Knowledge Creation and Multi Cultural Management in the New Product Development Process
-Centering on the Competitive Advantage and the Project Leader's Multicultural Management Capability-

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(1) Definition of the Issue

As reflected by the growing importance of knowledge intensification and knowledge work in industry, the analytical perspective from the theory of "knowledge creation" has assumed a seemingly significant role, whether in competitive strategy theory or innovation theory. When looking at organizational capability as a source of competitive advantage, the dynamic capability view, which departs from critical inspection of the existing competitive strategy theory in being capable of responding to changes in the competitive environment, has commanded formidable attention (Hamel, G. and C.K. Prahalad: 1994, Goldman, S.L., R.N. Nagel. and K. Preiss: 1995, Teece, D.J., Pisano, G., and A. Schuen: 1997, Brown, S.L. and K.M. Eisenhardt: 1998, Dosi, G., R.R. Nelson and S. Winter, (ed,): 2000, Kawai, T.: 2004). As such, there have been advances in research relating to "intra- and inter-organizational learning" and the basis of dynamic capability (Argyris, C.: 1977, Argyris, C. and S. Donald: 1978, Senge, P.: 1990, Matsuyuki, Y. and A. Matsuyuki.: 2004), as well as in research pertaining to "knowledge creation," competitive advantage and management (Konno, N. and I. Nonaka.: 1995, Nonaka, I. and H. Takeuchi: 1996, Grant, R.M.: 1997, Spender, J.C.: 1996, Ruggles, R. and D. Holtshouse (eds.): 1999). From the view that "learning" is by nature a "transfer of knowledge" from the best practices of other organizations, "learning" can also be classified alongside knowledge management as a category of knowledge creation theory.

In addition, even from the viewpoint of innovation theory or management of technology theory (MOT), progress has been made regarding the examination of the relationship between new knowledge creation and product development. (e.g., Leonard, D. 1995, Christensen, C.M.: 1996, Tidd, J., Bessant, J. and K. Pavitt: 1997, Burgelmen, R., M.A. Maidique and S.C. Wheelwright: 2001, Christensen, C.M. and M.E. Raynor: 2003, Lester, R. and M. Piore: 2004).

The geographical decentralization of the global model or standard of scientific and technological knowledge production (Tidd, J. J. Bessant and K. Pavitt: 1997, Hayashi: 2004, 2006, 2007), the increasing risks associated with research and development, the growing significance of responding to foreign markets and the global market as a whole, as well as the rapidly shortening trend of the speed of product development has staggeringly increased the strategic importance of the practical application (opening) of external knowledge (Badaracco, J.: 1991, Rosenbloom, R. and W. Spencer: 1996, Robert, E: 2001, Chesbrough, H.: 2003, 2006). In this regard, while the development of internationally renowned new technology needs constant contact between multiple technical fields, this trend has at the same time led to the necessity for truly collaborative research with other internationally distinguished organizations in related fields. As a result, the internationalization (i.e., globalization) of research development and networking has become an inevitable trend (e.g., Pearce, R.D. and M. Papanastassiou: 1996, Nakahara: 2000; Takahashi, H.: 2000, Hayashi: 2000, Serapio, M. and T. Hayashi: 2004, Medcof, J.: 2001, 2004, Hayashi, T. and M. Serapio: 2006, Iwata, S: 2007).

In this changing competitive environment, business organizations have been under considerable pressure to respond even more dominantly to rival firms with the "development of an even more differentiated new product" on an even larger global scale. Most notably, generating new technical knowledge and new concepts that are in high demand in order to develop new products has become a necessity more than ever before. In order to raise the probably of success in new product development, the general policy which had been used until recently was to invest further in R&D and human resources, and in so doing to raise the significance of R&D within the organization. However, due to changes in the global competitive environment and the shortening trend of the product lifecycle, strengthening R&D merely in many organizations merely led to the further lowering of R&D investment efficiency. The more global the company, the more it was "pressured" to employ R&D

(Research and Development) human resources in a strategic manner regardless of nationality. As a result, these global companies were able to retain their multicultural knowledge resources as part of their institutional capability. The more the production of scientific technical knowledge has decentralized globally against the backdrop of even the most global companies having difficulty in forming a competitive global edge from the base of their national technical development capacity, it is evident that the focus has shifted to centering on the principle of "metanational innovation" [1] (Doz. Y, J. Santos and P. Williamson: 2001, Doz: 2006, Asakawa: 2006[2]).

This thesis will review the issue of "knowledge creation" within the context of management strategy theory and innovation theory from the reference point of "knowledge creation" within the context of the product development process. The focus of this analysis rests on the relationship between knowledge creation within the product development process and the diversity of context, cognitive approach and culture, as well as with boundary management. The main reason for the directional shift toward the "decentralization of scientific technical knowledge on a global scale and metanational strategy" lies in the awareness that "effective knowledge creation activities are subject to cross pollination across borders and cultures, and that the context and cognitive approach has departed from past models being performed within a meta-national framework. Now, an inherently different knowledge creation mechanism is being sought even in regard to the product development process."

(2) New Product Development and Knowledge Creation

(2)-1 The Structure of New Product Development and Knowledge Creation

As indicated in the chart below, the commercial success rate of a typical newly developed product in a standard global corporation is as follows: Among seven concepts selected as prospects for the exploratory research development stage, only four projects advanced to the development stage and, after the commercialization process, ultimately only one of these four projects succeeded.[3]

Furthermore, based on observations from the idea stage of a new product, three out of eleven ideas will generally advance to the product development level and, from there, 1.3 will enter the market. Out of this, only one idea will ultimately achieve commercial success (R. Cooper, ibid., p. 11)[4]. In the past, in order to increase the success rate of new product development, most companies gave priority to R&D by adopting the general policy of increased investment in R&D and human

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[1] The "metanational company," unlike a "global company" which expanded globally from a specialized knowledge territory or homebase, is a business that expanded globally by creating unique metanational advantages, while skillfully integrating the high-level of knowledge that is being decentralized worldwide.

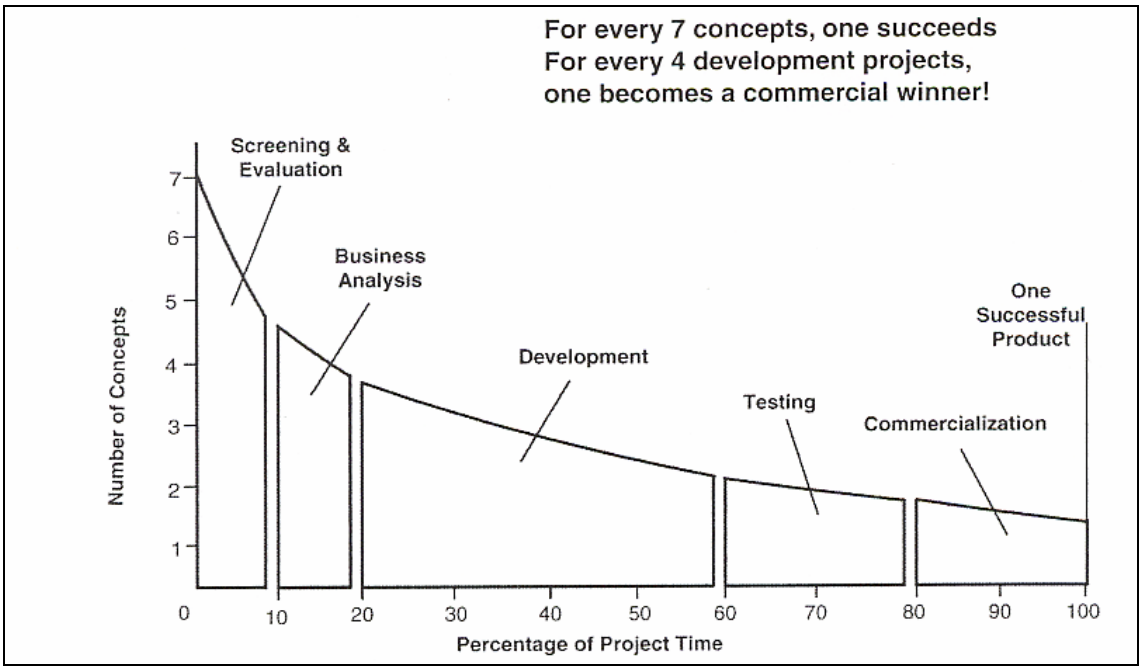
[2] Regarding the issues surrounding this metanational management theory (strategic theory), Asakawa (2006) has consolidated and discussed the matter in *The Seven Dilemmas* (****).

