Scientists and Engineers' Occupational Community and Organizations: Their Partial Inclusion and Role Conflict in Organization

Chae In-Seok
Senshu University

> Turning to Robert Lund, the supervising engineer, [Jerald] Mason [then senior vice president of Morton Thiokol, Inc.] directed him to "take off your engineering hat and put on your management hat." The earlier no-launch recommendation was reversed.
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> Roger Boisjoly was deeply upset by this reversal of the engineers' recommendation.......—*he was an engineer*. It was his *professional* engineering judgment that the O-rings were not trustworthy. He also had a *professional* obligation to protect the health and safety of the public, and he evidently believed that this obligation extended to the astronauts. Now his *professional* judgment was being overridden [emphasis in original]. (C. E. Harris, Jr., M. S. Pritchard and M. J. Rabins, *Engineering Ethics: Concepts and Cases*, 5)

> Group leader Yoshida then feared that this unfolding situation could lead to a crisis that would threaten the survival of the company [Mitsubishi Motors], and resolved that "in order to protect the company from the Ministry of Transport's audits, I would persist with the fabrication *in my position as a manager* in the Quality Assurance Department" [emphasis added]. (T. Okuyama, *The Power of Internal Whistle-blowing: What Does the Whistleblower Protection Act Protect?*, 24)

> The next day, just 73 seconds into the launch, the *Challenger* exploded, taking the lives of the six astronauts and schoolteacher Christa McAuliffe [emphasis in original]. (*Engineering Ethics: Concepts and Cases*, 6)

I. Introduction

Japanese society has witnessed many scandals in recent years, including the Tokaimura nuclear accident at a JCO plant, concealment of cracks at nuclear power plants operated by TEPCO, fabrication of earthquake resistance data by Aneha Architect Design Office and others in the construction industry, Misuzu Audit Corp.'s involvement in window-dressing of financial reports, faking of data by academics at Tokyo University, and concealment of product recalls at Mitsubishi Motors. Shocking though the frequency of these scandals and the involvement of workers on the spot rather than mainly top management as in the case of past scandals may have been (Tanaka 2002), even more shocking has been the involvement of members of the professions, such as university researchers and scientists, engineers, physicians, accountants, and architects, who with their recognized advanced skills and expertise had been regarded as setting an example for society. Ironically, one effect of this wave of scandals has thus been to stoke interest in the role and position of the professions.

The involvement of the professions in several scandals has prompted some reflection in organizational behavior studies, which seeks to explain the attitudes and behaviors of people who work in organizations: firstly, that the study of the professions, which completely disappeared from the field's research agenda at the beginning of the 1970s, should be resurrected as a serious subject of research;[1] and secondly, that such research must examine the professions through both the lens of the occupational community and the lens of the organization (Van Maanen and Barley 1984, 288), the latter being of particular importance.[2]

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[1] The professions were a subject of vigorous research in the field of organizational behavior from the later 1950s to the 1960s, when the primary focus was on scientists and engineers. From the beginning of the 1970s, however, interest almost entirely vanished. Interestingly, this largely coincided with when the U.S.'s superiority in its fierce rivalry with the U.S.S.R. surrounding science and technology became apparent with the Apollo 11 lunar landing. It is not hard to imagine that the end of the Cold War spurred this trend further. Since then, interest in organizational behavior has concentrated mainly on blue collar and white collar workers. Research on scientists and engineers, who as special groups do not even make 10% of an organization's members, may already have lost much of its appeal to researchers of organizational behavior.

[2] The term "occupational community" used in this paper signifies horizontal groups of people employed in the same work or occupation, such as the various groups of craftsmen frequently observed on construction sites (Van Maanen and Barley 1984). A profession, on the other hand, is an occupational community with a particular knowledge base, such as physicians and lawyers. Professionalization is defined as the process by which an occupational community becomes a profession (Wilensky 1964). Prominent examples of occupational groups that have professionalized are nurses and engineers.

