# Promotion of R&D Professionals in Japan: Influences of Inter-Functional Transfers and Inter-Organizational Mobility*

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This study analyzed the career development of R&D professionals, focusing on internal promotions. In this study, two research questions—whether inter-functional transfers are a prerequisite for their promotion and whether inter-organizational moves have a negative influence were examined by analyzing original data on four types of organizations: national laboratories emphasizing basic research, those focusing on applied research, private laboratories in the electric and electronics industry, and those in the pharmaceutical industry. Inter-functional transfers increase and inter-organizational moves decrease prospects for promotion only in private laboratories in the electric and electronics industry, which produce highly-integrated products and demand cross-functional coordination. There are two avenues of career development for R&D professionals: The first is through inter-functional transfers and internal promotion within an organization, while the second is career development specializing in and advancing specific functional knowledge, which is sometimes pursued through inter-organizational moves. The characteristics of knowledge that each organization requires its R&D professionals to possess influence the nature of its R&D professionals' career development. Because the first type is the majority in the Japanese economy, the labor market for R&D professionals is immobile.

## I. Introduction

Many scholars studied characteristics of Human Resource Management (HRM) practices in large Japanese firms and Japanese labor markets after World War II. Recruitment of new graduates, the practice of long-term employment until mandatory retirement age, and seniority-based promotions and pay raises were considered to be typical characteristics of Japanese HRM. After the bubble economy burst in the 1990s, many companies changed their HRM practices. They put more weight on performance and abilities when determining employees' remunerations, increased mid-career hiring, and discontinued long-term employment security until the mandatory retirement age. However, the change was not so drastic that Japanese labor markets have been basically immobile. Therefore, Japanese workers tend to pursue their career development through intra-firm transfers and internal promotions.[1] This trend has been observed not only with white-collar workers, but also

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[1] A seniority-based promotion system does not mean that workers are promoted automatically as they get older. The essence of the system is relatively late selection of outstanding employees. In contrast to the early selection in the United States, workers belonging to the same entry cohort are not

with R&D professionals. Although there has been little quantitative research on the career development of R&D professionals, some notable studies exist. For example, Sato (1995) compared the career patterns of R&D professionals in the U.S., the U.K., Germany, and Japan. The author found that the percentage of R&D professionals who had firm-to firm job mobility was only 5.8% with the Japanese sample; on the other hand, all the other countries had percentages of over thirty. In Japan, national laboratories are more likely than private firms to hire R&D professionals at mid-career. However, even in national laboratories, Murakami (2002) reported that the percentage of R&D professionals with outside work experience was 17.2% in the Japanese sample, which was lower than the 30.2% in the American sample.[2] Such low rates of inter-organizational mobility in Japan seem to imply that career development within an organization is very important for Japanese R&D professionals. Therefore, this paper will study internal promotions of Japanese R&D professionals.

The focus of this paper is on whether inter-organizational moves and inter-functional transfers influence R&D professionals' promotion. Prior research has found that in Japanese firms, employees transfer between functional units more frequently than in U.S. firms, and the pattern of transfers is highly standardized. For instance, Sakakibara and Westney (1985) compared cases at electronics firms between the U.S. and Japan. The authors found that Japanese R&D professionals assigned to the corporate-level R&D laboratory spent the first five to seven years there doing research work, then moved to a divisional lab to engage in development projects, and several years later, they were promoted to line managers. On the other hand, American firms used various methods of recruitment and exhibited multiple career patterns for employees. Therefore, the authors concluded that there was no typical career pattern of R&D professionals in U.S. firms.