[3] The success rate of new products differs depending on the industry, the company, the production process and the product. G.L. Urban (1987. p.4) introduces a pertinent example from the U.S. market. According to Urban's research on the success rate for novel products, the figure is 75-80% for industrial goods, 65-70% for consumer goods, 73% for cases where the product lines of existing goods expand, 69% for cases where new brands emerge from existing product categories and 54% for completely brand new products. According to *Business Week* Magazine (August, 1993), in the 1980's, among 1,000 new products which 77 American companies invested in, the percentage of products that were still left on the market five years later was only 56%. In addition, according to Cooper, R.G. (2001, p. 11), the success rate of new products in the second half of the 1990's was 59%. According to P. Boer (1999), upon coming up with many commercially prospective ideas, the success rate of a stage zero idea after being filtered and designated as a research-worthy project is 1 in 3000 (0.033%) (p. 24, 26, Japanese Edition p.50, 53). These examples can be assumed to be from the chemical industry.

[4] When discussing the success rate of new products, there is a disparity in the rate depending on the phase. As shown in Figure 1 above, the rate is 1 in 11 (about 9%) if viewing a new product at the idea phase, 1 in 7 (about 14%) if viewing it at the product concept phase, 1 in 4 (25%) if viewing it at the development phase and 1 in 1.3 (76.9%) if viewing it beyond the commercialization phase.

resources. This, however, actually led to the decline in R&D investment efficiency due to global changes in the competitive environment and the shortening of the product lifecycle.

Figure 1: The Success Rate of New Products



Source: R.G. Cooper (2001), p. 12.

The biggest reason for this was the advent of a dilemma for the conventional company-centered closed model of product development. This dilemma saw the cost of R&D skyrocketing while R&D investment efficiency was decreasing. This was compounded by various realities, such as the lowering of barriers for entry into the global markets, the international geographical decentralization of knowledge production capabilities, the rise of software technology for Internet use, the shortening of product lifecycles and the diversification of markets. The dilemma we are facing now is inherently similar to what happened in the 1980's. We saw then that GM, Ford and other American automakers could not keep up on a development level with the leading Japanese automakers, even though they were pumping extravagant investments into research development and human resources. The problem of the declining R&D investment efficiency in American automakers did not have to do with the amount of the investment into research development or the size of the research development staff, but was rather due to the actual system of research development, and the organization's inherent capabilities (Hayashi and Komoda: 1993 [p. 3], Hayashi: 2006b [p. 8]). The differences in the systems can be summarized as follows: GM and Ford's development system for new cars, in addition to developing and manufacturing 70% of the components in-house, had systems with limited cooperation among the different departments, a feature representative of relay-like development operations. In comparison, Japanese automakers not only relied on outside vendors to develop and manufacture over 70% of the components they used, but also employed a "Sashimi-Style" development system, a "cross-functional" or "multi-functional" simultaneous development system in which they involved engineers from the outside component vendors, as well as participation from members of various related departments.[5] Such a cross- (multi-) functional engineering system

[5] Hayashi (1993, p. 3) and K. Clark and T. Fujimoto (1991, p. 5) discuss the differences in engineering methods of the automakers.

is the structural foundation for an effectively running Concurrent (i.e., simultaneous) Engineering System.[6]

Considering the current competitive environment, there needs to be a qualitative shift in the fundamental product development issue faced by various companies. This is not a matter of intensifying the volume, but rather moving toward a "new product development model" which is suitable to the aforementioned current paradigm shift. Regarding the "organizational development capability of new products," we should be cognizant that, within the process of creating new product concepts and the process of producing mock-up or prototype concepts, there is a high level of demand for the development of a new system which integrates knowledge by making use of the diverse cognitive approaches of participating members.

(2)-2 The Application of External Knowledge and the Internationalization of Research Development

The decentralization of the production of scientific technical knowledge on a global scale, and the shortening of the product lifecycle can be ascribed to the increasing risk of the decreasing efficiency rate of the research development of a closed company. As such, the R&D strategy of the typical corporation came to rely even more heavily on the technical resources of external organizations. Based on his research, E. Roberts found that, out of 209 Japanese, European and North American knowledge-based industries, the following percentage responded that they "rely heavily on outside technical resources."[7]

Figure 2: Change in Dependence toward External Knowledge for Japanese, European and North American Knowledge-Based Industries

	1992	1995	1998	2001(Forecast)
Japanese Industries	35%	47%	72%	84%
European Industries	22%	47%	77%	86%
North American Industries	10%	30%	75%	85%

Source: E. Robert (2001), p. 34.

According to the same research, these Japanese, European and North American knowledge-based industries are leading the trend in relying upon external knowledge.

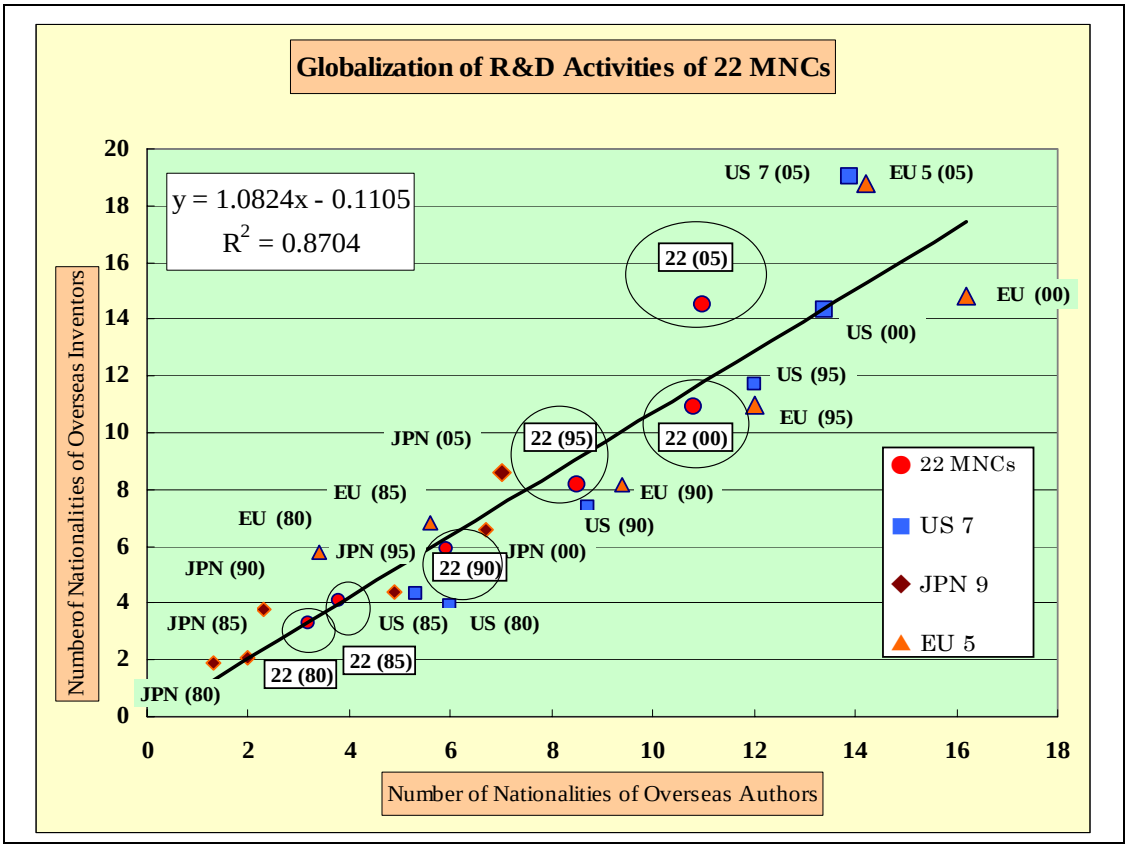
[6] Even if a development organization is a cross-functional system, whether it is an effective concurrent engineering system is a separate matter for examination. According to E. Roberts' (2001) 1999 Report, the percentage of companies that utilized multi-functional teams in their development organization was 54% for Japanese companies, 67% for European companies and 72% for American companies (E. Roberts, 2001, p. 35). There are also other pertinent factors to consider such as the scope of authority of the project leader, the degree of joint responsibility among the participating members, their trust in each other, and so on in determining whether the system was functioning properly.