Viewed through the lens of the organization, which emphasizes the superiority of the objectives and values of the organization over the individual, obedience to directions and orders based on the legitimate authority and power of management, coordination between departments, roles as employees, and loyalty to the organization, the behavior of Mitsubishi Motors group leader Yoshida is entirely understandable. Boisjoly's attitude and behavior, however, cannot be explained or predicted using any single organizational lens. This is because regardless of what judgment he may have come to as an engineer, as an employee he had to comply with the decision of management. Viewed through the lens of the organization, his attitude that his "hat as an engineer was a source of pride" even appears as a form of deviant behavior. Boisjoly's behavior cannot be explained or predicted without understanding the occupational community of engineers to which he belonged.

Interestingly, unlike researchers of organizational behavior, who have mainly used only the lens of the organization, the general public instead uses mainly the lens of the occupational community when judging the attitudes and behavior of professionals, as amply demonstrated by the public outrage that has greeted the involvement of professionals in the recent wave of scandals. The public interprets and judges their behavior according to the popular image and perception of the profession, rather than the organization to which the individual belongs. This is a clearly different attitude from that of seeing the structure of the organization to which the individual belongs as the problem, rather than blaming the individual, when people in management positions create scandals. And herein lies the reason why researchers of organizational behavior, who have hitherto employed mainly the lens of the organization, must reassess their approach to the professions.

Based on this reassessment, this paper considers the professions working within organizations, and in particular the attitudes and behavior within organizations of scientists and engineers. I argue that in order to understand and predict the attitudes and behavior within organizations of scientists and engineers, it is above all necessary to employ the lens of the occupational community. Focusing on two thorny problems associated with the management of scientists and engineers—i.e., their limited inclusion and role conflict in the organization—I explore how they should be managed in corporate organizations that are growing increasingly dependent on scientists and engineers, and what should be the relationship between them and the organization.

II. Organizations as Role Systems and the Inclusion of the Individual in the Organization

Among the diverse ways of looking at organizations (e.g., Morgan [1986]), one persuasive approach is to see them as role systems (Katz and Kahn 1966). Role, which from an early stage has drawn the attention of researchers as a bridge linking between the individual and the organization, is defined as the aggregate of expectations of a “focal person”—i.e., a person holding a specific position in a group, organization, and various social institutions—held by those around him/her (Jacobson, Charters and Liberman 1951; Kahn et al. 1964; Katz and Kahn 1966). An organization is thus seen as a single system in which the roles expected, formally and informally, of various positions essential to the attainment of organizational objectives are intricately linked, both vertically and horizontally.

If the organization is a single role system, then the individuals that work in it are actors who fulfill the roles expected of them by the organization. In practice, people are exceedingly sensitive to the roles demanded of them, and role is an extremely effective concept for explaining and predicting the attitudes and behavior of individuals in an organization. Just how sensitive people are to roles is clear from the significant changes that occur in the speech, attitudes, and behavior of focal persons in the event of changes in their positions as a result of vertical or horizontal movements. In addition, roles can in certain situations exert a major impact even on the values of the individual. In the case of the Challenger disaster, for example, it may be speculated that the reason why “things appeared extremely different when Lund was wearing his manager’s hat” (Fujimoto 2002, 5) was that he abandoned his role as an engineer and accepted his new role as a manager. Roles thus have the powerful potential to change even people’s outlooks and values.

If the organization is regarded as a single role system, then the relationship of the individual to the organization by which he or she is employed is necessarily limited. Katz and Kahn (1966) explain this using the concept of “partial inclusion.” Partial inclusion here refers not to a relationship of the individual to the organization that subsumes his/her entire character (personality, values, psychology, feelings, and mentality in their entirety), but simply a relationship limited to the work and roles demanded by the organization. In reality, an individual cannot bring his/her entire character into the organization no matter how great his/her loyalty to the organization is, for while he/she may be fulfilling the role expected of him/her by many others, he/she will at the same time be working while thinking of his/her family and private life.

While it is true that the individual is only partially included in the organization, the degree of inclusion will differ considerably according to the individual. When considering the extent of inclusion of the individual of the employing organization, the concept of role furnishes us with an important insight. This is because even outside the employing organization, the individual belongs to various organizations, communities, and social systems, and has a variety of roles. In reality, the individual performs a variety of roles, including not only his/her role as an employee, but also the roles of husband and parent, expert and teacher, and citizen and local community resident.

