Comparisons between the career orientations of R&D professionals in Japan and the United States

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Research objectives
The debate over the career orientations of R&D professionals in terms of their professional research has until now involved two main categories, namely managerial orientation and technical orientation (Allen and Katz, 1986). The compensation and benefits system that corresponds with these categories is the dual ladder, the specialist system found in Japan. The former, “managerial orientation,” denotes a career path where a professional is promoted into managerial positions, while the latter, “technical orientation,” denotes a career path involving progression into specialist positions only. Managerial positions in Japan include Section Chief, Department Manager, and Director, while managers in Europe and America are referred to by titles such as Project Manager, Director, and Vice President. Technically oriented positions include Managing Engineer, Chief Engineer, and Chief Researcher in Japan, and Senior Scientist, Senior Fellow, and Senior Researcher in Europe and America.

An alternative career orientation which does not fit the technical/managerial categorization, however, has been suggested by Allen and Katz (1986). This orientation, which they call project orientation, refers to professionals who are not concerned with whether their promotion is of a managerial or technical nature; rather, project-oriented professionals are motivated by projects that capture their interest. Allen and Katz (1995) further consider the types of individuals who are project oriented. While they found this orientation in higher age groups, for whom further promotion had been precluded, they also found evidence of project orientation among younger age groups. Allen and Katz surmise these younger professionals to be individuals who act according to their own internal values.

Further research suggests that career orientations have become increasingly diversified. Bailyn (1991), who focused on the mobility of personnel in Japanese firms in conducting interview-based research, discovered yet another career orientation which she terms technology transfer orientation. Technology transfer orientation involves the sense of satisfaction gained by professionals from the transfer of technologies they have developed to other departments for commercialization. Furthermore, Kim and Cha (2000), who carried out research on 1240 professionals at both private and public sector R&D departments in South Korea, add what they term “entrepreneurial orientation” on top of managerial, technical, project, and technology transfer orientations. These types of orientations are each seen to correspond to the five career anchors suggested by Schein (1978).

However, of the various career orientations identified by these researchers, technical transfer orientation can be considered an offshoot of technical orientation. This is due to the fact that the careers of professionals with technical transfer orientations have been
greatly affected by the sense of self satisfaction gained by these professionals through the practical application of their technology. Meanwhile, entrepreneurs who become independent from organizations exhibit a management capacity in the form of the establishment of a new business, and we therefore consider entrepreneurial orientation as deriving from managerial orientation.

Taking these debates into consideration, this working paper analyzes data obtained from interviews with R&D professionals in Japan and the United States. Our research revealed self perceptions of Japanese R&D professionals with regard to their careers that were closely linked to a worldview subconsciously adapted by these professionals through their R&D work, which cannot be explained by existing research. Our research objectives are to use our findings to reconsider the existing debate over the carrier orientations of R&D professionals, examine the effects of our findings on innovation systems, contribute to the foundations of designing compensation systems for R&D professionals, and further education, research, and MOT personnel education.

The main subjects surveyed for this working paper were R&D professionals at Japanese semiconductor consortiums. We chose to carry out our survey at consortiums due to the fact that they engage in cutting-edge R&D projects rather than projects aimed solely for commercialization, and the fact that it was possible to exclude factors such as the effectiveness of teamwork and organizational factors other than the work process, making it more likely for individual consciousness and abilities to be reflected in performance. In addition, because Japan's consortiums are composed of personnel dispatched from participating firms, it provides an opportunity for these personnel to reevaluate their careers somewhat at a distance from their usual workplace. For these reasons, we concluded that we would be able to collect data that reflected the informants' objective thoughts regarding their abilities and the future of their careers.

With the objective of performing a comparative study between Japanese and American R&D professionals, we also surveyed professionals working at semiconductor consortiums in the United States. Interviews were carried out at the semiconductor consortiums MIRAI and Selete in Japan, and SEMATECH in the United States, and the two organizations were compared.

