account for the variety of Kyocera's partner providers in US. In US as well as in Japan, Kyocera has rather focused on the middle or lower market. As one of the major CDMA vendors, Kyocera has retained the stable market share, about 5%, in US.

The success of these manufacturers might be attributed to the manufacturer-provider relationships distinctive among both non-Japanese and Japanese manufacturers in US. Sanyo and Kyocera are not the traditional vendors of NTT DoCoMo, which has been the largest Japanese provider based on the PDC technology, the Japanese-specific standard. As CDMA handset vendors, Sanyo and Kyocera face difficulties to build dominant positions in the Japanese market, but have chances to make use of the CDMA-related technologies, such as wireless core, platform design, basic telecommunication software, middle ware, and so on, across borders.

The technological bases have also minimized the necessity of "heavy" collaborations ranging over design/engineering activities with specific customer providers, so that the manufacturers could reduce the development cost as well as leadtime. These factors have enabled the manufacturers to build the close relationships both in the Japan and US markets. In the close relationships with US providers, these firms, particularly Sanyo (6), enjoy the high evaluations on the products and drastic sales growth in the US market.

The handsets for the Japanese market are more advanced and complex than for the US market (7). Reflecting the difference between these markets, the product development strategy largely rests on how to apply the technologies and capabilities, which have been already verified in Japan, in the relationships with the US customer providers.

As is the case of other manufacturers in Japan, Sanyo and Kyocera develop specific handsets in their close relationships with customer providers, particularly CDMA providers, in US (8). These manufacturers have experienced in the handset business in the close relationships with the only CDMA provider, KDDI, in Japan. Most of the advanced features and functions of their handsets, not least related to mobile telecommunication services, are transferred from Japan to US in the relationships with their customer providers (*e.g.*, contents download, data transmission, music player, user-friendly color graphical interface).

These Japanese manufacturers, particularly Sanyo, have introduced advanced features, color display, digital camera, MPEG player, shell style design, and so on, in advance of major US and European manufacturers. Yet, the handset development performances (*e.g.*, leadtime, Clark and Fujimoto 1991, Eisenhardt and Tabrizi 1995) are on average better those of competitors (9). Their novel handset development leadtime of these manufacturers, 10-12 months, are not longer than other competitors (10). The leadtime of the modified models following their Japanese handsets is at the longest 6-8 months, mostly dedicated to software refurbishment, even though the models concerned include the most advanced features for the US market.

CUSTOMER INTERFACE PROCESS IN PRODUCT DEVELOPMENT

In Sanyo and Kyocera, the handsets for the US market are roughly divided into two types: the handsets designed specifically for the US market and the applied handsets of Japanese models to the US market. Both the firms adopt similar handset development process in both the projects for US and Japan.

In many cases of the former type model development, both the hardware and software are designed for specific models for each US provider. These manufacturers develop model-specific designs without definite basic designs and common parts.

Yet, common resources for the CDMA manufacturers, which are mostly arranged or provided by a leading US CDMA technology vendor, Qualcomm, are available for these manufacturers. These manufacturers exploit common components particularly related to wireless connection (*e.g.*, baseband chip) and software (*e.g.*, BREW/JAVA applications and application platform, wireless interface software) in the models for both US and Japan. Also reference designs, which layouts the fundamental configurations of baseband chips, RF units, related components on basic circuit designs, may be shared among the models for both the US and Japanese markets.

Based on these common resources, these manufacturers develop new product designs (circuit and mechanical designs) and components mostly relevant to applications (*e.g.*, camera, display, keyboards). Software and related data are developed or modified in accordance with the services and specification requirements of customer providers (*e.g.*, model/ provider-specific applications, user-interface, wireless connection).

On the other hand, projects for the latter type model reuses basic hardware design, components, and software of past models for the Japanese market. Considering specifications demanded by the US providers and subscribers, the manufacturers modify the portions of elements (*e.g.*, applications, protocols, user-interface) of preceding Japanese models.

In Sanyo and Kyocera, handset development activities for US are separated from those for Japan.

Nevertheless, these firms adopt similar handset development process, including product planning, in both projects for US and Japan. The coordination at product planning stages is carried by product planning groups. Planning members including managers usually do not devote to a single project, but are involved in several projects.