[7] According to E. Roberts (2001), this figure reflects the responses of 209 companies out of the 400 companies that expended approximately 80% of all research development expenses in Japan, Europe and North America. Hayashi (2003) further corroborates this fact.

What we need to take heed of in this current fundamental tidal wave is that the more a business expands globally, the more it must increase the internationalization of its research development activities. The decentralization of the production of scientific technical knowledge on a global scale (Tidd, J., J. Bessant and K. Pavitt: 1997, Hayashi: 2006, 2007), or the decentralization of intellectual power on a global scale, leads to the necessary global expansion of the usage of external knowledge in relation to the R&D strategies of multinational industries. In this paper, we will examine the degree of internationalization of the research development activities of 22 Japanese, European and North American electronics companies.

Generally, the more internationally strategically significant the results of a company's research and development activities are, the more American copyright or patent applications are submitted, and the more mention they receive in foreign journals. Thus, we will investigate the story behind the international application of external knowledge by these 22 multinational companies by examining the American copyrights and patents they have received, as well as the mentioning of the researchers affiliated with these companies in U.S.-published thesis journals. Figure 3 illustrates the changes in the internationalization of research development from 1980 to 2005 in five-year increments (Serapio, M. and T. Hayashi: 2004, Hayashi, T. and M. Serapio: 2006).

Figure 3: The Internationalization of Research Development in 22 Japanese, American and European Electronics-Intensive Companies
(The Number of Patent Holders with American Nationalities and the Number of Published Theses by Writers with American Nationalities)



Note 1: The 22 companies the subject of this study included nine Japanese companies (Sony, Hitachi Corporation, Toshiba, Sharp, NEC, Fujitsu, Canon, Mitsubishi Electric and Matsushita Electric), seven American companies (IBM, Intel, Kodak, Xerox, HP, Texas Instruments, and Motorola), five EU

companies (Phillips, Siemens, Nokia, Thomson, and Ericsson) and one Korean company (Samsung Electronics).

Note 2: The horizontal axis represents the number of nationalities of authors whose theses were published in American journals (affiliated researchers in-house or collaborative researchers from outside facilities), and the vertical axis represents the number of nationalities of overseas inventors. Incidentally, the number of nationalities of American patent holding inventors at IBM was 25 different countries, and the number of nationalities of authors whose theses were published in American journals (including the nationalities of authors who collaborated on joint theses) was also 25 different countries.

Source: M. Serapio & T. Hayashi (2004), Hayashi, T. and M. Serapio (2006) with additional data added from 2005.

The horizontal axis on the figure above represents the number of nationalities of the researchers and collaborative researchers (on joint research) affiliated with the 22 companies who published in American scientific and technical journals. The vertical axis represents the number of nationalities of inventors affiliated with the 22 companies who obtained American patents.[8]

Thus, the average of the number of nationalities on the figure— all 22 companies which include an average of seven Japanese companies, seven American companies, five European companies and a Korean company (Samsung Electronics)—are computed for each year 1980 (80), 1985 (85), 1990 (90), 1995 (95), 2000 (00) and 2005 (05).

The average number of nationalities of the nine Japanese companies were, in 1980, 1.3 nationalities for the authors and 1.9 nationalities for inventors. In 2005, this data had steadily risen to 8 nationalities and 8.5 nationalities respectively. At the same time, in 1980, the average number of nationalities of the seven American companies were 6 nationalities versus 3.9 nationalities respectively; the average number of nationalities of the five European countries was 3.4 nationalities and 5.8 nationalities respectively; and the figures for the Korean company Samsung Electronics was 0 and 0 for both. In comparison, by 2005, for the seven American companies, the average nationalities were 13.9 and 19; for the five European companies, the average nationalities were 14.2 and 18.8; and the figures for the Korean company (Samsung Electronics) were 11 and 15.

Regarding the average of the 22 companies, in 1980, the average nationalities of authors was 3.2 and the average nationalities of inventors 3.3. In 1990, the average nationalities were 5.9 and 5.9 respectively; in 2000, it was 10.8 and 10.9 respectively; and, in 2005, it was 11 and 14.5 respectively.[9] If we look at the research development systems of these 22 multinational electronics-based companies, we can see that, regarding the theses publication base, there is a network of collaborative research comprising researchers from 11 different countries. Regarding the patent technologies, there are technical developments among researchers and engineers from 14.5 different countries. As of 2005, among the nine Japanese companies, the companies with the most nationalities of authors were Toshiba and Mitsubishi Electric with 11 different nationalities, and the companies with the most nationalities of inventors were Canon and Matsushita Electric with 11 different nationalities. Among the seven American companies, IBM had the most nationalities for both authors and inventors with 27 and 32 different nationalities respectively. Among the five European companies, Siemens of Germany claimed the most number of author nationalities with 23, while Nokia of Finland claimed the most number of inventor nationalities with 25. Finally, Samsung Electronics of South Korea had

[8] The nationalities of the patent holders and the published authors indicated here are either their passport nationalities or the nationality of the company with which they are affiliated. Regarding the nationality of the published authors, the nationality of the collaborator, if, for example, a researcher from IBM presented a joint thesis, is also included. Since many collaborating authors are researchers at foreign universities, the nationalities of their affiliated institutions are also included here. Regarding the nationalities of patent holders, it can be assumed that most of the researchers belong to IBM, even if they were involved in collaborative inventions.

[9] Regarding examples of individual industries, refer to Hayashi (2007a), (2007b), (2007c) and (1998).

authors from 10 different nationalities and inventors from 15 different nationalities. Breaking down the data for the 22 companies, the company that had the most number of nationalities for both authors and inventors and thus, it could be said, had utilized the most internationally diverse intellectual power was IBM. Global changes in the competitive environment stress the need to establish competitive superiority on a global scale. Consequentially, the more global business that a company aspires to, the more it is required to develop products and services that claim competitive superiority in the global markets. As this becomes the mission of product development, it is an absolute necessity for a company to adopt a dual-sided approach, both from the perspective of the overseas major markets (the demand side) and the application of decentralized global intellectual knowledge (the supply side).