At MIRAI and Selete, we conducted interviews with 16 personnel dispatched from firms, each of whom was responsible for research. The interviews took place in July and September of 2003. At SEMATECH, interviews were held with 11 directly employed researchers in March 2004. In addition, to also consider researchers not dispatched to consortiums, we used additional data from interviews we conducted with R&D professionals at private firms prior to our current research, and applied this data to our analysis.

2. The two types of technical orientations in Japan

Our analysis of the data from interviews we conducted among R&D professionals in Japan and the United States revealed differences between the informants of the two countries that would be classified as being technically orientated existing current researches. Although technical orientation could readily be identified as non-managerial orientation in America, as in the preceding research, too much disparity was seen among Japanese informants to equate non-managerial orientation with technical orientation. More detailed analysis of these informants' remarks revealed that they could be classified into two orientations based on their worldview on R&D: namely, research orientation and
engineering orientation.

Firstly, interviews with R&D professionals in Japan revealed the following:
1 From questions, “What would you call your occupation?” and “How do you define research and engineering (development),” we identified a common perspective among professionals involved in R&D. This worldview holds that research and engineering are at opposite poles of the same dimension.
2 Informants’ answers regarding their occupational identity were given based on their perceived positioning between the two opposite poles of science and engineering, which they determined based on their work and ability.
3 This perspective, while seemingly similar to the R&D linear model, comes from a severance of research and engineering, rather than a continuous linear model.

**Differences between definitions of research and engineering**

In our interview, we included the questions, “What would you call your occupation?” and “How do you define research and engineering (development)?” Regarding the first question, more Japanese informants answered “engineer” rather than “researcher,” while a split was seen between “engineer,” “scientist,” and “researcher” was seen in the answers of American informants. The use of the word “scientist” stands out among American informants.

Responses regarding definitions of research and engineering (development) given by each Japanese respondent is outlined in the following table, in relation to the occupations cited by the respondent.

<table>
<thead>
<tr>
<th>Definition of research</th>
<th>Definition of engineering</th>
<th>Occupation cited</th>
</tr>
</thead>
<tbody>
<tr>
<td>A search for causal relationships</td>
<td>No search for cause and effect, only decisions</td>
<td>Researcher</td>
</tr>
<tr>
<td>Cutting edge; doesn’t lead directly to sales</td>
<td>Commercialization, realization</td>
<td>(No answer)</td>
</tr>
<tr>
<td>The creation of new concepts</td>
<td>Clear target for commercialization</td>
<td>Engineer</td>
</tr>
<tr>
<td>To make possible the impossible</td>
<td>Some jobs only involve laying down on-site conditions</td>
<td>Engineer</td>
</tr>
<tr>
<td>Work that doesn’t generate profit</td>
<td>Works close to the manufacturing site</td>
<td>Researcher</td>
</tr>
<tr>
<td>Something basic</td>
<td>Clarification of objectives</td>
<td>Engineer</td>
</tr>
<tr>
<td>Something new</td>
<td>Mass production</td>
<td>Researcher</td>
</tr>
<tr>
<td>A quest for the essence of things</td>
<td>Self-evident; commercialization</td>
<td>Engineer</td>
</tr>
<tr>
<td>Something which may or may not be useful</td>
<td>Based on a specific idea</td>
<td>Engineer</td>
</tr>
<tr>
<td>Opening up of new areas in science</td>
<td>Improving on-site technology</td>
<td>Engineer</td>
</tr>
<tr>
<td>Pursuit of creativity with fundamental research</td>
<td>Applied research</td>
<td>Engineer</td>
</tr>
</tbody>
</table>
Research and engineering as defined by American respondents

<table>
<thead>
<tr>
<th>Research</th>
<th>Engineering</th>
<th>Occupation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trying to understand the origin of the problem in a deeper level than the problem itself in order to solve it.</td>
<td>Trying to solve the problem as is</td>
<td>Scientist or Engineer</td>
</tr>
<tr>
<td>Applied research also involves the application of high level scientific reasoning where the investigation or inquiry if focused on revealing an unknown.</td>
<td>The application of scientific reasoning and principles to achieve practical, functional designs and the development of efficient operational structures, equipment and systems of value.</td>
<td>Engineer</td>
</tr>
<tr>
<td>An investigative activity in which one explores and discovers advancements in science or technology.</td>
<td>An effort by which the research is turned into a final product</td>
<td>Engineer</td>
</tr>
<tr>
<td>Trying to understand something new.</td>
<td>Adjusting processing conditions to produce optimized results</td>
<td>Scientist</td>
</tr>
</tbody>
</table>