If the individual is thus regarded as being incorporated into various organizations, communities, and social systems, the extent of inclusion in the employing organization will differ substantially according to the following three factors. These are: the number of roles held by the individual, the level of priority of the role as employee in the employing organization among the various roles held, and the level of commitment to the role as employee (Katz and Kahn 1966). Other things being equal, the fewer the roles held by an individual, the greater the level of priority of the role as employee, and the greater the commitment to his/her role as employee, the greater may be expected to be the individual's inclusion in the organization.

Assuming this to be so, occupational communities—i.e., groups of people performing the same work—could be an additional important factor affecting the level of inclusion of the individual in the employing organization. Below, I examine in detail the characteristics of occupational communities and professions.

III. Occupational Communities and Professions

Occupational communities, which may substantially impact on the extent of the individual's inclusion in the organization, are typically defined as horizontal groups of people employed in the same work and occupation who have a powerful "consciousness of kind" (Van Maanen and Barley 1984).[3] For

[3] Van Maanen and Barley (1984) provide a detailed analysis of occupational communities,

those who belong to an occupational community, their work and occupations are not simply a means of earning a living or deriving satisfaction, but also a definitively important means of distinguishing the self from others. They consequently have a strong tendency to identify themselves with their work and occupations, and their occupational lives penetrate deeply into their private lives, human relations, and leisure pursuits. There is also known to be a strong tendency for such people to adopt their coworkers as a reference group vis-à-vis the self, as a consequence of which the occupational community develops norms and assessment criteria regarding work, occupational ethics, and occupationally specific clothing, terminology, and culture (Van Maanen and Barley 1984).

This does not, of course, mean that all occupations and types of work form occupational communities. There are some, however, that form occupational communities in a relatively visible and identifiable form, good examples of which are the various groups of craftsmen observable on construction sites, firefighters, police officers, train drivers, pilots, physicians, dentists, nurses, scientists, and engineers. Of these various occupational communities, it is the professions, such as physicians, lawyers, and scientists, that most clearly bear the hallmarks of a community and also exercise considerable influence in society. While the precise definition and characteristics of a profession may be open to some debate, it is still possible to identify the following features as characterizing the "ideal-type profession" (Greenwood 1966; Hall 1968; Hodson and Sullivan 2002; Kerr, Von Glinow, and Schriesheim 1977; Nagao 1995).[4]

Firstly, a profession, more than various other occupational communities, is

observing that it is extremely important to adopt a participant rather than an observer perspective when identifying occupational communities. For example, members of an economics faculty may appear to be observed to form a single occupational community, but for the participants, "modern economics" and "Marxist economics" are completely separate occupational communities. Far from sharing a feeling of solidarity, the two are more often at loggerheads.

4 For a definition and description of the characteristics of professions, see Windt (1989). It should be noted, however, that these characteristics are derived from the characteristics of physicians, lawyers, and holy orders, which have traditionally been treated as serving as the ideal type for professions in Western societies. Accordingly, the various professions presently in existence do not necessarily have all of these characteristics, and may also differ in the extent to which they exhibit them (Greenwood 1966; Vollmer and Mills 1966).

possessed of a knowledge base that provides a monopoly of certain knowledge and skills of definitive importance to people's life or death and happiness, or organizations' competitive advantage. The knowledge acquired by professions is of three kinds: theoretical knowledge (such as knowledge of anatomy and the theory of physiology) acquired through intensive education at specialist institutes of learning such as universities; applied knowledge required in order to provide services to actual clients (such as various knowledge concerning the symptoms and diagnosis of cancers); and technical knowledge (such as the various medical skills necessary to actually treat cancer patients) (Hodson and Sullivan 2002).

Secondly, a profession demands autonomy and self-control as a group. By autonomy is meant the selection of themes and goals to pursue, the methods of their performance, work priorities, methods of problem resolution, and so on based on its members' independent judgment free from external pressure, such as pressure from clients or employing organizations (Hall 1968; Nagao 1995). Because professions have a strong belief that appropriate checks and assessments of their work and performance are performed only by associates involved in the same specialist field, they additionally exhibit a strong tendency for the community itself to exert self-control without outside intervention in the various issues that arise within the profession. The trend toward the regulation of bioethics through the creation of standards and guidelines by the medical community itself, which has recently become a hot issue in medical circles in Japan, provides an excellent example of self-control by a profession.