In order to develop groundbreaking new products and services that exemplify competitive superiority in a global market, it is also necessary to create "new concepts that transcend cultural differences" and to further "the cooperation of diverse technical knowledge." Furthermore, to accomplish these things, the "requisite diversity"[10] will be necessary. As long as the mission of new product development projects is focused on achieving global competitive superiority, a qualitatively high level of diversity will be required.

(3) Knowledge Creation and Cultural Diversity

(3)-1 Cultural Diversity and the Diversity of Context

As mentioned above, a company that has globalized needs to develop new products that can differentiate itself on a global scale, the source of its global competitive edge. In order to do this, it requires radical innovation based on key insights which embrace, at its core, "new concepts that transcend cultural differences with an acknowledgement toward cultural differences" and "the cooperation of diverse technical knowledge." In return, to create these "new concepts that transcend cultural differences with an acknowledgement toward cultural differences," it is necessary to understand the differences in the "context" which provides the base for cultural differences. Next, this thesis will explore the meaning of "cultural difference" in this context. Figure 3 conceptualizes the multi-layered and multidimensional cultural backdrop and influences that form a person's personality. An individual's values, thoughts and methods of perception are prescribed by national culture, geographical culture, cultural differences in gender and generation, family structure, lifestyle, and academic background as well as in an individual's genes.[11] Henceforth, I will use the definition of

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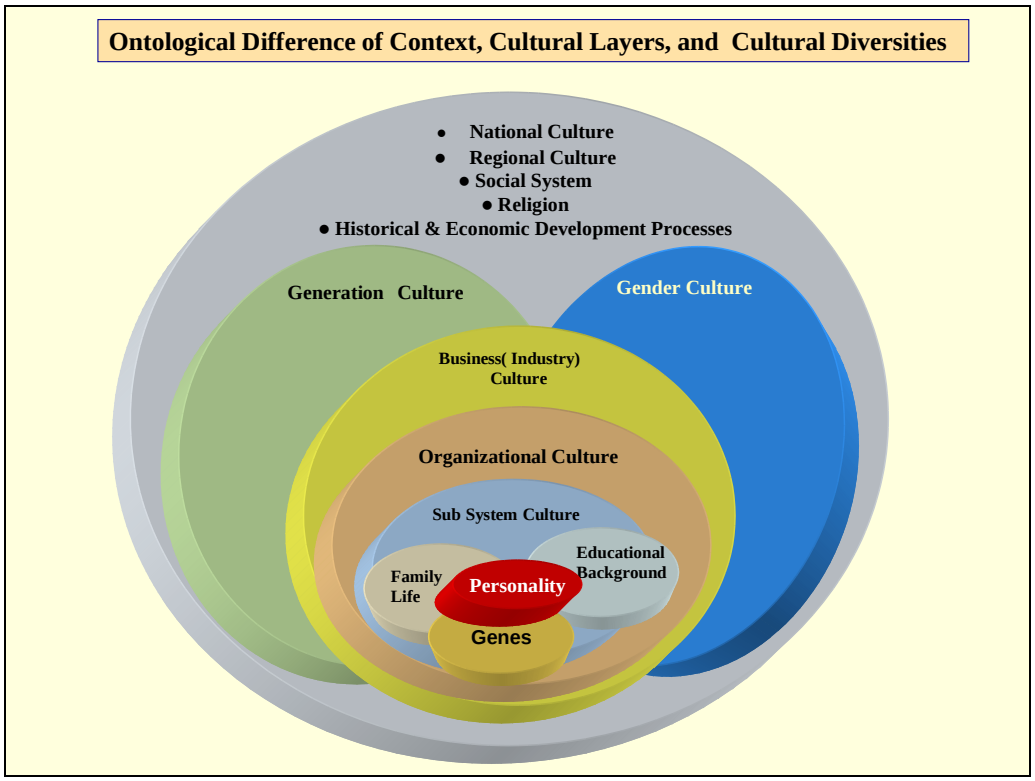
[10] The connotations in Nonaka's thesis regarding "Requisite Diversity" (requisite variety) (Nonaka and Takenaka: 1996, p. 133, Nonaka, I. R. Toyoma and N. Konno: 2002, p. 62) can be summarized as follows: In order to respond in a flexible manner to variety and complexity in the environment, it is highly effective to have diversity within the organization itself. This can assist in stabilizing the order and chaos, and it is between this order and chaos, at the edge, where this knowledge creation occurs.
This thesis places at issue the cultural diversity of an organization's members, and views multi-cultural management and diversity management from this perspective. Instead of using the adaptability of an organization's internal diversity to changes of the environment as the pivot of the argument, this thesis views "knowledge creation" within the context of the differences in the cultural diversity of an organization's members. As such, this is referred to as "requisite diversity" in this thesis.

[11] It is not scientifically proven to what degree an individual's personality is determined by their genes. For the sake of this argument, the author is putting aside issues of whether human genes common to all mankind are the hereditary traits of human existence from over 35 hundred million years ago, or whether they are from the first bipedal hominids (*Australopithecus afarensis*) between 3 and 4 million years ago, or whether they are the results of a genetic process from *homo sapiens* who appeared 170,000 years ago. One cannot deny that every individual's personality is somehow dependent on the particular arrangement of the genes. The author referred to S. Oppenheimer (2003) as an authority on this point.

culture, taken from G. Hofstede, as mental programs or software of the mind (Hofstede, 1991, p.4, Japanese Edition p. 3) that guide the "pattern of thinking, feeling and doing," if you will, a "collective programming of the mind that distinguishes the members of one group or category of people from others" (G. Hofstede, 1991a, p.9). At the same time, this paper will additionally define culture as a commonly held "reasonable (effective) knowledge" (culture as a set of valid knowledge) (D. Pauleen et al., 2007, p.5) collectively created to solve the various problems in our surroundings.

Naturally, there are important individual differences in the various cultural influences that influence the formation of an individual's personality. As indicated in Figure 4, the magnitude of the cultural territory also differs among individuals. For example, if we were to compare the influence of national culture on the personality of someone living in the Middle East to the influence of the national culture affecting the personality of someone living in Japan, from a strictly religious perspective, the influence of religion in the former region would be larger. Likewise, when comparing the influence of cultural values relating to gender in influencing the personality of someone living in Finland to that of someone living in Japan, generally speaking, it would be the influence in the latter region that is larger. Even within the same national culture, factors such as an affiliated industry, an affiliated organization, the subsystem of an organization, family environment as well as educational background have a large influence on each individual's personality.

Figure 4: Cultural Multi-Layering, Cultural Multi-dimensional Personalities



Source: T. Hayashi and Hayashi Seminar (2006) "Innovation and Cross-Cultural Management" p. 63 G. Hofstede (1991), p. 10, p. 190 used as basis for creation of chart

As a result, every individual's mind is determined by the mental program against the backdrop of a multi-layered culture.[12] Therefore, cultural multi-dimensionality, with a basis of cultural multi-layering, provides the context in which communication among its constituents can be conducted. From this viewpoint, it is necessary to understand that all communication is "multicultural communication."

As long as there is dialogue, effective communications and exchange of ideas among members of new product development projects, there are inherent differences even within this clearly defined context as the actors participate in "multicultural communication."