Moreover, Lynn, Piehler, and Kieler (1993) compared engineers' careers between Carnegie Mellon University alumni and Tohoku University alumni. These two universities are among the elite universities in the U.S. and Japan, respectively, and are roughly comparable. Although "engineers" in their research is a broader category than R&D professionals in this paper, they found clear signs of less inter-organizational mobility and more frequent job rotation in their Japanese sample. In total, 74% of the Japanese respondents have never changed employers, and 61.9% of them had been assigned to other areas outside their pri-

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differentiated during the first 10 to 15 years in terms of positions in the corporate hierarchy and wages. However, even during these years, OJT is conducted through intra-firm transfers, and workers' abilities, performances, and behaviors are observed by their bosses. The information collected by the observations will be used for competitive selections for middle or higher managerial positions in 10 to 15 years. In contrast to the U.S. system, in which winners and losers are clearly screened in the early stages for their careers, the Japanese promotion system gives all workers hope that they will be promoted to higher hierarchical positions, which in turn motivates them to acquire firm-specific human capital. See Ohashi and Teruyama (1998), Koike (1991), and, Ariga, Brunello, and Ohkusa (2000).

[2] The study is a comparison of national laboratories conducting agricultural research between Japan and the U.S.A. The number of R&D professionals in the American sample is 93, and 87 for Japanese sample. See Murakami (2002).

mary responsibility or specialty. In the American sample, the former value was 43.4%, and the latter was 40.4%. In addition, Japanese respondents experienced jobs outside their specialty multiple times, and the areas to which they were transferred were mainly research/design/development, production, and marketing/sales.

Intra-organizational transfers of R&D professionals in Japan have important functions, such as internal transfer of information and knowledge, cross-functional coordination, job-matching, and training and development of R&D professionals (Kusunoki and Numagami 1996). Therefore, obtaining a wide range of knowledge through inter-functional transfers may be a prerequisite condition for R&D professionals to be promoted. However, R&D workers are also professionals who are required to have a high level of expertise. Therefore, only those who have concentrated on research/development alone and have acquired advanced knowledge about a particular functional area/discipline may be promoted. In fact, some previous research has indicated that those who experience more frequent job transfers are likely to be promoted faster or reach higher positions (Imano 1991; Noda 1995; Kusunoki and Numagami 1996), and other work has shown that job rotations crossing over branches/functional units are not always helpful for workers' promotions and sometimes hinder them (Matsushige 1995; Imada and Hirata 1995).

Why have different associations between promotions and intra-organizational transfers been found in the prior research? When we consider the roles of intra-organizational transfers, an answer to this question seems to be in characteristics of knowledge that R&D professionals in managerial positions should have. Hence, this paper will pay attention to organizations' outputs and argue that depending on the characteristics of each organization's output, R&D professionals are required to possess different types of knowledge and skills, which, in turn, cause different associations between promotions and inter-functional transfers/inter-organizational moves. I will elaborate on this idea and construct hypotheses in Section II and examine them in Section III.

## II. Types of R&D Performed by National Laboratories and Industries

Kusunoki (1997) classified knowledge used for innovation into function knowledge and production knowledge. The former is knowledge about elements, such as components of products (engine, brake, transmission, etc.), disciplines (electronics engineering, machine engineering, information engineering, etc.), and functions (research, development, manufacturing, marketing, etc.). The latter knowledge contributes to product integrity. Clark and Fujimoto (1991) defined product integrity as the extent to which the totality of a product achieves a balance of numerous product characteristics, including basic functions, aesthetics, semantics, reliability and economy. Product integrity has internal and external dimensions. Internal integrity is consistency between the function and structure of a product, including how well parts fit and components match. In order to produce integrated products, knowledge about linkages between individual components/parts and coordination between functional units are indispensable. On the other hand, external integrity refers to how a product's function, structure and concept fit customers' demands. Knowledge about market needs and market competition are necessary for external integrity. Production knowledge includes these two types of knowledge required for internal and external integrity.

The importance of function knowledge and production knowledge depends on organizations' outputs. In an organization that produces a highly integrated product, production knowledge is more important than function knowledge. On the other hand, an organization that specializes in producing a specific component or works in a particular functional area requires more function knowledge than production knowledge. Therefore, we need to consider organizations' outputs in order to discuss career development. In order to clarify the influence of outputs on the career development of R&D professionals, this paper will compare promotions in four kinds of organizations that produce different types of outputs—national laboratories focusing on basic research (NLB), those with an emphasis on applied research (NLA), laboratories of private companies in the pharmaceutical industry (PLP), and those in the electric and electronics industry (PLE). The electric and electronics industry includes manufacturers of electronic information and communication equipment, electronic parts and devices, and electrical machinery and equipment.