Thirdly, a profession is a group that has powerful authority over the client and demands the client's strong compliance with its members' judgment. Greenwood (1966, 12) observes that one striking characteristic that distinguishes professions from other occupational communities is that whereas non-professions have customers, the professions have clients. Generally speaking, whereas the customer can personally choose the goods and services that he/she requires, the client cannot, the reason for this being that, as is apparent from the relationship between physician and patient, lawyer and client, and scientist and organization, the client lacks the skills and expertise to resolve his/her problems. This is at the root of the profession's strong authority over the client.

Fourthly, professions espouse stronger occupational ethics, especially altruism, than other occupational communities. Altruism here consists of two aspects: the moral rule that one must sacrifice one's own interests if necessary to serve the interests and happiness of the client, and the obligation to use one's skills and expertise for the general public (Hodson and Sullivan 2002). Specific examples of altruism are the Hippocratic Oath and the ethical charters often observed in the rules and regulations of academic associations of scientists and engineers. While it may certainly be negatively argued that such altruism is only advocated to preserve a profession's power, authority, and interests, it does go beyond simple lip service in one respect. This is that because professions monopolize knowledge and skills of definitive importance to people's life or death and happiness, the misapplication of this knowledge and skills can potentially have a serious impact on not only the client, but also the public, as is evident from the diversion of expertise into the development of nuclear weapons. If specialist skills and expertise become frequently abused, the high status, prestige, and power built up hitherto by a profession can be undermined. In order for a profession to maintain its own social position, therefore, its members must inevitably be strongly committed to occupational ethics. That is why commitment to altruism is not simply a matter of lip service.

These characteristics of a profession raise tricky questions when its members are employed by an organization. Before proceeding to the issues arising in the case of employment by an organization of scientists and engineers, which are the main subject of analysis of this paper, I consider firstly the dependence of the organization on scientists and engineers, and their contribution to the organization.

IV. Dependence of the Organization on Scientists and Engineers

The processes by which scientists and engineers form professional communities differ considerably.[5] It was not until early in the 19th century

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[5] Regarding the process of formation of occupational communities of scientists and engineers, numerous insights are provided by Murakami (2000, chap. 1) and Kornhouser (1962, chap. 4). Particular attention should be drawn here to the professionalization of engineers. While engineers certainly embarked on the road to professionalization early in the 19th century, the prevailing view is that they are still in the process of achieving full professionalization (Kerr, Von Glinow, and Schriesheim 1977; Raelin 1991). Regarding the differences between science and technology, see Allen (1997), and regarding the differences between scientist and engineer groups,

that science, originally the pursuit of groups of amateurs with a shared intellectual curiosity, formed a professional community (Kornhauser 1962; Murakami 2000). In contrast, engineers, who were already forming an occupational community with clients, commenced on the path to professionalization when the technical potential of science came to be recognized and technology was linked to science as systematic knowledge. In short, the two followed completely opposite trajectories, with scientists professionalizing from the top (knowledge) to the bottom (occupation), and engineers professionalized from the bottom to the top (Kornhauser 1962, 86-87).

Though the processes differed, professionalization was in both cases spurred by strong demand for scientists and engineers in industry. Following the end of World War II in particular, industry emerged fully as a client of scientists and engineers, and industry's demand for their services has surged further since the end of the Cold War under the mantra of transferring military technologies to the private sector and collaboration between industry and academia. As a result, the communities of scientists and engineers exemplified by specialist academic societies now have many members working in industry, as well as at universities and government research institutes.

It goes without saying that behind the strong demand for scientists and engineers in industry lurks science and technology's increased importance to companies as a source of competitive advantage. As information technology, genetics, nanotechnology, medical drugs, environmental technologies, and so on all show, the knowledge and skills acquired by scientists and engineers are directly linked to a company's competitive advantage. The importance of science and technology as a source of competitive advantage is also evident from the superior financial performance of companies that pursue a more research and development (R&D) oriented business strategy (Capon, Farley, and Hoenig 1990). Industry's dependence on scientists and engineers has heightened further in recent years due to the addition of speed as another source of competitive advantage (Chae 1999; Pfeffer 1994; Stalk and Hout 1990).