Even if the relevant people were communicating with the same terminology in the same language, there are still inherent differences in their perspectives and the context of their ideas because each person has their own unique individuality. In other words, even if these same persons use the same terminology while conversing, it is highly unlikely that are all coming from the same context. There are inevitable disparities in each individual's acknowledged contexts, and the degree of their commonality is inherently limited to differing degrees. This fact does not cease in the acknowledgement of commonly-held contexts, but also implies the existence of "ambiguity." The disparities in this "ambiguity," as defined in this paper, lead to the acknowledgement of differences within the dialogue, and consequently new "insights" and "discoveries" are possible on a reciprocal basis (R. Lester and M. Piore: 2004, pp. 52-52, Japanese Edition P.s. 68-70).

Regarding Figure 5, supposing that the leader of a development project strictly adhered to an analytical approach.[13] He would likely analyze various characteristics, such as the "length of the eyelashes," "the height and angle of the nose," "the angle of the chin," "the necklace on the neck," and so on, and conclude that the picture is that of a "relatively young woman."

Figure 5: Ambiguous Figure

Analytical Approach, Interpretational Approach, Comprehensive Approach

Source: Additional data from http://www.rci.rutgers.edu/~cfs/305_html/Gestalt/Woman.html

[12] On the other hand, one cannot deny that an individual's personality is simultaneously determined by his genes (physical program). This paper stands from the viewpoint that culture (mental program) and genes (physical program), in addition to having their own autonomous roles, also partake in the forming of a personality based on their interaction.

[13] This particular analytical approach can be defined as "applying substantially analyzable parameters such as the characteristics, size and weight of a product's marketability" (R. Lester and M. Piore, p. 54, Japanese Edition p. 71).

If the structure of this project was the conventional hierarchical "Top Down Structure," then it is very likely that the project leader's conclusion would neither be questioned nor amended, and that the project would continue as is. Considering that a "dialogue" is inherently an act of observing the same situation through different viewpoints, this can also be labeled as "interpretation" (Lester, R.K.: 2004, p.53). Reverting back to the above example of the development project, if the structure of the organization provided an open "space" in which other members were also able to offer their interpretations[14], it is likely that, regarding Figure 5, other observations, such as "a large nose," "a defined chin," "a sunken left eye," and so on, would be made. Thus, the observation that it is in fact an "old woman" would also be immediately pointed out.

Based on the integration of an "analytical approach" and an "interpretational approach," all members of the project can see the picture in a much more comprehensive manner, thus bringing a new perception and awareness to all. Conversely, in a project with a more hierarchical management structure, the following could occur. The project members would probably only express opinions that would garner the approval of the project leader, interpretations would be disvalued and a correct, comprehensive view of the picture would not be achieved. We can see the same process at work in product development. If a new product was developed based on concepts drawn from a particular cultural background and a particular cognitive approach, the product may be suitable for that particular market (for example, the Japanese market), but may not be suitable for other cultural markets (such as the Chinese market).

As mentioned above, the more a new product expands from its native market to foreign markets, the more these new product development projects must obtain a comprehensive operation by integrating all the various market characteristics. It falls upon the project leader to value the diverse cognitive contexts of the culturally diverse group of project members, to harmonize the differences that arise from these various contexts, and to design a "space" in which this is possible. As long as the mission of new product development remains to aspire for global competitive superiority, there will always remain a demand for "requisite diversity" and a qualitatively high level of multiplicity. Thus, the project leader will be called on to possess high levels of meta-cognitive ability and multi-cultural management capability.

(3)-2 The Project Leader and the Competency to Integrate Diverse Fields

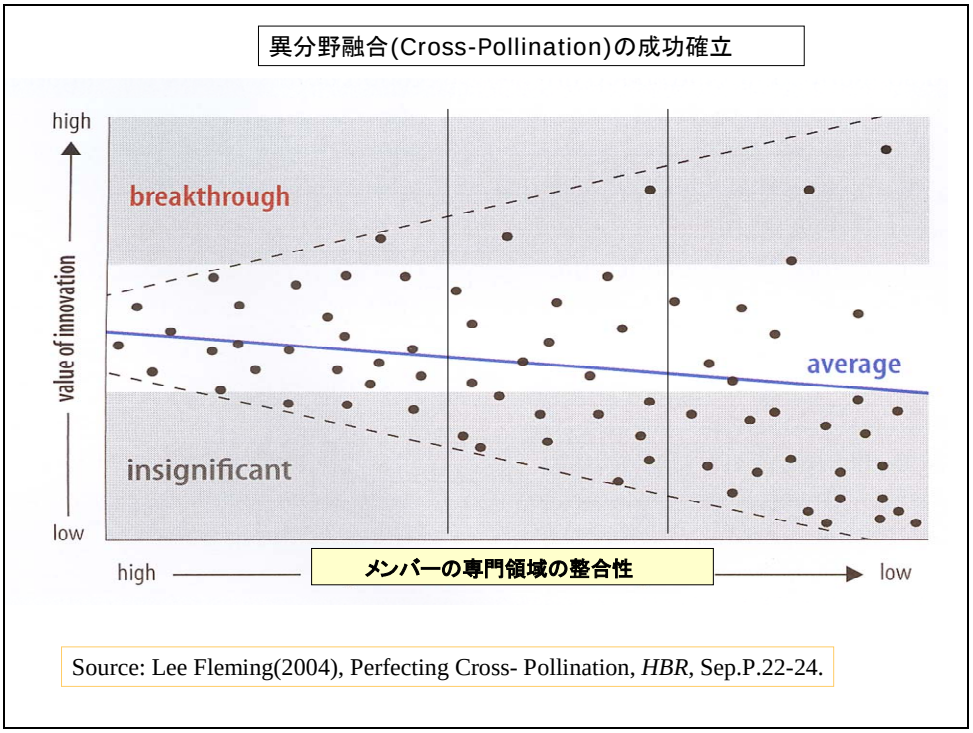
As long as the mission of new product development projects is to continue to expand new products in foreign markets, this means that the essence of competition will also take on international characteristics. Consequently, the new products must spring forward from radical innovations that depart from conventional technical bases. In order to create products that embody new insights and concepts based on unconventional technical bases, it is necessary to integrate the technical skills of a wide variety of fields.

In Figure 6, L. Fleming (2004) illustrates the relationship between cross pollination (the integration of diverse technical fields) and the success rate of technical innovations. It also illustrates the extent of integration among project members of different fields, and the success rate of the commercialization of products from an analysis of around 17,000 U.S. patents. The vertical axis indicates the market value of technical innovations, and the horizontal axis indicates the different research development fields to which the various research development supervisors belong (L. Fleming, ibid., pp22-24). This figure indicates that the greater the differences among the specialty fields of the research developers, the more technically innovative breakthroughs that were achieved. There was also a higher risk of failure. This shows that the project leader must possess the ability to recognize strategic potential in a new blended knowledge which integrates the various knowledge that comes from diverse technical fields (sectors).

[14] On the other hand, if a firm launches a brand new product on the market or, in opposing a rival firm, conducts research to provide a differentiated product, then the interpretational approach which assesses a situation from varying perspectives and points of view will be the determining factor.

Figure 6: Cross-Pollination and the Value of Innovation

"Established Success of Cross-Pollination"



"Consistency of the Specialty Fields of Members"

As long as the technical field of development projects overlaps with other fields, there will be a growing demand for competent skills of deepening knowledge in individual technical fields as well as for skills in integrating this knowledge with knowledge from other fields. There will be a high demand for analytical and interpretational approaches, as well as a multidisciplinary approach. All of this can be expressed as a T-shaped capability.[15] Indeed, there are risks of commercial failure in research development products that integrate diverse fields as they strive to achieve breakthroughs in their technical knowledge and product features. As the need to bear these risks increases, there will be increases in collaborative research with other research organizations. This also means that the project leader for such collaborations among various organizations and research departments will need to be able to facilitate cross-pollination and multicultural communication. As such, the "requisite diversity" in these development projects will increase.