In general, national laboratories focus on research work and private laboratories put more emphasis on development and design. The major outputs of national laboratories are papers describing scientific principles, theories, and experimental results. Therefore, a high level of function knowledge is necessary for R&D professionals in national laboratories. However, there are some variations in research subjects and missions among national laboratories. Some national laboratories focus on basic research, and others on applied research with a specific practical purpose. In the latter type of national laboratories, both patents and papers are valuable output.

On the other hand, the main outputs of private companies are products and services that are sold on the market. Therefore, laboratories of private companies pursue research that may improve the companies' products and manufacturing process. Their research results should be embodied somehow in their final products or production process, and papers and patents are byproducts. As a result, the importance of production knowledge is generally greater in private laboratories than in national laboratories.

In addition, the importance of production knowledge depends on their products' integrity level. For example, Japanese firms in the electric and electronics industry that manufacture such items as personal computers, printers, facsimiles, and copy machines focus on producing highly integrated products in a timely manner. Those companies confronting highly competitive global markets adopt a main strategy of supplying improved models earlier and at lower cost than their competitors. Several authors have emphasized inter-functional coordination as a key element of the competitive advantage of those Japanese firms (Nonaka and Takeuchi 1995; Ikejima 1999; Yoneyama and Nonaka 1995; Okimoto and Nishi 1994; Takeuchi and Nonaka 1986, 1993; Nonaka 1989). Their development teams are composed of members from a wide range of functional units, such as R&D, production, sales/marketing, planning, and service. From the beginning of the development process, team members from the R&D and manufacturing units communicate and closely collaborate for efficient manufacturing. In order to produce new products better suited to consumers' current demands and the latest technology, feedback from marketing to development is provided, even after the development process has started. Therefore, each phase of the development process, such as R&D, manufacturing, and marketing, is not isolated from the others; nor is the development process conducted linearly or step by step. In Japanese firms, where each phase overlaps, production knowledge is very important.

In such Japanese firms, the core members of production development teams experience inter-functional transfers (Nonaka and Takeuchi 1995). Kusunoki and Numagami (1996) argued that such transfers enable workers to possess broader knowledge. Due to their own cross-functional knowledge obtained through the transfers, they can efficiently solve some engineering problems related to cross-functional coordination on their own. In other words, cross-functional integration can be spontaneously realized at the individual level before managers coordinate intentionally, which saves time that would otherwise be spent on interpersonal information transfers.

On the other hand, R&D in the pharmaceutical industry is conducted in a linear fashion, from drug discovery through preclinical research to clinical trial. Drug discovery is the process of finding a lead compound that has a desirable effect. The probability that a discovered candidate compound will proceed to the preclinical research is just one in one thousand, and its probability of becoming a final product is only one in six thousand (Kuwashima 1999). In other words, drug discovery research is highly uncertain. However, drug discovery is extremely important because new scientific discoveries in this stage determine the essential traits of drugs, such as efficacy and safety. In preclinical research, information about safety is collected through animal testing. Preformulation development studies of candidate compounds are also conducted to determine dosage forms. Once satisfactory information has been gathered on the quality of the products and the Minister of Health, Labor, and Welfare has approved them, the products are moved into human testing. This last stage is called clinical trial.

In contrast to R&D in the electric and electronics industry, which adopts the overlap model, R&D phases in the pharmaceutical industry are separated from each other, and the first phase, basic research, is vital for their success. Henderson and Cockburn (1994) studied research productivity in the pharmaceutical industry and found that the frequent exchange of rich, detailed information across disciplinary or disease area boundaries did not positively influence research productivity. Kuwashima (1999) argued that success in drug discovery research basically depends on individual researchers' abilities and efforts. Their success does not require collaboration between team members involved in the drug discovery, preclinical research and clinical trial phases. Therefore, function knowledge about each phase and discipline is more significant than production knowledge for research and development of drugs.