Sanyo and Kyocera enroll focused US providers in development process as is the case in Japan. These manufacturers and providers have routines to exchange/share their proposals and requests. Yet, in projects for US, intensive involvement of providers is held for 3-4 months of product planning stages in entire handset development process (6-12 months).

In the process, manufacturers' product planning groups and product design ones collaborate to contrive basic product concepts, exterior designs, features, specifications as well as development costs and schedules. The process draws on technologies and products already verified in Japan. Bearing the results, Sanyo and Kyocera offers handset model plans to providers.

Providers review the proposed handset development plans on the base of their product and service plans. Reflecting providers' reviews, manufacturers' product planning groups select and combine specifications and technologies to elaborate product concepts, basic designs, features, costs, and schedules, and so on. The manufacturers improve original plans in the process, and offer revised plans to providers.

Information exchanged/shared in the search-plan-review cycle includes materialized requirements as well as intangible requests. The information ranges from basic wireless technology specifications and costs to components, designs, and software to other miscellaneous features. These elements are related to providers' product strategies and service plans.

Basic requests from providers could be presented in materialized forms (*e.g.*, basic specifications, cost, schedule, technological requirements). Furthermore, providers suggest intangible requests (*e.g.*, application features, body color, exterior design, user-interface).

The search-plan-review cycle is usually repeated at least several times. During the process, product planners, particularly planning leaders, communicate with providers more than once in a week. When providers accept the proposal, the handset development project is formally approved.

The intensive manufacturer-provider collaboration confined within upstream stages (See Fig. 2) is different from those of both European and US manufacturers and other Japanese manufactures. In the Japanese market, manufacturers would need to develop high-specification handsets according to advanced mobile services of provider. The process requires manufacturers to develop model-specific design, components, and software and to

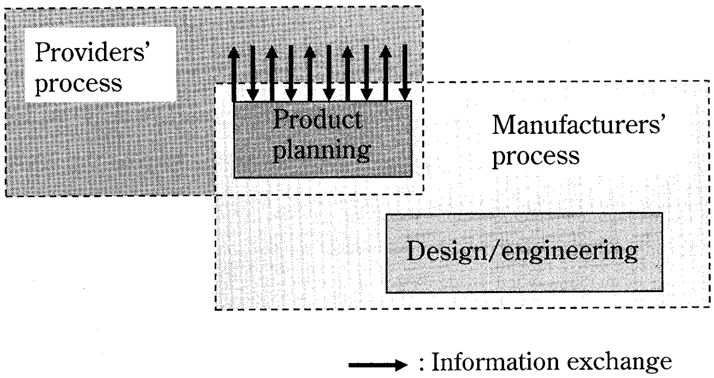

Figure 2 Overlapping confined to product planning process

furbish specifications and design elements by projects (Yasumoto and Fujimoto 2005a).

As is the case in automobile industry, the Japanese mobile handset industry is characterized with closed interfirm relationships (Funk 2002). In the closed relationship, Japanese manufacturers collaborate with domestic providers through almost entire development process including design/engineering process.

On the contrary, major global manufacturers are liable to exploit the basic product designs/platforms modifying specifications for providers in the world. The handset development process is also not adhere to any specific providers, but is applicable to multiple providers. Thus, the handset development process is rarely overlapped with providers' process.

Yet, it should be noted that Sanyo and Kyocera neither simply offer their standardized products nor simply follow providers' requirements. The differences between Sanyo and Kyocera and other manufacturers in manufacturer-provider relationships rest on the interactive process confined to product planning stages. The process in these manufacturers would contribute to boosting the selection and combination of specifications and technologies aligned with providers. As a result, these firms could make use of their technologies and design capabilities instead of specific model designs.

CONCLUSIONS

The article attempts to explore how a firm could exploit its technologies and capabilities assimilating specific knowledge from more than a few customer firms. The study draws three findings from the anecdotal case.

At first, effective customer interface process does not rely on a few local customer firms. Second, the process (*i.e.*, product planning) contributes to maintaining close interfirm relationships, which enhance the assimilation of specific knowledge from more than a few customer firms. Third, the process helps a firm effectively exploit the technologies and design capabilities to select and combine technologies and specifications aligned with customer firms' requirements and strategies.

