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A Transaction Costs Analysis of

Japanese Employment Relationships

by

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Abstract

A TRANSACTION COSTS ANALYSIS OF JAPANESE EMPLOYMENT RELATIONSHIPS

by Mary Sullivan Taylor

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The literature concerning the reasons for the establishment of an internal labor market in a firm suggest both economic and non-economic motivations. An important economic rationale for internalizing the employment relationship is provided by transaction costs theory. This research is designed to test the applicability of this approach to studying when employment relationships are internalized and the circumstances which lead them to be externalized.

A survey of 550 R&D engineers and scientists and R&D managers working in 17 major Japanese firms in a variety of industries was conducted to gather information on environmental uncertainty, core R&D job, the transaction costs of the employment relationship, and human resource management practices used to govern the R&D engineers and scientists. In addition, 89 interviews were conducted with a subset of the respondents and R&D managers. The technological environment was found to affect the core R&D job of the R&D engineers and scientists, and the core R&D job was found to affect the transaction costs of the employment relationship. Few effects of the transaction costs on human resource management practices were found.

The implications of these findings are discussed and future research directions are recommended.

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CHAPTER ONE

INTRODUCTION

1.1 Introduction

The core task of the discipline of Human Resource Management (HRM) is the creation of effective systems of personnel policies and practices to govern a firm's employees. Until recently HRM researchers have focused most empirical work on the relative merits of specific personnel practices (e.g. individual versus group compensation plans) rather than on investigation of effective sets of HRM practices that are integrated with a firm's overall corporate strategy. Recent research trends in HRM point to increasing awareness of the strategic importance of HRM systems (e.g. Fombrun, Tichy and Devanna, 1984; Lawler, III, 1984: Schuler and Jackson, 1987).

The awareness of the importance of HRM systems points to the necessity of understanding the forces that affect the design of these systems. A number of factors in the external environment can have an effect, from government regulations to labor market conditions to technological change. Any one or combination of these factors can lead to the necessity of changing the HRM system used by a firm.

There is evidence that firms both large and small do change their sets of HRM practices or important components of them. In setting up the new Saturn plant, for example, GM created a HRM system from the ground up that differs significantly from that used in the rest of the firm (Oddo, 1987). In recent years IBM and Hewlett Packard have modified their personnel practices in ways that break with the past. The large number of mergers that has occurred over the past few years have often entailed restructuring of the HRM system. These and other examples point to the increasing mutability of HRM systems. For the scholar as well as the practitioner it has become critical to understand what leads to changes in HRM systems and what are the most efficient sets of practices for any particular firm.

The present study examines the appropriateness of different HRM systems. The approach used adopts the framework that there are two basic ways in which an HRM system can be structured. The first is as an internal labor market (ILM), and the other is as an external labor market (ELM) (Mahoney, 1982).

An ILM requires a personnel system that relies on promoting those already in the organization to vacancies rather than seeking someone from outside the firm (Osterman 1984a: Doeringer and Piore, 1971; Mahoney, 1982). In such a system, hiring of employees occurs at a low and narrow range of jobs; extensive training is provided by the firm, and compensation is determined administratively rather than by external market forces. At the other end of the spectrum is an ELM in which the firm fills vacancies from the pool of candidates outside the firm, provides little training, and pays according to present abilities and performance.

To say that a firm adopts either an ILM or ELM would of course be an oversimplication. Yet the general approach adopted by a firm towards the management of its employees will be infused by one or the other of these philosophies. In changing its HRM system a firm must examine whether a change in basic philosophy will be necessary as a first step. Obviously change from one end of the spectrum to the other would entail reorganization and probably lead to a great deal of stress among employees.

Considerable attention has been given to ILMs versus ELMs in the last forty years, particularly by labor economists and sociologists (e.g. Doeringer, 1967; Kerr, 1954; Osterman, 1984a). A relatively recent addition to the list of those concerned with the choice of labor market orientation is Oliver Williamson (1975). His analytic framework, called transaction costs theory, has been applied to a number of fields in which contracting forms the basis of the relationship. Transaction costs include uncertainty, that is the difficulty of determining if a party to the contract is truly fulfilling his part of the bargain

and the inability to determine all necessary behaviors a priori, and asset specificity, that is the degree to which the assets necessary to carrying out the contract are specific to this contract, which can lead one party to behave opportunistically. In general, the greater the uncertainty and asset specificity, the more pressure is felt to internalize the relationship within the firm.