Based on the above consideration, the following relationships between promotions and inter-functional transfers/inter-organizational moves can be inferred. First, in organizations in which the importance of production knowledge dominates, R&D professionals with more frequent inter-functional transfers are likely to be promoted because the transfers provide good opportunities for acquiring knowledge through learning by doing. Second, production knowledge may also be acquired through informal communication and experiences on cross-functional project teams. Therefore, R&D professionals who have experienced inter-organizational moves would be at a disadvantage in terms of promotion in organizations with an emphasis on production knowledge. Hence, I posit the following hypotheses:

**Hypothesis 1a**: In private laboratories of the electric and electronics industry, where greater importance is put on production knowledge, R&D professionals with more frequent inter-functional transfers are likely to be promoted to managerial positions.

**Hypothesis 1b**: R&D professionals who have experienced inter-organizational moves are less likely to be promoted to managerial positions in private laboratories of the electric and electronics industry.

**Hypothesis 2a**: In national laboratories and private laboratories in the pharmaceutical industry, which puts a greater emphasis on functional knowledge, inter-functional transfers of R&D professionals will not increase their promotion prospects.

**Hypothesis 2b**: In national laboratories and private laboratories in the pharmaceutical industry, the experience of inter-organizational moves will not prevent R&D professionals from being promoted to managerial positions.

## III. Empirical Analysis

To test the above hypotheses, I used data collected by a survey on the career development of Japanese R&D professionals and their Human Resources Management. The survey was conducted in 1999 in eleven laboratories of internationally known companies and ten national laboratories, with financial support by the Agency of Science and Technology. The survey questions concern a wide range of topics, including the respondents' personal careers, their organizations' HRM, their satisfaction with their working environment, their communication and information exchange, etc. The questionnaires were distributed to R&D professionals through each organization's general/personnel department. Five hundred ninety-four completed questionnaires from ten national laboratories and 909 completed questionnaires from eleven private laboratories were collected in all, yielding response rates

Table 1. Factor Analysis of Performance

| Performance | Factor 1 | Factor 2 |
|---|---|---|
| Papers in Japanese journals | 0.450 | 0.048 |
| Papers in international English journals | 0.617 | -0.060 |
| Presentation at international conferences | 0.714 | -0.026 |
| Presentations at Japanese conferences | 0.782 | -0.142 |
| Prizes given by other organizations | 0.319 | 0.199 |
| Domestic patents | -0.037 | 0.745 |
| Overseas patents | -0.002 | 0.723 |
| Practical use of research results | -0.052 | 0.473 |
| Prizes given by their employers | 0.078 | 0.468 |
| Eigenvalue | 2.384 | 2.143 |
| Cumulative factor contribution rate (%) | 26.491 | 50.307 |

*Notes*: 1. Principal factor analysis was applied.
2. The figures in the table show the factor loading after varimax rotation.

of 59.4% and 90.9%, respectively.[3]

First, I selected respondents who fit the four categories mentioned above: NLB, NLA, PLE, and PLP. Because private laboratories are part of large manufacturers, it is simple to distinguish the industry to which each individual private laboratory belongs. However, it is not easy to determine whether each national laboratory is basic-research oriented or applied-research oriented. In this study, the following method of distinguishing these two types of laboratories was adopted.

In the survey, the respondents reported their research performance for the past five years as measured by the number of domestic patents, overseas patents, papers in Japanese journals, papers in international English journals, presentations at Japanese conferences, those at international conferences, practical use of research results, prizes given by their employers, and prizes given by other organizations. When I applied factor analysis to those measurements, two factors with eigenvalues greater than one were obtained (Table 1). Because the first factor had high factor loadings with papers and conference presentations, it can be labeled “scientific performance.” The second factor had high factor loadings on patents and practical use of research results. Therefore, it can be called “practical performance.”

Next, the ten national laboratories were ranked based on their average values of respondents’ factor scores on the scientific performance and the practical performance scales,

[3] The questions on the questionnaire and their answers’ distributions are shown in Shakai Kogaku Kenkyujo (2000).