Being constantly exposed to fierce competitive pressures, corporate

see Goldner and Ritti (1967). The reader should note that this paper has in mind scientists, who are nearer to the ideal type.

organizations' primary interest is naturally in whether R&D performance is higher if scientists and engineers are more committed to the professional community. Though scientists and engineers may appear to form a single monolith group when viewed in terms of the ideal type, there can exist considerable variation in their degree of commitment to the professions at the individual level. Gouldner (1958) already found the existence of six groups among university academics that differed according to their orientations in the late 1950's. Such differences between individuals observable in professions have been researched to date employing mainly the concept of professional commitment. Professional commitment is defined as the extent of psychological attachment to a specialist field, such as the extent of identification of the self with the occupation and specialist field to which one belongs, and the extent of the desire to strive for the development of the specialist field (Aranya and Ferris 1984; Chae 1999; Hall 1968; Morrow and Wirth 1989). The stronger the attachment to the specialist field and the desire to strive for its development, the greater the professional commitment is considered to be.

The problem is the relationship between professional commitment and R&D performance. Most empirical research into the relationship of the two in the case of scientists and engineers has reported a significant positive statistical correlation between the two. Gouldner (1958) and Tuma and Grimes (1981), for example, both investigated the relationship between the two focusing on scientists working at universities, and found that researchers with greater professional commitment produced higher research performance. This finding was confirmed in a study by Chae (1999) of the relationship between the two focusing on scientists working at science and technology faculties at universities in Japan and South Korea, and scientists and engineers working at leading enterprises' institutes of pure research in South Korea. Chae reports that when several attribute variables that could affect the research performance of scientists and engineers, such as acquisition of doctorate qualifications, are controlled for, the number of presentations at academic conferences, number of papers published in journals, and number of patents applied for increase with researchers' professional commitment.

Considering that scientists and engineers are motivated above all by intrinsic factors such as commitment to their specialist fields and knowledge internalized through long specialist education and training, the approval of their peers, and interest in their work (Badawy 1970; Kerr, Von Glinow, and Schriesheim 1977), these findings are perhaps unsurprising. At any rate, they illustrate corporate organizations' growing dependence on scientists and engineers, especially those with a strong professional commitment in sustaining or improving competitive advantage of organization.[6]

V. Communities of Scientists and Engineers and Organizations

While corporate organizations grow increasingly dependent on scientists and engineers as competition surrounding science and technology grows fiercer, their belonging simultaneously to a corporate organization and a professional community brings with it two tricky problems for their management. One is the professional community's functioning in a manner that hinders scientists and engineers' inclusion in the corporate organization, and the other arises from the collision of scientists and engineers' roles as professionals and as employees (Scott 1966; Kornhauser 1962).

As already observed, the inclusion of the individual in the employing organization is influenced by the number of roles held by the individual, their order of priority, and the individual's level of commitment to his/her role as an employee. This being so, scientists and engineers' inclusion in an organization is inevitably lower than that of managers and regular employees. This is because scientists and engineers, as members of professional communities, have more roles, and, moreover, their roles as professionals are likely to take top priority due to the particular social prestige and strong influence wielded by their professions in comparison with other occupational communities. The low level of inclusion of scientists and engineers in organizations is clear if one compares the careers and nature of the commitment of scientists and engineers with those of managers, whose inclusion in the organization is considered to be relatively high.