These findings make us infer that contrived customer interface process may help a firm links product strategies, such as platform/multi-project strategies (Cusumano and Nobeoka 1998), with customers' requirements in a consistent manner (Fujimoto 2004). Contrived customer interface process would also drive the coordination of spreading knowledge in overlaps between firm and knowledge boundaries (Brusoni and Prenicipe 2001a, 2001b).

The study is intended to envisage the characteristics and significance of customer interface process in product development activities across borders. How local knowledge should be transferred and combined is a critical issue for international firms (Bartlett and Ghoshal 1989, Kogut and Zander 1993, Subermanian and Venkatraman, 2001). Globalization requires firms to shape the capabilities to develop products simultaneously for multiple customers/markets (Bartlett and Ghoshal 1989, Prahalad and Doz 1987, Subermanian and Venkatraman 2001).

Yet, the attempt to meet the requirements of diverse customers/markets may sometimes contradict the exploitation of firms' technologies and capabilities common across customers/markets. The study reveals that the contrived customer interface process could help firms overcome the difficulty. The case in the study would contribute to elucidating the international knowledge integration mediated by the contrived customer interface process.

The findings are expected to provide multinational firms with guidelines for effective exploitation of technologies and capabilities spanning the differences between customers in the diversity of the global markets.

We need to further understand the attributes of customer interface process and knowledge exchange/sharing between related firms. Also the relevance of customer interface process to technological bases and strategies should be examined hereafter.

＊ ACKNOWLEDGEMENT

The research was supported by the Grant-in-Aide for Young Scientists (B) for Scientific Research (14710127) from 2002 to 2005, the Ministry of Education, Culture, Sports, Science and Technology, Japanese Government. I wish to express my gratitude to the directors, project managers, and staffs for participating in the research.

NOTE

(1) CDMA is the Code Division Multiple Access technology (here including cdma One, cdma One 1x and cdma One 1x EV-DO). WCDMA is the Wideband Code Division Multiple Access. Both are based on IMT-2000 by ITU (International Telecommunication Union).

(2) After the introductions of "ez-web" by KDDI in 1998 and "i-mode" by NTT DoCoMo in 1999, Japanese manufacturers have preceded European and US manufacturers in the experiences of high-specification handset development closely related to wireless services. Furthermore, the introduction of the 3G after 2001 accelerates high-specification handset development in Japan.

(3) The clinical data of projects for the Japanese market were collected from Kyocera (Oct 18, 2000; Dec 2, 2003) and Sanyo (Dec 26, 2002; Jun 25, 2003). For the projects for the US market, interviews were held at Kyocera (Sept 24, 2004) and Sanyo (Dec 26, 2002). Afterwards, additional data were successively supplemented by project managers through e-mail correspondences from 2003 to 2005. For the details of the case, see Yasumoto and Fujimoto (2005b).

(4) The CDMA subscribers account for 46 % (70.5 M) in US (EMC World Cellular Data Base, Apr, 2004) and 21 % (17.25 M) in Japan (TCA, Apr, 2004).

(5) Soumu-syou (The Ministry of Internal Affairs and Communications, Japanese Government), 2004, *Jouhou Tushin Hakusyo (Information and Communications in Japan 2004).*

(6) Strategy Analytics, press release, 2005.

(7) "U.S. Wireless Mobile Phone Evaluation Study", JD Power, press release from 2002 to 2004. The handset performance rank is evaluated by features, durability, physical design, battery function, and usability.

(8) Sprint PCS is the 4th largest US providers in 2004. Sprint PCS also procures the handsets from Samsung, Nokia, LG, Motorola, and Toshiba.

(9) Verizon Wireless also procures the handsets from other major CDMA manufacturers, LG, Samsung, Motorola, and so on.

(10) Interview researches from 2001 to 2005.

(11) For instance, advanced handsets in Japan are equipped with complex product functions (more than 1 million step software in 2003). Handsets with equivalent functions prevail in US at least 1~2 years later than in Japan.

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【2006年8月7日受理】