Table 2. Variables for the Logit Analysis for Promotion

| |
|---|
| Dependent variable: managerial position=1, others=0 |
| Independent variables |
| ・Age: respondents' ages at the time of the survey |
| ・Doctorate dummy: doctorate holders=1, others=0 |
| ・Inter-functional transfers: the number of inter-functional transfers |
| ・Organization change dummy: if respondents changed their employers, organization change dummy=1, others=0 |
| ・Loan of personnel dummy: if respondents experienced loan of personnel, loan of personnel dummy=1, others=0 |
| ・Scientific performance: factor scores of the "scientific performance" factor |
| ・Practical performance: factor scores of the "practical performance" factor |
| ・12 kinds of organization dummy variables (NLB1-4, NLA1-4, PLE1-3, and PLP1): if a respondent belongs to NLB1, NLB1=1, others=0. The same rule was applied to NLB2-4, NLA1-4, PLE1-3 and PLP1. |

respectively. When the rank of the scientific performance of a national laboratory was equal to or greater than that of its practical performance, the national laboratory was classified into NLB; otherwise it was classified into NLA. As a result, each category has five laboratories. All of the NLB research is in the fields of medical science or materials science, and all of the NLA research is in the fields of agriculture, engineering, or information technology.

In order to test the above hypotheses, I conducted the following logit analysis regarding each of the four kinds of laboratories. The independent and dependent variables are shown in Table 2. The dependent variable is whether or not the respondents were managers. The independent variables include "organization change dummy" and "inter-functional transfers." In the survey, functions were divided into four units: basic research, applied research, development and design, and others. The number of transfers between these functional units is captured by the variable of "inter-functional transfers."

In addition, control variables are age, doctorate dummy, scientific performance, practical performance, loan of personnel dummy and 12 kinds of organization dummy variables. Age is an important variable in organizations using the seniority-based promotion practice. Previous research about promotion practices for white-collar workers has shown that educational attainment is a key factor for promotion in Japanese companies.[4] Because R&D workers have at least a bachelor's degree, a doctorate dummy was used to show educational attainment in this paper. In addition, performance may also influence promotion because even in Japanese organizations, it is quite unusual for age and length of experience alone to

[4] See Tachibanaki and Rengo Soken (1995).

determine promotion. In this paper, scientific performance and practical performance, as mentioned above, were added to the dependent variables.

Moreover, Japanese companies dispatch their employees to other related organizations for training, coordination between accepting and sending organizations and so on, which is called *shukko* in Japanese.[5] Some respondents of our survey experienced the loaning of personnel in private companies, national laboratories, universities within and outside Japan, etc. Loaning of personnel may have a similar effect on promotions as inter-organizational moves in the sense that R&D professionals who are on loan to other organizations may miss good chances to acquire production knowledge. Therefore, a loan of personnel dummy was added to the independent variables. Finally, 12 kinds of organization dummy variables were used to represent differences in promotion policies between organizations.

Basic statistics for the independent variables in each type of organization are shown in Table 3. As can been seen in the table, the average of the organization change dummy is highest for NLB at 0.32, and less than 0.1 for the two types of private laboratories, PLE and PLP. This result stems from a difference in hiring practices, namely that national laboratories employ mid-career hiring more often than companies. On the other hand, the average number of inter-functional transfers is lowest with NLB, where function knowledge is important, and highest with PLE, in which highly integrated products are manufactured. As far as performance is concerned, both kinds of national laboratories show high scientific performance, with NLB being particularly high performing. PLE shows the highest practical performance. These results reflect differences in the R&D focus of the different types of organizations.