(4) Boundary Management and Knowledge Creation

[15] The T-shaped capability embodies the competent skills of further deepening knowledge of one's one specialty field, and the integrative and generative ability to forge new technical meeting points with other fields of specialty (D. Leonard, pp.75-77, Japanese Edition 109-112). The notable American industrial design firm, IDEO, mentions this T-shaped capability on its website (http://www.ideo.com/ideo.asp) "People here are T-shaped: broad and deep. Broad in their skills and interests and able to work with a wide range of people. Deep in their knowledge and experience in one or more disciplines."

(4)-1 Boundaries and Knowledge Creation

Innovative insights and expansions arise more often than not in the boundaries between communities (E. Wenger, 2002, p.153). The concept of a community is defined here as a "social organization which possesses clear goals, and which selectively incorporates knowledge and learning (E. Wenger, pp.51-53). E. Wenger defines this as a "community of practice." This "community of practice" referred to by Wenger is described as a "group of people who share common interests, problems and passions and who deepen their knowledge and expertise in their specialty fields by continuous cross-pollination" (Wenger, p.4, Japanese Edition p.33).[16] From the key features relating to "community" [17] which include "regionality," "commonality" and "continuity", in this paper the feature of "regionality" is omitted and "community" is described as the "collective body of continuous knowledge creation, the essence of which is a specific, systematized cooperative framework which houses specific principles from in and out of a firm-specific setting." Additionally, this paper defines the concept of "space" as the "temporary space in which knowledge is created by multiple members who are joined together in collaboration from time to time for specific missions." Thus, the former concept of "community" possesses a "higher range of cultural collectiveness" and the latter concept of "space" occurs where there is a "lower range of cultural collectiveness." E. Wenger's "community of practice" concept falls somewhere in the middle of these two concepts.

In the "space," individual members generate knowledge through direct communications and by going through the transfer processes of taking commonly-held implicit knowledge, creating concepts out of it, legitimizing it and then by creating prototypes of this knowledge (Nonaka and Takenaka: 126-132). Through these processes, members are able to recognize their respective differences and share their knowledge.

On the other hand, D. Leonard (1998) discusses the creation of new knowledge from the perspective of "creative abrasion." He reasons that it is through this creative abrasion process that individuals integrate their various problem-solving approaches, and that this gives rise to new insights and knowledge. "Innovation rises from the boundaries of "diverse" mindsets and is not borne from one piece of knowledge or skill" (D. Leonard, p.64, Japanese Edition pp. 93-94). However, unlike "diversity" based on gender and ethnicity which is not an absolute necessity because they inhabit contrasting styles of creative abrasion, it is necessary to take notice of the cognitive approaches of problem-solving and innovation" (D. Leonard, ibid., p.64, Japanese Edition, p.94). Put another way, general cultural diversity does not necessarily give rise to new knowledge and concepts merely because it yields different viewpoints or different approaches to problems. What is important is developing and utilizing an institutional capacity that embodies diverse cognitive approaches that stems from valuing the various cognitive styles of its diverse members.

Essentially, the emphasis should be on the elucidation of the mechanisms that generate these innovative insights and knowledge from those boundaries that are the composites of specialty-specific knowledge of members from specific domains. From here, the matters of discussion will not be limited to the scientific and technological knowledge domain of those who participate in the mechanism of knowledge creation at the new product development state. The paper will also discuss the culture-specific context of the affiliated organizations (i.e., suppliers and other research facilities) and related departments of the participating members. Regarding the idea of "boundaries," this paper will not only examine the participating members' scientific and technological domain-specific knowledge, but also the members' cultural differences that influence their differences in perspective.

Figure 7 below schematizes the types of skill and knowledge that form core abilities as presented by D. Leonard.[18] Public or scientific types of knowledge are relatively easy to define and

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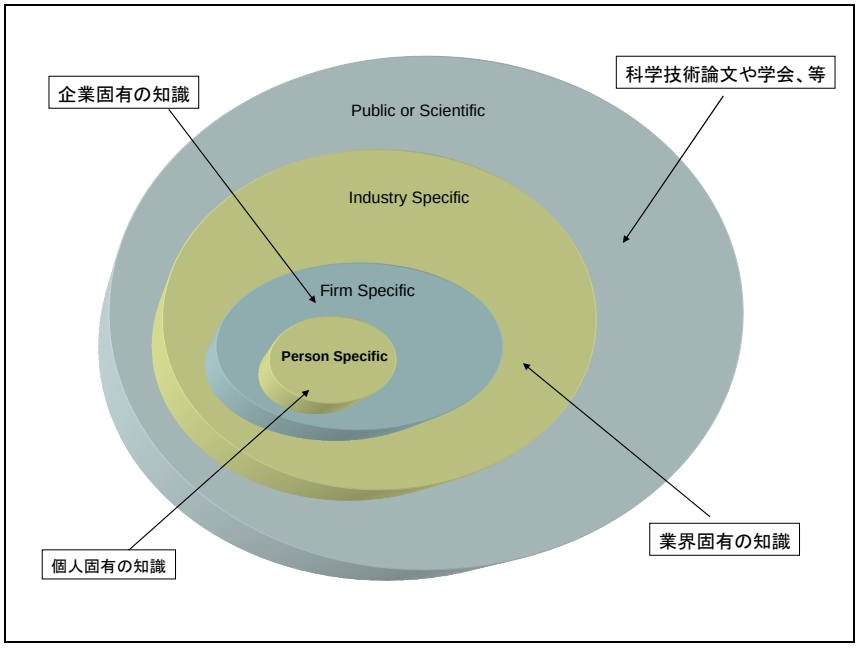
[16] This is not a new concept. Rather, these are "knowledge-based social structures having, at its core, knowledge from the beginnings of humankind as man resided in caves, gathered around fires and discussed the most strategic way to hunt or shape a bow and arrow or to find the best grass roots for food" (Wenger, p.5, P.. 34).

[17] Regarding the concept of community, I referred to Matsumoto (2007).

[18] D. Leonard (1998), pp. 2122, Japanese Edition, pp. 32-33.

codify, and are types of public goods that are easily accessible via specialty journals, academic conferences or databases. Although spread by specialists such as suppliers or consultants, industry-specific knowledge is also available for newly-entering firms. However, firm-specific in-house knowledge cannot be duplicated. Including knowledge that is formulized and patented, in-house knowledge is implicit knowledge that is amassed, structured and codified and embedded in software, hardware and the like. This results in a comprehensive technical system which is more than just the summation of its components.[19]

Figure 7: Types of Accessible Skills and Knowledge



Source: Amendments from D. Leonard (1998), p.21

Thus, industry-specific knowledge is more difficult to transfer than scientific (public) knowledge, and firm-specific knowledge is more difficult to transfer than industry-specific knowledge. Furthermore, it is even more difficult to bring out the knowledge in the minds of individuals. It is especially difficult to transfer the knowledge retained by an individual because it is "sticky" and particular to that individual (Von Hipple, E.: 1994; G. Szulanski, 1996, Sugiyama: 2001, Asakawa: 2002). As a result, the fundamental role of the project leader at the initial stage of the development of new products is to fulfill the role of a boundary spanner[20] between the specific domains of knowledge. Hence, keeping all of the above in mind, knowledge creation at the "boundaries" is further examined here.