This research adopts a transaction costs approach to the study of what makes a particular labor market orientation attractive to a firm and its employees. There are at least three reasons why a transaction costs framework can be usefully applied. First, the transaction costs theory points to a clear linkage between environmental factors and choice of labor market orientation. Second, transaction costs theory is specifically concerned with the factors that affect whether to conduct an exchange relationship in the market or within the firm. Finally, this theory has received a considerable amount of attention but has yet to be fully tested in empirical settings in relationship to employment contracts. It thus provides a potentially fruitful avenue for understanding which has not yet been fully explored.

The central concept in this research is that changes in the environment surrounding the firm can lead to significant changes in the core job tasks of certain employees. These changes in core job task in turn lead to changes in the costs of conducting the employment exchange. Different levels of costs are posited to induce the parties to chose one labor market orientation over another (ILM versus ELM) and this choice leads to the design of the HRM system. A schematic representation is given below.

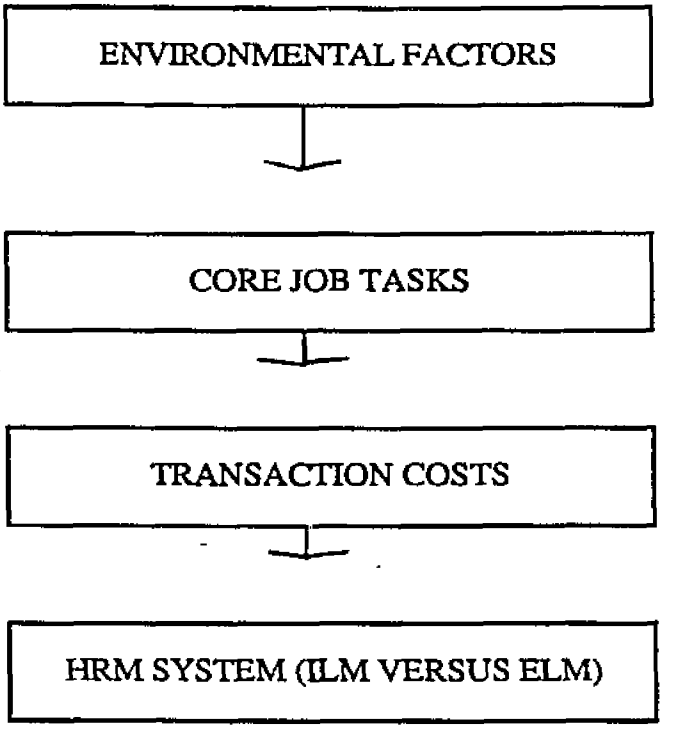

FIGURE 1.1
THE INFLUENCE OF ENVIRONMENTAL FACTORS ON HRM SYSTEM DESIGN

The particular environmental factor affecting job design chosen to be studied in this research is the technological environment. This factor was chosen because the writings of such scholars as Doeringer and Piore (1971) and Osterman (1984) suggest that this can be a major factor affecting the job tasks of employees and hence the choice of labor market orientation.

Japan was felt to be an appropriate setting for this study because of the predominance of the ILM HRM systems in large Japanese firms since World War II (Taira, 1971; Abegglen, 1958; Levine, 1958; Aoki, 1988; Koike, 1988; Mosk, 1989). The presence of these ILMs is well-documented, and hence any movement toward an ELM should be clear. Recently the environment in which Japanese firms do business has been changing a great deal, particularly technologically. As Japan has reached the limits of followership it has been forced to take on the task of doing more basic research to create the radical technological innovations which propel growth in many of the emerging industries. This emphasis on radical innovation should lead to predicable changes in the jobs of corporate researchers, which in turn influence the transaction costs of the employment relationship and the HRM system.

1.2 Plan of the Dissertation

Chapter Two examines the major ideas concerning labor market orientation, develops the reasoning for choosing an economic perspective, and outlines the transaction costs theory and its application to the employment relationship. Chapter Three develops the rationale for choosing the particular research setting of Japan and describes features of the environment crucial to an understanding of this study. The hypotheses of the research are presented in Chapter Four, while Chapter 5 describes the research approach used to test the hypotheses. Chapter 6 presents the results of the research. Chapter Seven discusses the research results, while the final chapter, Chapter 8, draws implications of the research and outlines its limitations, and suggests fruitful research directions.