For managers and regular employees that have not formed occupational communities, a career means a career of advancement in accordance primarily

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6 It goes without saying that due to the huge facilities and research expenditures on R&D necessitated by the drastic increase in scale of science and technology projects, scientists and engineers, too, have grown increasingly dependent on corporate organizations. In other words, corporate organizations and scientists and engineers are growing increasingly interdependent.

with the hierarchy inside the organization. In contrast, the career of a profession, such as a scientist or engineer, is a career of "centrality" (Van Mannen and Barley 1984). Centrality here means not that the individual is no more than a single member of a profession, but rather that as a result of successively achieving skills and expertise held in high regard by the profession, a central position in the network of the community is attained and the individual's prestige and respect in the community steadily increases accordingly. In reality, scientists write papers frequently cited in the community and make discoveries, as a result of which they move from the margins to the center in scientist community they belong to. Interestingly, the career of centrality can potentially impact on the career of advancement in the organization, as not promoting a person who occupies a central position in a professional community is by no means a sensible choice for a corporate organization. The practice often observed in R&D organizations of making a person who has produced scientifically outstanding research performance the head of an organization (Kornhauser 1962; Marcson 1960), illustrates how the external power of an occupational community also affects careers within an organization.

The low level of inclusion of scientists and engineers is apparent also in their commitment to the organization. Managers and regular employees, who are insulated from the outside and lack anything with which to identify themselves apart from the organization, acquire company-specific knowledge and skills through, for example, on-the-job training, internal training programs, and internal transfers, resulting in a steadily increasing "continuance" commitment. Thus, they are likely to develop continuance commitment, which is a type of commitment that arises from individual perception of the cost associated with separation from the organization, such as the economic loss that one would suffer if one were to quit the company (Allen and Meyer 1990; Suzuki 2002). In contrast, scientists and engineers acquire specialist knowledge and skills of value on the external labor market, and so are not committed to the organization for reasons of continuance. They are committed to the organization due to factors such as a perception of its suitability as a place for developing a career as a professional, the presence of role models for specialists, and access to experimental facilities and research funds. Scientists and engineers thus develop quite equal relations with the organization compared with regular employees and managers, and their commitment to the organization is also quite instrumental and conditional in nature (Scott 1966).

The extent of inclusion has a substantial impact on the extent of influence and control of the organization over the individual. Typically, the influence of the organization is proportional to the extent of the individual's inclusion in the organization (House, Rousseau, and Thomas-Hunt 1995). The flip side of this is that the influence of the organization on scientists and engineers is quite low. In practice, the organization's influence on what most concerns corporate organizations, such as scientists and engineers' motivation, level of effort, research performance, and so on, is quite limited. This is because factors such as the strength of scientists and engineers' commitment to the professional community and the extent of internalization of the occupational ethics embraced by the professional community have a stronger influence than the organization's methods of control and human resource management. This means that human resource management that functions well in the case of managers and regular employees, whose level of inclusion in the organization is high, may not necessarily function well when applied to scientists and engineers. In practice, there exists in Japan, too, a deep-rooted doubt that the human resource management strategies traditionally pursued by Japanese companies have not always been entirely effective in R&D departments where many scientists and engineers work (Fukui 1989; Ota 1994; Sakakibara 1995).

As scientists and engineers belong to professional communities, there arises another thorny problem. This is that scientists and engineers acquire a role as a professional through long formal and informal education and socialization before entering an organization, and this increases the likelihood of a collision with the newly required role of employee after joining an organization. The role conflict experienced by scientists and engineers was recognized some while ago by Gouldner (1957, 1958), who classified people who work at organizations into two types: cosmopolitans and locals. Cosmopolitans are those who have low commitment to the organization but high commitment to their own specialist knowledge and skills, and have their reference group outside the organization. Locals, on the other hand, are completely the opposite. Gouldner (1958) observes that scientists and engineers employed by an organization are placed in a position in which, due to their strong cosmopolitan orientation, they are susceptible to experiencing conflict in the organization. The following four types of role conflict that can tend to be experienced by scientists and engineers as a result of having cosmopolitan values and norms have been identified (Chae 1999; Hall 1968; Kerr, Von Glinow, and Schriesheim 1977; Kornhauser 1962; Marcson 1960; Raelin 1986, 1991, 1994; Scott 1966).