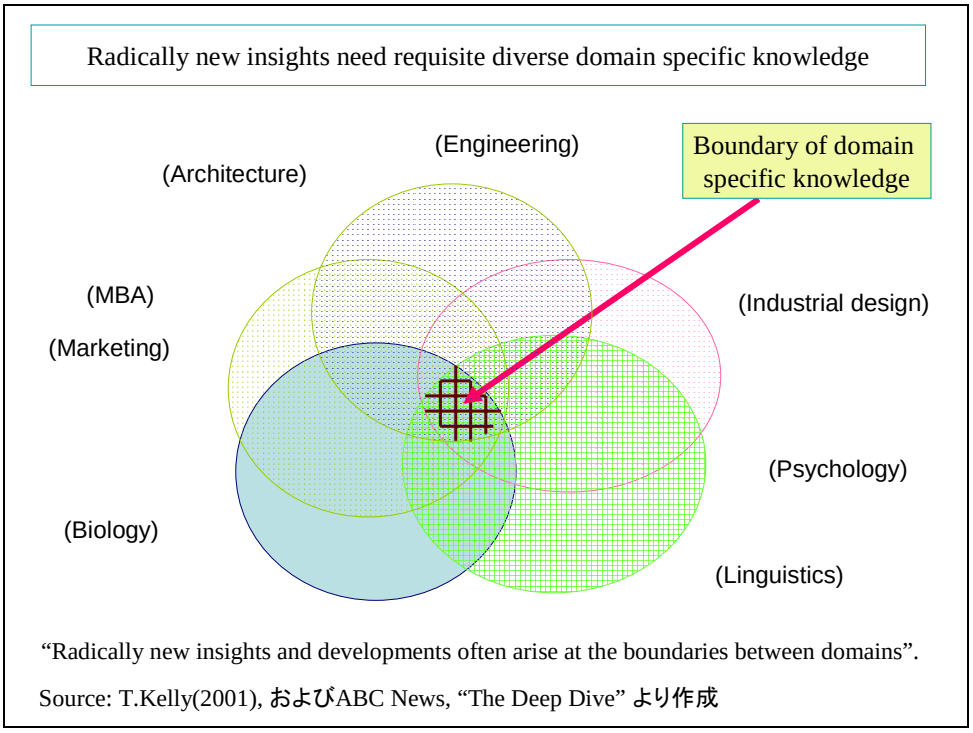
Figure 8 was prepared using information from the development project members at the notable American industrial design firm, IDEO, regarding the creation process of new and necessary knowledge from the initial conceptual stage of research development of new products, to making the mock-ups, and on to the completion of the final models. This particular project case-study dealt with creating a prototype for a 21st century shopping cart over five days and involved 10 staff members

[19] D. Leonard (1998), p.22, Japanese Edition, p.34.

[20] D. Leonard, ibid., pp.158-159, Japanese Edition pp.228-229.

from 8 suitable specialty knowledge domains. New insights and knowledge were more often than not created in all the overlapping domains of the participating members. The primary reasons for this are that the members shared a common goal, proceeded with serious "discussion," deepened their respective specialty knowledge domains, came to comprehend the differences in their respective perceiving contexts, exchanged knowledge correctly, clarified their "ambiguities," acknowledged the meeting points with other knowledge domains, and were able to successfully integrate their knowledge. The key factor here is whether the project leader is able to share with all his project members the overall mission of the project, as well as the goal of each development stage as the project progresses. It is also about how effectively the project leader can practice boundary management by being the boundary spanner among the varying knowledge domains, and promote communication among them. In other words, the boundary management capability of the project leader is the determining factor in the structural creation of knowledge.

Figure 8: Domains and Boundaries



Source: Created from information provided by T. Kelly (2001) and "The Deep Dive," ABC News

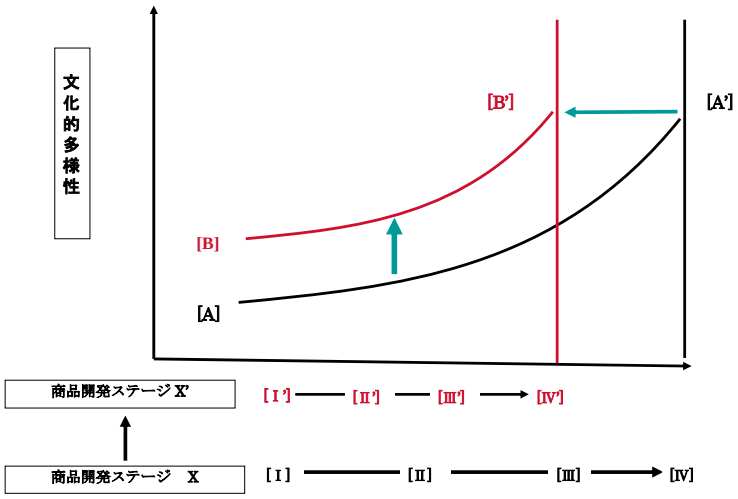
Put another way, if the best of each relevant field participated in a development project, the project would be unlikely to succeed if the boundary management capability of the project leader was poor (Ancona, D.G., and Caldwell, D.F.: 1997). Only the project leader's dynamic process of structural creation of knowledge can lead to the project members attaining new insights and knowledge (R. Lester and M. Piore: 2004, pp.51-73, Japanese Edition, pp.67-95). Conversely, regarding Figure 7, if the project members' dialogue is only restricted to two or three different specialties, then the approach is likely to become more analytical. Reacting to the inclination of members to delve deeper into their respective fields, the quality of the "dialogue" will become even more "interpretive" with the increased variety of the specialty fields with which the members are

affiliated.[21] As a result, the contextual elements that the members are cognizant of will be even more diverse and "ambiguous" and will require more openness and continuity in the "space of dialogue." The necessity for an even more open and continuous "dialogue" will require members to disclose the valuable information and knowledge they possess, and necessitate "trust" among the members. A fundamental role of the project leader as knowledge facilitator is to establish the "space" and the management and to "create and maintain a suitable culture for the space" (E.H. Shein, 2004, p.11). In other words, the more diverse the participating members of a development project are, the more the project leader's role of knowledge producer becomes, simultaneously, a boundary spanner[22] between different fields and cultures *and* a culture producer.

(4)-2 The Shortening of the Development Period and Diversity Management

Even if a newly developed product successfully enters the market, there is no escaping the shortening lifecycle of products due to ever increasing global competition. Additionally, to develop products that feature new insights and concepts from an unconventional technical base, it is necessary to integrate technical skills from various fields.

図表8 商品開発ステージの短縮化と開発プロジェクトメンバーの文化的多様性



Source: Created based on an interview with Kao Corporation

The global advancement of markets and competition demand breakthrough developments and a shorter product development process. This means that a shorter product lifecycle and development lead time are necessary. Development projects will then need to give precise feedback of market and technology production information from the nascent stages, and to continue the development process in a cross-functional manner. In other words, right from the beginning of the development stage, there needs to be a special emphasis on incorporating cultural diversity and sharing of concepts.

[21] Lester's analytical approach and interpretive approach is similar to D. Leonard's judging type and perceiving type (p.70, p.100).