The results of the logit analysis are shown in Table 4. Looking at the inter-functional transfer variable, a significant positive coefficient can be seen only for PLE. In other words, R&D professionals with more frequent inter-functional transfers are likely to be promoted only in the electric and electronics industry, in which production knowledge is highly valuable. Therefore, Hypothesis 1a and Hypothesis 2a were confirmed. In addition, it is only for PLE that the coefficient of the organization change dummy is significantly negative. In other type of organizations, the coefficients are insignificant. R&D professionals recruited by their present employers in mid-career have fewer opportunities for advancing their production knowledge than those hired immediately after obtaining their degrees. Therefore, in the electric and electronics industry, where the importance of production knowledge is quite high, R&D professionals recruited in mid-career have more difficulty being promoted, even if the effect of inter-functional transfers is controlled for. In other types of organizations, the experience of an inter-organizational move does not positively or negatively affect promotion prospects. Therefore, Hypothesis 1b and Hypothesis 2b were also confirmed.

[5] Nagano (1989) pointed out that *shukko* is sometimes used to discharge unproductive employees, usually elderly workers.

Table 3. Basic Statistics

| (*org.*) Variables | Minimum | Maximum | Average | s.d. |
|---|---|---|---|---|
| *NLB* | | | | |
| Age | 29.0 | 59.0 | 44.17 | 8.69 |
| Doctorate dummy | 0.0 | 1.0 | 0.53 | 0.50 |
| Inter-functional transfers | 1.0 | 5.0 | 1.47 | 0.81 |
| Organization change dummy | 0.0 | 1.0 | 0.32 | 0.47 |
| Loan of personnel dummy | 0.0 | 1.0 | 0.51 | 0.50 |
| Scientific performance | -0.78 | 5.28 | 0.73 | 1.21 |
| Practical performance | -1.02 | 1.14 | -0.55 | 0.31 |
| *NLA* | | | | |
| Age | 25.0 | 60.0 | 41.87 | 8.92 |
| Doctorate dummy | 0.0 | 1.0 | 0.41 | 0.49 |
| Inter-functional transfers | 1.0 | 6.0 | 1.87 | 1.21 |
| Organization change dummy | 0.0 | 1.0 | 0.14 | 0.34 |
| Loan of personnel dummy | 0.0 | 1.0 | 0.50 | 0.50 |
| Scientific performance | -0.81 | 4.74 | 0.42 | 0.89 |
| Practical performance | -0.89 | 2.38 | -0.41 | 0.41 |
| *PLE* | | | | |
| Age | 26.0 | 57.0 | 38.79 | 6.12 |
| Doctorate dummy | 0.0 | 1.0 | 0.19 | 0.39 |
| Inter-functional transfers | 1.0 | 6.0 | 2.19 | 1.27 |
| Organization change dummy | 0.0 | 1.0 | 0.07 | 0.26 |
| Loan of personnel dummy | 0.0 | 1.0 | 0.30 | 0.46 |
| Scientific performance | -0.81 | 6.35 | -0.04 | 0.73 |
| Practical performance | -0.66 | 4.83 | 0.68 | 1.03 |
| *PLP* | | | | |
| Age | 27.0 | 55.0 | 37.30 | 5.71 |
| Doctorate dummy | 0.0 | 1.0 | 0.21 | 0.41 |
| Inter-functional transfers | 1.0 | 6.0 | 1.56 | 0.91 |
| Organization change dummy | 0.0 | 1.0 | 0.01 | 0.11 |
| Loan of personnel dummy | 0.0 | 1.0 | 0.46 | 0.50 |
| Scientific performance | -0.81 | 0.52 | -0.56 | 0.23 |
| Practical performance | -0.68 | 4.81 | -0.13 | 0.73 |

*Note*: Assignment to the first functional unit is counted as one transfer.