Firstly, there can arise conflict concerning the goals pursued by each party. Scientists and engineers are socialized to adopt contributing to progress in science and their own specialist fields as personal goals, and emphasize above all else creativity and new ideas in research. The goal of a corporate organization, on the other hand, is to raise corporate performance through the development of new products and exploitation of new markets. The differences between the goals pursued by the two might be an important cause of the role conflict experienced by scientists and engineers. Secondly, there can occur conflict between autonomy and coordination. It has already been observed that scientists and engineers set exceedingly great value on autonomy. Insofar as the organization is a role system consisting of a complex horizontal and vertical intertwining of roles and expectations, management in order to coordinate roles is essential. The control necessary for coordination may well as a result constrain the autonomy valued by scientists and engineers. Thirdly, there is conflict concerning the source of authority respected by each party. The authority respected by the organization is ultimately associated only with the position held, and in most instances is the authority of management. Scientists and engineers, on the other hand, who set an exceedingly high value on the authority of the professional community, are reluctant to recognize the authority of management. The differences in the sources of authority respected can thus be an important cause of conflict between the two parties. Fourthly, there is the conflict surrounding evaluation criteria. Scientists and engineers have a strong tendency to believe that evaluation of the individual, too, should be based on his/her scientific achievements. On the other hand, the evaluation criteria valued by the organization include the individual’s contribution to the commercialization and development of new products, and his/her loyalty to the organization. Such differences in evaluation criteria could be another important cause of the role conflict experienced by scientists and engineers.

Naturally, not all scientists and engineers experience role conflict in an organization, and the role conflict experienced will vary according to a number of factors. Researchers have noted that role conflict is more likely to be experienced by scientists, who more closely resemble the ideal type of professionals than engineers, by scientists and engineers who work in corporate organizations rather than professional organizations such as universities, hospitals, and government research institutes, by scientists and engineers involved in applied and development research rather than pure research, by scientists and engineers who come into contact with management, such as team leaders and institute directors rather than people in low positions, by scientists and engineers who work at research institutes other than those that are among the top in their industry, and by scientists and engineers who have a strong professional commitment (Chae 1999; Goldner and Ritti 1967; Fujimoto 2005; Kerr, Von Glinow, and Schriesheim 1977; Kornhauser 1962; Marscon 1960; Raelin 1991).

The results of role conflict are never desirable. According to the literature (Kahn et al. 1964; Kahn and Byosiere 1992; Rizzo, House, and Lirtzman 1970), role conflict not only lowers the job satisfaction and commitment to the organization of role performers, but can also lead to more frequent work absences and employee turnover, and lower productivity. Overpowering role conflict can also lead to deviant behavior among scientists and researchers, dealing a fatal blow to the research performance of the individual and the ability of the organization to innovate (Raelin 1986, 1994). Specific examples include loss of interest in the organization's affairs, ceasing to be absorbed in research or work, a weakening of sense of responsibility, disregard for the organization when tackling something that contributes to one's career, performing only pre-assigned work, and constantly looking for new places of employment. In short, role conflict can in some cases even cause deviant behavior that is fatal to scientists and researchers' research performance.

VI. Conclusion: Adaptation of the Organization to Scientists and Engineers

Assuming that companies' competitive advantage will in the future depend heavily on scientists and engineers' motivation and research performance, the objective of corporate organizations should clearly be placed on how to improve their creativity to the utmost. This is by no means an easy problem to resolve, however, as scientists and engineers are embedded in professional communities, and not just organizations. The core argument of this paper is that in order to resolve the problems involved in managing scientists and engineers, it is necessary to employ the lens of the professional community as well as the lens of the organization. Thus, without intensive researches on how professional communities form in Japan, to what extent the values and occupational ethics of professional communities are internalized by scientists and engineers, and how the values and occupational ethics internalized by scientists and engineers are changed by corporate organizations in Japan, there can be no real solution of the problems associated with the management of scientists and engineers.

It is well known that Japanese companies have traditionally sought to maximize employees' sense of belonging and loyalty to the organization, and scientists and engineers have been no exception. Japanese companies have applied the same strategy to scientists and engineers as well, such as through intensive education and training on the factory floor when they are hired, frequent re-allocation to other departments outside R&D, and fostering of a strong commitment to manufacturing in accordance with inclusive uniform management. Combined with long-term employment, age-based pay and promotion, retirement payment systems, corporate pension plans, and other elements of Japanese employment practice that hindered the interorganizational movement of scientists and engineers, such a strategy resulted in the mass production of scientists and engineers who were as a result confined to the organization. As a matter of fact, the interorganizational movement of scientists and engineers is known to be extremely low in Japan (Fujimoto 2005).