CHAPTER TWO

THEORIES OF INTERNAL LABOR MARKETS AND THE APPLICATION OF TRANSACTION COSTS THEORY

2.1 Introduction

The purpose of this chapter is to establish the theoretical basis for the study. Explanations for the phenomenon of internal labor markets (ILMs) are examined, including explanations based on transaction costs theory. A model based on the transaction costs approach is developed.

2.2 The Challenge of ILMs to Classic Theory of Labor Markets

Recognition of the existence of ILMs became prevalent in the 1950's, and since then there has been debate concerning what constitutes an ILM, how it is generated, the factors that influence the form it will take, and how and why it evolves. Research, both theoretical and empirical, has provided considerable material upon which to draw in formulating a model of ILMs.

The existence of ILMs challenges the picture of the allocation of labor provided by traditional economic theory in much the same way that the New Trade Theory challenges many of the assumptions of the traditional trade theory based on comparative advantage (Krugman, 1987). In the traditional view of labor markets, wages and employment are determined by just two forces: supply and demand. That is, wages rise with a decreasing supply of candidates for a job, and the number of candidates is equal to those available in the external labor market. Rising wages attract candidates from other parts of the market, a process that continues until equilibrium is restored. In its purest form, this view sees labor turnover as costless to both workers and employers, ignoring the 'stickiness' of labor markets as well as the question of job search information. Even the neo-classical conceptualization of labor markets of Alfred Marshall (1938), which acknowledges that the supply of skilled labor can be inelastic because of the time needed to acquire skills, still

maintains that the market is the main determinant of wages. Labor supplies may not flow as easily, but they do flow.

The neo-classical view of labor markets began to come under serious attack in the early 1950's (e.g. Kerr, 1950; Reynolds, 1951; Kerr and VonGlino, 1954; Livernash, 1957). With the publication of his article "The Balkanization of Labor Markets" by Clark Kerr in 1954, the existence of labor markets that do not respond to supply and demand forces as predicted by traditional theory became widely recognized. While it is possible to think of 'the' labor market over several generations, in the short term workers cannot freely move toward the jobs paying higher wages due to a lack of preparation. Consequently, in the short run "...most individuals are not in competition with each other" (Kerr, 1954; 94) . Drawn heavily from Cairnes' (1874) arguments, Kerr's first salvo undercut the foundations of the assumption of one labor market, underscoring the difficulties associated with the problem of inelasticity of supply that Marshall (1938) had theorized. The second salvo was even more damaging, however. Kerr pointed out the existence of what he termed 'institutional (labor) markets' (1954: 93). These markets do not change constantly over time, and their "...dimensions are set not by the whims of workers and employers but by rules, both formal and informal" (Kerr, 1954: 93). The crucial challenge to traditional economic explanations of labor markets is the addition of this third variable, rules, to explain the determination of wages and allocation of labor. Moreover, the rules are not necessarily engendered by efficiency or economic motivations, and often seem to carry more weight than either supply or demand.

These rules ultimately segment the labor market into distinct and less interrelated compartments (Kerr, 1954). Moreover, they can have an effect on economic performance, rather than being necessarily a result of conventionally conceived economic forces (Kerr, 1954). That is, an economic institution such as an ILM exists which does not appear to be

the outgrowth of the economic forces of supply and demand, yet which affects economic efficiency. Doeringer and Piore (1971) also view ILMs as a factor that must be considered in addition to supply and demand when analyzing labor markets. They state that the rules, "(i)f rigid...will interrupt or transform economic influences, causing the ILM to respond to dynamic economic events in a manner not readily predicted from conventional economic theory "(1971; 5). This is a position at odds with the traditional economic view of institutions as "...simply mechanisms for registering and acting upon market forces" (Osterman, 1984a: 5).

Osterman (1984a) takes issue with the idea that the existence of ILMs completely negates the usefulness of traditional views of labor markets. He argues that the work rules of an ILM can be seen as similar to the technology factor in the production function. Both work rules and technology simply affect the relationship between inputs and outputs, and hence need to be taken into account by analysts. Yet while the production function can encompass the work rules, Osterman admits that the apparently non-economic forces which generate ILMs pose a challenge to conventional analysis.

What exactly are these institutional labor markets to which Kerr and others refer? A fairly safe, if broad, working definition has been provided by Osterman (1984a), which echoes in large part that provided by Doeringer and Piore (1971). Osterman's lengthy definition is valuable as a guide:

> ...the pricing and allocational functions of the market take place within rather than outside of the establishment. The ideal type of such a market consists of a set of rules that limits hiring to certain occupations, or ports of entry, and reserves the remainder of the firm's jobs to those already employed. Rules and procedures govern who is eligible to move into given jobs and how the decision is made. Wage determination is similarly subject to formalized rules which often carefully spell out a set of relationships among all the jobs within a given family. (Osterman, 1984a: 2).