These data reveal the perspectives held by these professionals in terms of their R&D. It was observed that American informants position research and engineering on a linear progression. The data also revealed a general agreement among professionals that research denotes investigation and understanding the unknown or new, while engineering denotes application or problem-solving. In addition, in relation to the definitions of research and engineering, professionals understand the application of research to be development and therefore regard these as sequential. Their understanding therefore implies a continuum on the R&D linear model.

In terms of their occupation, some American informants indicated that their work was sometimes for research-focused, whereas at other times their work was more engineering-focused; others answered that their work spanned both categories. Some professionals who indicated that they call themselves scientists do so out of a desire to continue to work in a job that is closely related to science. This suggests that they consider research and development to be sequential processes.

Japanese R&D professionals demonstrate differences in their understanding of research and engineering. Unlike the agreement seen among American professionals on the continuity of research and engineering, Japanese professionals seem not to regard the two as continuous.

This can be thought to indicate that definitions of science and technology do not exist in Japan as commonplace understandings. Among other reasons, this may reflect the fact that systematic science education is not carried out within the Japanese education system. It is possible that because Japanese enter their professions without a clear understanding of the definitions of science, technology, research, and engineering, each come to create
their own definitions in their own way.

The perspective held by Japanese R&D professionals in terms of R&D has been affected by the diversity and ambiguity of these definitions.

A more detailed investigation and analysis may be necessary, but it seems as if an implicit assumption exists among the majority of Japanese informants that research involves scientific issues, whereas engineering involves working with technical matters. Research, like science, is understood as involving something new and basic, and something that may not be useful or lead to profit—something that involves the pursuit of the basic essence. In addition, there is a strong trend among Japanese professionals to define science as something based on curiosity which has no clear objective. Some informants even indicated science to be in the realm of Nobel Prize candidates, and quite out of their category. These results stood in stark contrast to science as defined by American professionals—as something that exists in everyday life, and something encompassed by their own work.

In Japan, engineering is understood as something close to society, as on-site technology, as the pursuit of technologies leading to commercialization, as mass production, and as activities that lead to the generation of profit. In particular, the existence of informants who define engineering in terms of mass production or profit stand out as a trend not seen among American informants. The following comments by Dr. A and Dr. K at Selete, and Dr. N at MIRAI, demonstrate this difference.

Engineer: “I think development involves work based on a specific idea, where you are instructed to create a particular product that will go on sale at a particular time. On the other hand, I personally think research involves work that might be interesting but you don’t really know if it’s going to lead to anything useful.”
(Dr. A, a researcher from Selete who defined himself/herself as an engineer)

(In answer to a question on the difference between his or her image of engineers and researchers)

“For engineers, there’s basically a fixed target in the application of the technologies they’re developing in their work, as well as a clear timeframe. Engineers don’t start from scratch, and to put it in extreme terms, engineering involves technologies that will be used in a product several years later… This is just generally speaking, but I’d say that basic engineering is work that’s definitely going to be of practical use to society, or work that involves something that is going to be applied. But I think research is at a level where you’re doing something scientific and you’re not sure at all if it’s going to lead to anything, but you’re hoping that it will.”
(Dr. K, a researcher from Selete, who defined himself/herself as an engineer)

(In answer to a question on the difference between researchers and engineers)

Personally speaking, the work of engineers tends to involve products. Engineers handle research that’s closer to society. Or their work involves the development of technology that’s justifiable… On the other hand, researchers probably carry our investigations that are very scientific, or investigations that may not be related with a particular product, but whose findings might be useful in future products. Their research might not contribute directly to top-of-the-line products, but they study issues that must be studied.
(Dr. N., a researcher from MIRAI, who defined himself/herself as a researcher)
What is characteristic of the comments given above, as well comments that are not introduced, is that no informants touch on the continuity that exists between research and development. This stands in stark contrast to informants in the United States, who clearly stated that the application of research is engineering.