This strongly suggests that scientists and engineers in Japan face greater pressure to be included in corporate organizations than their counterparts in the West, and also that the logic of the organization is more prevalent among scientists and engineers in Japan. Far from leading to role conflict in organizations, the strong inclusive pressure is thought to produce large numbers of "professionals who have dreams of the organization" (Fujimoto 2005) among scientists and engineers at top-level R&D organizations in industry, making a major contribution to the high R&D productivity of Japanese companies to date. In practice, the human resource management strategies of Japanese companies, which have required homogeneous scientists and engineers, have been observed to create extremely efficient R&D organizations and to have contributed to the high international competitiveness of Japanese manufacturing (Clark and Fujimoto 1991; Sakakibara 1995).

If inclusive pressure on scientists and engineers is strong and the logic of the organization is pervasive, however, the effects can also be harmful. A particular risk is that the human resource management strategies that seek homogeneity may reduce the diversity and heterogeneity of researchers essential for the breakthrough product innovations sought by Japanese companies in the future (Sakakibara 1995). In some cases, a too pervasive logic of the organization may even have tragic consequences, as highlighted by Murakami's (2000) insightful interpretation of the causes of the Tokaimura nuclear accident at a JCO plant.

Murakami (2000) traces this incident above all to the quality control (QC) circle activities that have traditionally been admired in Japan and abroad, and his argument is as follows. Despite being an incident that should essentially have been avoidable had workers had a basic knowledge of nuclear power, the company left many decisions to regular employees on the spot who lacked this knowledge, and QC activities that should have been undertaken to enable the people on the spot to further raise efficiency for the company resulted in the incident. The problem here was that improvements to systems that had been computed and designed in minute detail to prevent a criticality incident were left to a QC circle that gave priority to efficiency without having the requisite knowledge of nuclear power. Underlying this may be glimpsed the logic of the organization of Japanese companies of leaving to these domestically and internationally admired QC circles even work that by its nature should be performed under the guidance and judgment of scientists and engineers.

At the same time, there is an undeniable possibility that Japanese companies' excessive emphasis on the inclusion in the organization of scientists and engineers may also have acted to heighten their role conflict. This is because, notwithstanding the effect of the powerful logic of the organization, scientists and engineers in Japan have not abandoned their cosmopolitan orientation (Chae 1999; Fujimoto 2005) and have retained considerable latent potential for movement to other organizations (Fujimoto 2005; Ota 1993). In view of these two facts, it may well be that scientists and engineers in Japan who either have a particularly high professional commitment or work in R&D organizations located lower in the industrial hierarchy experience even greater conflict due to the powerful logic of the organization.

What is required above all else in order to reduce the role conflict experienced by scientists and engineers in organizations is their accommodation by corporate organizations (Kornhauser 1962; Marcson 1960; Raelin 1986, 1994). What this means in concrete terms is granting significant recognition to the values and needs of scientists and engineers by, for example, respecting and at times positively encouraging contributions to the development of science and specialist fields, autonomy in research and development, the authority as professionals, and their outside activities as experts. Even regarding research performance, which are corporate organizations' principal concern, the adaptation of the organization to scientists and engineers is of extreme importance given that research shows that their performance increases as the organization takes measures to accommodate the values and needs of scientists and engineers (Chae 1999, 2002).

Furthermore, the present trend in business ethics is toward encouraging greater adaptation of the organization to scientists and engineers. This is because the world described by Friedman (1962), in which the values and ethics pursued by professional communities and corporate organizations are fundamentally different, and corporate organizations are not under any special moral obligations *qua* economic entities, is steadily drawing to a close, to be replaced by a growing emphasis on companies' social responsibility, business ethics, and compliance. This trend means nothing more or less than that corporate organizations must actively accept the values and occupational ethics of scientists and engineers. As long as communities of scientists and engineers and corporate organizations are growing increasingly interdependent as important social players, each must adapt to the other. Needless to say, it is very likely that better relations between the two will emerge if, in the process, simultaneous use is of the occupational community lens as well as the lens of the organizations.

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