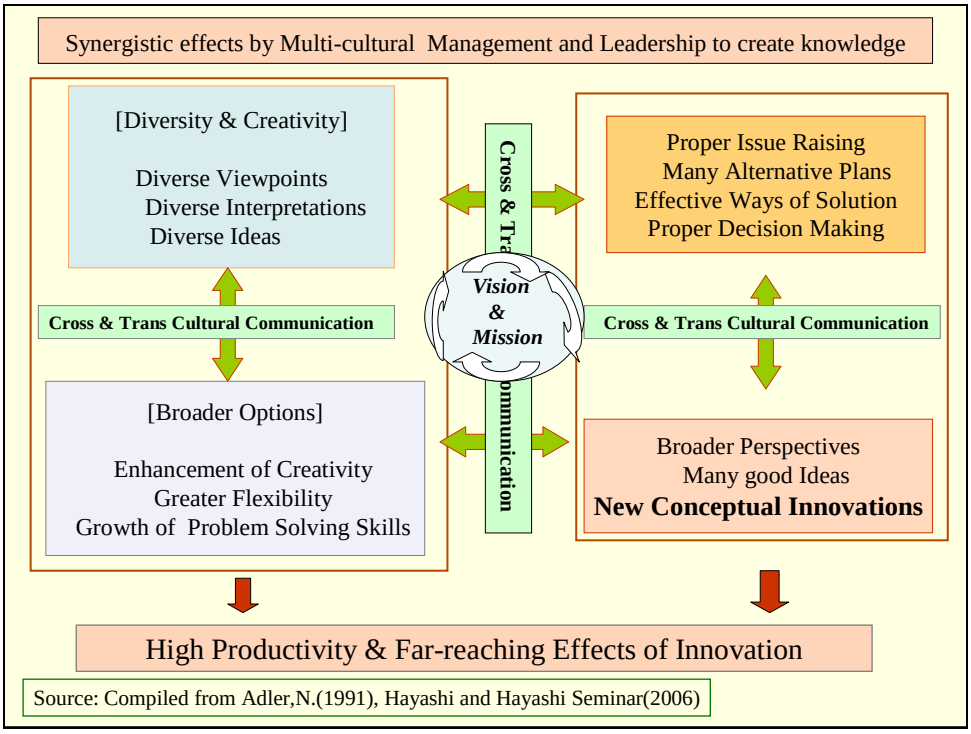
[22] D. Leonard, p.158, p.228.

Figure 9 schematizes the relationship between cultural diversity and shortening of the product development stage, based on an interview with supervisors of the research development department at Kao Toiletries Maker.

The vertical axis in this figure represents the extent of cultural diversity among the participating members of the development project. The horizontal axis represents the timeline of the development stages.[23] As the demand for development projects that give precise feedback of market and production technology information to the initial stages of product development grows, there is growing participation from members of related fields, such as research laboratories, operational development departments, manufacturing departments, marketing departments, and so on, who bear responsibility in the sharing and creation of information and knowledge.[24]

As shown in the figure, for cross-functioning operations to run smoothly from the initial development stages, the development lead time shrinks from [A'] to [B'] as does the time for each stage of the product development process from [X: I • II • III • IV] to [X': I' • II' • III' • IV']. This leads to a shift in the cultural diversity curve from [A • A'] to [B • B']. However, to shorten the product development stage, and still increase the development rate, it is necessary to maximize the synergy effects of cross-cultural collaboration (N. Adler: 1991, Hayashi and Hayashi Seminar: 2006a, Hayashi, Seki and Sakamoto: 2006b) while acknowledging the contextual disparities that arise from cultural disparities. As the conceptual diagram expressed in Figure 9 indicates, in situations where the requisite diversity of the participating members of the development organization is maintained, and the project leader is able to effectively demonstrate his boundary management and cross-cultural (multi-cultural) management skills, a great innovation effect comes into play. This leads to the generation of "creativity," "flexibility," and "diverse ideas."

Figure 9 Synergistic effects by Multi-cultural Management and Leadership to create knowledge



[23] Regarding the relationship between the cultural diversity of the members and the development stage, the author found that it was nearly identical in the case of industry goods such as building machines.

[24] Hayashi and Hayashi Seminar (2006b) further discuss Kao Corporation's development system and cross-cultural management practices.

Source: Hayashi and Hayashi Seminar (2006a) and N. Adler (1991), pp.102-103

As global competition increases, project leaders will be called upon to demonstrate, as their working skills, the ability to maximize the merits of cultural diversity and to minimize its demerits by exhibiting cross-transcultural management capabilities.[25] If the "creation and management of culture"[26] is fundamentally part of the job of a project leader, then this means that the "creation and management of a new culture" by fostering "knowledge creation (collaboration)" is also part of this job. The leader will need to maximize the merits of cross-cultural synergies which, at their core, embody "cross cultural management" which advances multicultural communication and "transcultural management" transcending cultural differences. More importantly, as cultural diversity increases, the project leader will have participating members disclose important information, and encourage the sharing of perspectives on issues. As such, to create new knowledge and concepts, the project leader's main responsibility is to establish a "space" or a "community" in which diverse individuals can share their principles and goals, acknowledge the differences in their contexts, and value and trust each other as well as the "space" or "community."

Furthermore, the project leader will need to embrace this meta-cultural "space," this cultural diversity, and aim to shift the present circumstances to a "community" in which common principles and a common culture is shared. A project leader's fundamental role is to establish a "community" which is meta-cultural, cross-cultural and trans-cultural, as well as to develop a knowledge-creating form "community" in which there is a shared culture. The knowledge producer project leader is also, therefore, a boundary spanner and a culture producer.

Thus, the changes in the competitive environment have led to a paradigm shift from an innovation system that increased its research development expenses and bolstered its R&D personnel to a new multi-cultural and generative innovation system.

(5) Conclusion

The flow of business strategy theory has shifted from a resource-based view to a dynamic capability view to a knowledge-based view. Those globally-expanding firms that have been able to keep up with the globalization of markets and competition have been able to steadily apply external knowledge and internationalize their research development activities. Nevertheless, whether it is business strategy theory or innovation theory, it seems that when theorizing about knowledge, there has always been an assumption of homogeneity of knowledge in the backdrop of the digitalization of industry or the globalization of markets. Even the knowledge creation theories up until now have seemed to undervalue the influence that "culture" has on knowledge. There also seems to have been an undervaluation of views regarding the discrepancies arising through culturally different mindsets, or even from communication in the same language. It is also true that there can be multiple interpretations even of knowledge expressed in the same language. G. Hofstede's view from the perspective of cultural theory is that the mental program of culture establishes the minds of individuals which then leads to differences in the individuals' minds which in turn leads to differences in context.

However, such cultural theory views are fundamentally the same as those fixed theories that espouse that the physical program of genes decides a personality. It professes that culture unilaterally sets a mindset and determines knowledge. In contrast, this paper attempted to take heed of the "culture creating aspect" of new knowledge creation by using the project leader as an intermediary who plays a key role in managing organized knowledge creation activities. Therefore, this paper attempted to show that, as the significance of knowledge labor increases, the project leader's ability

[25] Cross-cultural management acknowledges and values the discrepancies between different cultures. In contrast, trans-cultural management acknowledges and values these discrepancies, but goes one step further in creating a shared new culture (Hayashi, Seki and Sakamoto: 2006b, pp.171-173). Emiko Magoshi also references this point.

[26] E.H. Shein (1985)

and the knowledge creation system necessary to develop new products (and services) is the key to competitive superiority. Subsequently, this paper explored the fact that knowledge and context are not fixed or prescribed by "culture" (mental program) or "genes" (mental program), but that the process of creating new knowledge is the process of creating a new "culture" and that knowledge creation and culture maintain a dynamic, reciprocal and dialectical relationship with one another. Bluntly-put, the conclusion of this paper is that, in response to the changing global competitive environment, the dynamic capability of an "organizational capability to autonomously advance" lies in the "organizational creative ability to achieve knowledge based on the reciprocity of knowledge creation activities and culture." The point of contact among many cultures due to the advancement of globalization is, on the one hand, the source of "intercultural collisions," but, on the other hand, is also the source of "creating new knowledge and culture" (Hayashi, Seki and Sakamoto: 2006b, 172). The "strategic creation of new knowledge and culture" which makes organizational capabilities possible is the key to competitive superiority for the "meta-national innovation-type firms" of the 21st century.

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