For Japanese professionals, researchers and engineers handle separate types of work. Therefore, if engineering work were to evolve into research, or vice versa, it would imply a change in their occupational identity. In reality, Japanese engineers define their occupational identity from the content of the work they are currently involved in.

“In Japanese we would call researchers 'kenkyuin' (research staff). In English, I think either researchers or research engineers would be appropriate. I don’t think I can say I’m a scientist because I am not sufficiently involved in science. That would be a little presumptuous.”
(Dr. K, a researcher from MIRAI, who referred to himself/herself as a researcher)

“It’s true that we now hold posts such as Researcher and Chief Researcher, but that’s just a matter of how we address people. Because our work involves developing a product by such and such a time, I think it’s more appropriate to call our work, “development.” Because we develop pre-determined products, in my mind I’m an engineer.”
(Dr. A, a researcher from Selete , who defined himself/herself as an engineer)

“Researchers study things that might bear fruit far, far in the future. Their work would really be defined as 'kenkyu' (research) in Japanese. I feel that development is more in the realm of engineers. In this light, I’d position myself somewhere in development and research. Although personally speaking, the distinction between isn’t very clear.
(Dr. O, a researcher from Selete who defined himself/herself as a researcher)

The comments given here demonstrate that these professionals’ responses regarding their occupational identity are dependent on their perspective of R&D. Japanese professionals thus define their occupational identities based on their positioning of their own work on the spectrum between the two perceived polar opposites of research and development. As we pointed out earlier, engineers in the United States perceive research and development as forming a progressive spectrum, whereas such an understanding is weak among Japanese engineers.

These findings suggest that while researchers in the United States define their occupational identity regardless of the kind of R&D work they have engaged in, the occupational identity of Japanese R&D professionals is determined through their current and past projects.

These findings also suggest that the notion of labeling the career orientations of R&D professionals as simply technically oriented should be approached with caution. The technical side of the dual ladder system in the United States, which positions R&D professionals based on a technical orientation regardless of the rigidity of their common perspective and occupational identity, leads to the smooth functioning of innovation systems.

However, the diverse perspectives held by Japanese R&D professionals in terms of R&D, and the weak motivation found among individuals to consciously link research to development, may be impeding the functioning of an efficient innovation system.
Therefore, we believe that it is necessary to get a better grasp of the career orientations of Japanese R&D professionals through the categories of research orientation and engineering orientation, as based on their perspectives, from the perspective of what sort of roles they assume in their contribution to R&D activities. Accordingly, if we define research orientation and engineering orientation from this perspective, research orientation would be defined as an R&D orientation which involves an interest in the fundamental phenomena and principles of an issue, and which involves the desire to contribute to the organization through the creation of knowledge. Engineering orientation, on the other hand, would be defined as an R&D orientation that involves an interest in the commercialization or mass production of R&D findings, and which involves the desire to contribute to the organization through the development of prototypes and/or production technology.

3. Reconsidering managerial orientation

The term managerial orientation is not compatible with R&D engineers in Japan because most professionals reaching the mid-career stage are expected to progress from the post of R&D researcher to Project Manager. Project Managers in Japan therefore do not constitute an occupational category, but are high-ranking positions into which professionals are promoted via a seniority system. What is characteristic about Japan is that researchers, even after becoming project managers, are often not removed from frontline R&D activities. In Japan, as a professional is promoted from Section Chief to Department Manager to Director, their work progressively shifts from R&D in specialist fields to project maintenance. Therefore, defining managerial orientation in terms of progressing to the post of Project Manager does not fit the Japanese personnel system. While the choice between managerial and technical orientations on the dual ladder usually represents a horizontal spread in career types, the progress of Japanese R&D professionals into Project Manager positions constitutes a vertical career progression.