Table 4. Results of the Logit Analysis

| Variables | Organization | | | |
|---|---|---|---|---|
| | NLB | NLA | PLE | PLP |
| Constant | -1.983(2.517) | -0.973(1.288) | -8.519(1.976) ** | -16.555(3.254) ** |
| Age | 0.098(0.032) ** | 0.114(0.019) ** | 0.263(0.037) ** | 0.451(0.082) ** |
| Doctorate dummy | -0.814(0.456) | -0.730(0.307) * | 0.306(0.442) | 0.515(0.593) |
| Inter-functional transfers | 0.018(0.309) | 0.196(0.126) | 0.435(0.149) ** | 0.041(0.260) |
| Organization change dummy | -0.777(0.481) | -0.479(0.409) | -1.543(0.723) * | |
| Loan of personnel dummy | -0.901(0.460) | -0.368(0.282) | -1.086(0.388) ** | -0.676(0.523) |
| Scientific performance | 0.602(0.214) ** | 0.112(0.184) | -0.266(0.229) | -0.126(1.388) |
| Practical performance | -0.205(0.830) | 0.930(0.431) * | 1.274(0.252) ** | -0.031(0.404) |
| NLB1 | -1.833(0.788) * | | | |
| NLB2 | -0.711(0.793) | | | |
| NLB3 | -0.013(0.799) | | | |
| NLB4 | -0.264(0.782) | | | |
| NLA1 | | -0.804(0.553) | | |
| NLA2 | | -1.173(0.493) * | | |
| NLA3 | | -1.014(0.393) ** | | |
| NLA4 | | -0.816(0.410) * | | |
| PLE1 | | | -0.754(0.524) | |
| PLE2 | | | 0.368(0.538) | |
| PLE3 | | | -0.796(0.483) | |
| PLP1 | | | | -1.461(0.595) * |
| *N* | 133 | 311 | 308 | 166 |
| -2logL | 130.496 | 328.421 | 230.789 | 117.546 |
| $\chi^2$ | 47.506 ** | 97.813 ** | 188.037 ** | 109.655 ** |

*Notes*: 1. NLB: national laboratories focusing on basic research
NLA: national laboratories with an emphasis on applied research
PLE: laboratories of companies in the electric and electronics industry
PLP: laboratories of companies in the pharmaceutical industry
2. Values in parentheses show standard error.
3. **p<0.01, *p<0.05.
4. The number of organization changers is 43 in NLB, 42 in NLA, 22 in PLE and 2 in PLP. Because of the small number in PLP, the organization change dummy was not included in the model for PLP.

Looking at other independent variables, the loan of personnel dummy also has a significantly negative coefficient in the case of PLE. Loan of personnel does not end the relationships between R&D professionals and their employers. However, while these professionals work on other organizations' premises, they are not given chances for acquiring production knowledge. Therefore, loan of personnel has a similar effect on R&D professionals' promotion as an inter-organizational move.

For all of the models, the coefficients of the age variable are positive and significant at a 1% level. This reflects the seniority-based promotion system, which has been considered to be an outstanding feature of Japanese HRM practices. However, it is notable that performance also affects promotion. Scientific performance has a significantly positive coefficient for NLB, as does practical performance for NLA and PLE. Managers' roles are not only coordination among functional units, but also training, supervising and evaluating their subordinates. In NLB, where scientific performance is emphasized, R&D professionals showing high levels of scientific performance tend to be promoted to managerial positions. On the other hand, in NLA and PLE, where enhancing practical performance is important, R&D professionals whose practical performance is high are likely to be promoted.

## IV. Discussion and Conclusion

This paper analyzed the relationships between promotion and inter-functional transfers/inter-organizational moves. In organizations where highly integrated products are produced, coordination is an important responsibility for managers. Therefore, they need to acquire knowledge about the functional areas that must be coordinated. Learning by doing is the most efficient way of acquiring such knowledge, and inter-functional transfers provide good opportunities for doing so. Thus, I expected that R&D professionals with more frequent inter-functional transfers would be likely to be promoted. R&D professionals who were hired in mid-career have fewer chances for inter-functional transfers, assignment to project teams, and informal communication within an organization. Therefore, they seem to have difficulty being promoted. On the other hand, in organizations that produce outputs based on high levels of function knowledge, production knowledge and coordination among functional units are less significant. In such organizations, managers should have the high level of function knowledge that is necessary for training, supervising and evaluating their subordinates. Function knowledge can be acquired by dedicating oneself to a specific discipline and functional area. Additionally, it can be acquired outside the organization within which the individual is currently employed. Therefore, I expected that inter-functional transfers are not a prerequisite condition for promotion, and mid-career recruiting does not confer a disadvantage for promotion. I examined these hypotheses by comparing the relationships between promotion and inter-functional transfers/inter-organizational moves in four kinds of organizations. Only in private laboratories of the electric and electronics industry, in which production knowledge is highly respected, are R&D professionals with more frequent inter-functional transfers more likely to be promoted. It was also confirmed that in such organizations, mid-career recruiting reduces promotion probability.