On the other hand, in the American occupational system, there is little possibility for school graduates to be able to involve themselves in the actual R&D itself, and there is a trend instead for such professionals to work towards a Project Manager position. Therefore, as suggested by Allen and Katz (1986), if we concentrate on which ladder professionals show an interest in progressing up, we are able to identify a discrepancy in the personnel systems of Japanese firms between individual career orientations and the ladder system which they are placed in. Based on these findings, it can be said that in terms of career orientations as discussed in this paper, it should not be assumed that professionals will progress up a ladder that meets their respective career orientations; instead, the focus of the research should be on how professionals contribute to the work carried out in their respective workplaces.

Organize orientation

A sample suggestive of the presence of a managerial orientation, as in the existing dual ladder and career orientation debate, could not be identified among the engineers at Japanese semiconductor consortiums surveyed for this paper. However, a sample was identified among informants at US consortiums. In addition, in comparing Japan and the United States, professionals with managerial orientation were identified from the interview
data of R&D professionals at private firms in Japan, who were surveyed separately from the professionals at semiconductor consortiums.

American informants with a management orientation describe the roles of the Project Manager as being “to advance the work of the team, to create good human relationships and to promote opportunities,” or “to understand technological performance and to promote improvements, as well as to come up with flexible responses so as to contribute to changes in management goals. From these responses, it can be said that Project Managers play roles that fit the conventional managerial orientation mould.

In Japan, however, because of the personnel system which places R&D professionals within an R&D setup, all professionals must move up through the organization and assume management positions, regardless of whether they are managerially oriented, or whether they are suited to management. Accordingly, our analysis went beyond the concept of management, which has a strong position-based connotation, and reconsidered orientation from the standpoint of what roles professionals should play in contributing to their organization in order that innovation systems function smoothly.

As a result, we arrived at a hypothesis that the orientation in contraposition to technical orientation (research/engineering orientation) should not be referred to as managerial orientation, but organize orientation. Organize orientation should be defined, as an R&D orientation that involves the promotion of knowledge creation and acquisition (from both internal and external sources), and the accumulation and integration of knowledge, for practical application to products or technology, and which involves the desire to contribute to their organization through the systemizing and organizing of R&D activities. We believe that the participation of a professional with an organizational orientation in a project would bring about a more efficient functioning of the project’s innovation system. In addition, because the role of professionals with organizational orientations within a project would be to bring together all the knowledge that is created within a project, they would not necessarily be interested in promotion into managerial positions. It would therefore be possible to separate the issue of whether professionals desire promotion into managerial positions from the orientations debate.

Organize orientation was merely a hypothetical concept which we discovered through the perspective, gained from our interviews at Selete and MIRAI, that research orientation and engineering orientation were insufficient to analyze the orientations of R&D professionals in Japan. However, the renewed, supplementary analysis of data from interviews conducted before our research at semiconductor consortiums in Japan and the United States revealed informants who touched upon professionals who may be thought of as having an organize orientation.

“I am very capable of meeting specific needs. If I’m asked to work with a certain cost, I somehow manage despite the fact that I have never calculated costs before. And I am also able to respond well when it’s predicted that materials outlining the investment plans should be compiled at some point in future discussions. I’ve been commended that I’m good at pointing out what’s missing from a project, or suggesting that we focus on certain areas. It was only then that I realized I had this ability. (Dr. M, a Section Chief-ranked professional aged 40, who identified aspects for which he/she was highly evaluated as the overseeing of projects, including the management of progress and the setting of issues for research.)

It can be thought that this informant is a professional who discovers elements that are
lacking in the organization of a project, adds such elements to the project, and contributes to the organization of the entire project. It is significant that some professionals are self-conscious of the fact that this ability has been highly evaluated within an organization, and that this constitutes a strong point.

“Before becoming Department Manager, I was almost always positioned very close to the research. But for the Department Manager class—until the Head or Section Chief class, research is your main work, but when you progress from Section Chief to Department Manager, your main work starts to involve management, such as negotiating, thinking about specific business opportunities other than the technologies being developed, deciding whether or not to continue with a project, or considering who to cooperate with. You also deal with internal affairs, like accounts and where to obtain funds. For us, what’s most important is how to acquire consignments. These kinds of tasks suddenly increased [when I became Department Manager]. (Dr. Y, a Department Manager aged 50, who responded that the volume of management tasks he/she handles increased after he/she was promoted to the Department Manager position.)

This informant, while he/she suggest that he/she experienced an increase in tasks involving negotiations with other departments or business planning using real numbers, and that his/her job content evolved with changes in the job title—which overlaps with the work carried out by managers in the existing research—and these roles in negotiations with other departments and other tasks may be included in roles with an organize orientation. It is thought that Dr. Y had felt little resistance in taking on an organize orientation. Personnel most likely exist who feel averse to leaving frontline R&D activities, and who were originally not organize oriented, but who serve to bring a project together. In addition, there must be professionals whose roles change from research orientation and engineering orientation to organize orientation. We must therefore carry out further investigations into this personnel category.

“There was once a project that was discontinued at my company, and the project, together with the factory, was going to be sold off to another firm. A researcher thought he had to stop this from happening, so he created the project’s system architecture in just a month. This project is now responsible for one of our company’s leading products, and I was very impressed, very moved by his technical ability, as well as his ability to take action, in creating something like this in just one month. His diverse knowledge, and his ability to mobilize people—I mean, of course he’s thinking for himself, but he goes around asking everybody’s opinions on what’s possible. He collects this kind of information and brings it all together. So I was impressed with his ability to gather information that he lacked. (Dr. H, commenting on a highly capable Project Manager who brought together his information gathering and management abilities to handle the whole process, from development to commercialization.)

The individual this informant describes used the knowledge and experience he had accumulated through his R&D work to bring together and integrate the knowledge that he felt was lacking in developing the product he was responsible for, and in just one month succeeded in saving the project from being sold to another company.

Therefore, there is a strong possibility that individuals who play roles that we suggest constitute an organize orientation make a large contribution to the rapid and smooth
functioning of innovation systems.

Existing research, which focuses on the treatment of R&D personnel, or on R&D personnel themselves, has uncritically assumed that raising personal motivations would inevitably lead to an improvement in the probability of innovation (Ishida Ed., 2002). Furthermore, research which suggests that the presence of certain individuals heightens the probability of innovation, such as professionals in R&D organizations who assume roles as gate keepers as identified by Allen (1977), as well as transformers (Harada, 1998) who promote innovation by transforming knowledge that exists outside the organization into valuable information for use within the organization, focuses excessively on the roles of such individuals and neglects any deep analysis of the innovation systems that are created through the allocation of roles between the individuals with outstanding qualities and other personnel.

Therefore, we believe that the framework outlining the orientations of R&D professionals in Japan, which we have developed from the results of our analysis and which involves organize orientation, research orientation, and engineering orientation, is a useful hypothesis in explaining the roles that should be allocated among individuals within scientific/technological transformation systems for the efficient functioning of innovation systems, which also considers the individual career progressions of individual researchers and developers. In other words, our hypothesis involves a model demonstrating the allocation of roles and contributions required for efficient innovation in the management of a smoothly functioning innovation system.

4. The three career orientations found in Japan

A summary of the three types of career orientations seen in Japan are as follows:

- **Research orientation**: An R&D orientation that involves an interest in the fundamental phenomena and principles of an issue; professionals with a research orientation endeavor to contribute to their organization through the creation of knowledge.

- **Engineering orientation**: An R&D orientation that involves an interest in the commercialization or mass production of R&D findings; professionals with an engineering orientation endeavor to contribute to their organization through the development of prototypes and/or production technology.

- **Organize orientation**: An R&D orientation that involves the promotion of knowledge creation and acquisition (from both internal and external sources), and the accumulation and integration of knowledge, for practical application to products or technology; professionals with an organizational orientation endeavor to contribute to their organization through the organizing and systemizing of R&D activities.
No informants were identified as currently having organize orientations in our research carried out at Japanese semiconductor consortiums.

Some informants felt that, in their future career, they had no choice but to climb up the managerial ladder to become Section Chief, Department Manager, and so on. This matches the findings that, in Japan, the personnel system is such that promotions on the technical ladder are seen in a negative light, whereas those on the managerial ladder are encouraged (Sakakibara, 1995; Imano, 1992; McCormich, 1995).