Japanese firms, not only in the electric and electronics industry, but also the auto manufacturers and other mechanical assembled products industries, are known for their ability to create highly integrated products. Kusunoki (1998) found a source of this strength in the product development management style. He stressed that managers in functional units as well as product managers play key roles in product integration in Japanese firms. Japanese firms do not employ an integration process in which product managers bear all responsibilities for integrating independent functions and components. Before product managers do this, production knowledge has been used in each functional unit by functional managers, which enables integration to be done in an earlier stage. Hence, managers in functional units in Japanese companies need a wide range of knowledge and experience outside their area of expertise, which is different from Western companies, where functional managers are specialists. In that sense, Japanese managers in functional units are similar to production managers. Such features of R&D professionals and the Japanese method of training them could be one reason for the immobile labor market for R&D professionals in Japan.

In organizations producing highly integrated products, professional ladders do not seem to work well. A professional ladder provides several levels of non-managerial advancement. Employees climb the professional ladder depending on their level of expertise and can get pay raises just like employees climbing a managerial ladder. However, the professional ladder seems to be less attractive for R&D professionals in organizations emphasizing production knowledge rather than function knowledge. The *Nihon Seisansei Honbu* (Japan Productivity Center) (1991) found differences in the ideal patterns of engineers' career development between Japanese and U.S. private companies. The specialist orientation of American engineers was reflected in their wish to continuously work on front-line R&D, which became stronger with increasing age. On the other hand, Japanese engineers showed a stronger desire to become managers and a weaker specialist orientation as they got older. In Japanese firms with an emphasis on integrated products, managers have greater authority and higher status, which encourages Japanese engineers to prefer a managerial ladder to a professional ladder.

On the other hand, an inter-organizational move does not hinder promotion in national laboratories, where production knowledge is less important. Therefore, mid-career hiring is more often observed in national laboratories than private ones. In addition, more frequent inter-functional transfers do not assure promotion in national laboratories. There, promotions are determined by performance as well as age.

As discussed above, there are at least two types of career development of R&D professionals in Japan. The first type is advancing production knowledge through inter-functional transfers and promoting within an organization, which is typical for R&D professionals in the electric and electronics industry. The second type is developing function knowledge and professional abilities that are useful beyond the boundaries of organizations.

The latter type of career development includes inter-organizational moves, which are observed among R&D professionals in national laboratories. Prior studies of Japanese firms have focused mainly on the automobile industry and the electric and electronics industry, in which Japanese firms have strong international competitiveness.[6] As a result, the second type of career development for R&D professionals has been overlooked or has not been given much attention.

Although the second type of career development exists, it should be noted that it is in the minority. There were 820,000 researchers in Japan in 2006, and 58.7% worked for private companies, mainly in the industries of information and communication, transportation machinery, general-purpose machinery, electric machinery, and electronics parts and devices (Ministry of Education, Culture, Sports, Science and Technology 2007). The percentages for university and public laboratories were 36.0% and 4.2%, respectively. The dominance of the former type of employer in the Japanese economy, which relates to the present industry development, makes the Japanese labor market for R&D professionals immobile.[7] Future mobilization of the Japanese labor market will depend on what types of production strategies private companies choose and how they adjust their R&D organizations and employment practices to the strategies.

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[6] Aoki (1988) stylized Japanese firms and American firms based on prior research. In Japanese firms, job demarcation is fluid and ambiguous. Japanese workers perform a certain range of jobs as team members, rotate among the jobs, share information, and are trained as generalists. On the other hand, American firms emphasize sharp job demarcation and fine specialization. Individual workers are assigned to specific jobs and trained as specialists based on the principle of “the right person in the right place.”

[7] Murakami (2003) studied the labor market for R&D professionals in Japan.

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