Among informants at private firms rather than consortiums, personnel with organize orientations were identified. Moreover, as we pointed out earlier, personnel systems are such that when an employee reaches the mid-career stage, it is expected that he or she assumes roles as Project Managers. Therefore, a move away from research or engineering orientations to an organize orientation is seen as a natural progression within the occupational system.

However, even if an employee is appointed Project Manager, there is a strong possibility that he or she will also be placed in charge of R&D activities while occupying middle management, and little psychological difference is predicted between these organize-oriented project managers and other research or engineering-oriented professionals. This is a key difference between the Japanese and American models of managerial orientation. In the United States, Project Managers do not engage directly in R&D.

On the other hand, a great divide exists between research and engineering orientations. As we discussed earlier, this indicates that research and engineering are thought to be separate activities in Japan.

As we saw in the existing research, the categories, research and engineering, do not exist as separate orientations in the United States; instead, both are brought together under the concept, technical orientation. As we stated earlier, if we assume a linear model, research and engineering are understood as sequential activities.

Alternatively, it may be more appropriate to assume that research and engineering are linked in ways more akin to Kline (1990)'s chain–linked model rather than a linear model. A linear model involves a single-file progression, from research, through development, to commercialization. The chain–linked model, on the other hand, does not assume that the process always begins with research—various stages can constitute the starting point for the research process—and also assumes that research continues to be relevant in the commercialization stage. Scientific knowledge and technological knowledge are exchanged to link research to commercialization. The table below outlines the definitions of science and technology that were suggested in our interviews in the United States. American informants did not see a separation between science and technology, but understood each to stimulate the other. This makes it possible for individuals to discover new business opportunities in the relationship between science and technology, and to generate new business activities.
R&D engineers in Japan, however, for whom research and engineering are separate activities, seem to believe that tying the two together is an issue that is addressed by management or the team or group as a whole.

5. The Discrepancy between career orientations and career paths in Japan

We would finally like to explore the discrepancy that exists between career orientations and career paths in Japan. This working paper has thus far derived the concept of organize orientation as an alternative, non-technical orientation seen among R&D professionals in Japan. However, Project Manager is the position within the Japanese occupational system that corresponds to personnel with an organizational orientation, thereby denoting progression along the managerial ladder. While professionals remain Managers (Section Chiefs), they may spend a significant amount of time in direct involvement with R&D, and they may feel that they are directly contributing to the realization of products or technology through the accumulation and integration of knowledge. However, once these professionals assume the position of Directors (Department Managers), a large part of their jobs comes to involve the drawing up of business plans, negotiations with other departments, and other management tasks. This leads to near-retirement from R&D activities in a manner similar to the managerial ladder as seen in the United States.

Like Department Manager Y, professionals who are able to continue their R&D activities concurrently with their managerial tasks are not likely to feel averse to the changing content of their work. However, problems remain even in this case regarding the acquirement of managerial skills and strategic thinking ability that is required to progress up the managerial ladder. Professionals who have worked only on improving their technical skills until they reach mid-career positions are suddenly expected to acquire management skills. Whether this is possible or not heavily depends on individual efforts.

However, in the American system, professionals make their way up the managerial ladder, which corresponds to a managerial orientation, from a relatively young age. In addition, universities offer degrees that correspond to the managerial ladder in the form of MBAs and MOTs. Japanese universities have only recently begun to follow the United States in offering MBA and MOT courses. In short, within the Japanese occupational system, the career path only corresponds to organize orientation up to the mid-career stage of Project Manager. Higher ranking positions on the managerial ladder are of a wider managerial orientation, encompassing a range of activities to systemize R&D activities, such as the linking of research to the realization of products or technology, and call for the desire to contribute to the firm through an organizational standpoint. Future areas for research and investigation therefore include difficulties arising from the progression of
organize-oriented professionals into managerially-oriented positions, as well as an exploration of desirable career paths that correspond with organize orientation.

References


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