There are several crucial aspects of ILMs that should be highlighted here. First, ILMs largely divorce the allocation and compensation of employees within a firm from the larger, external labor market. Rules and regulations substitute for direct market forces. Second, the supply of candidates for many of the jobs in the firm is not the large pool available in the external market, but rather a reduced pool of workers within the firm who are eligible by virtue of already being employees. Third, weight is given to seniority, and both rewards and occupational positions are largely disassociated from the present human capital characteristics of employees. As a result it is not necessary that wages be tied to the productivity of an individual at any particular time. Finally, there are other mechanisms for adjustment to changes in the market than just wages, such as changing training procedures or subcontracting work (Osterman, 1984a).

In summary, the existence of ILMs poses problems for the proponents of the traditional view of the labor market. While economic factors are certainly partially responsible for the rise of ILMs, the next section also explores reasons for the genesis of ILMs which may be outside the traditional economic analysis.

2.3 The Generation of ILMs

As was seen in the previous section, ILMs provide a challenge to the traditional view of labor markets functioning through only demand and supply. In firms with ILMs, rules intervene in the workings of supply and demand. The question then becomes: Why do ILMs exist? Why do work rules arise, and what are their purpose?

There are two broad categories of explanations, each with its own subdivisions. The first category looks at ILMs from a macro perspective, in which the total labor market is divided into primary and secondary jobs (e.g. Braverman, 1974; Becker, 1964; Jacoby, 1984). Primary sector jobs are often governed by ILMs and are characterized by higher wages, greater security, more chances for advancement, written and customary work rules,

and generally favorable working conditions. Secondary sector jobs, on the other hand, tend to not be governed by ILMs, and to offer much inferior working conditions, benefits, and opportunities for advancement. The second broad category of explanations for the generation of ILMs focuses on the firm or micro level of motivations for the rise of ILMs, and this category will be the more fully explored of the two as it is at the firm level that the research in this study is undertaken (e.g. Baron, 1988; Doeringer and Piore, 1971; Osterman, 1984a; Williamson, 1975, 1986).

2.3.a Macro Environment Causes of ILMs

Among those who view ILMs from the broad, macro perspective, there is a group that sees ILMs as a way to divide the labor force across social lines (e.g. Braverman, 1974). This radical or class-based view emphasizes the inferior social status of secondary (non-ILM) jobs (Piore, 1979; Osterman, 1984a). Such a division motivates the 'have-nots' (secondary job holders) to try to join the 'haves' (those in the primary job sector), while at the same time avoiding a workers' revolution by pitting one group against another. In this view, the system has the purpose of gaining workers' compliance with an industrial economy. A major problem with the argument is that it sees the establishment of an ILM as an antilabor device that is set up by employers to create these class divisions. Yet as Osterman points out, the history of industrial relations in the U.S. provides many examples of workers, often unionized, demanding the establishment of ILMs (Osterman, 1984a), and work by Taira (1970) provides similar evidence from Japan.

The class-based explanation emphasizes the creation and maintenance of unequal distributions of wealth. A second, contrasting view is that ILMs are generated, at least in part, by social, political and regulatory pressures. Historical analysis of the rise of ILMs in the U.S. shows how in addition to the major factor of unionization, the two forces of government and personnel management were responsible for the spread of ILMs (Jacoby,

1984; Baron et al, 1986). Jacoby notes that while "...the bulk of the innovations that comprise the ILM were available by 1915, if not earlier, large firms implemented them only when prodded by external forces" (Jacoby, 1984: 55). In the early part of the century, personnel professionals evolved out of the social welfare movement, which saw the apparently chaotic allocation and compensation of labor as seriously disturbing to the social order. The three forces - union, personnel management, and government - were each powerful at different times. The U.S. government, for example, gave impetus to the spread of ILMs through the large number of labor regulations and data-gathering requirements it instituted during World War II to ensure labor peace. This gave incentive to employers to stabilize employment in their firms. The essential point, however, is that ILMs were imposed on employers from the outside.

The third explanation for the rise of ILMs views the phenomenon from a broad perspective and focuses on education and training (e.g. Becker, 1964). Jobs in the primary sector are those for which both employees and employers must invest in skill creation. The higher pay, greater opportunities for advancement, and greater job security given primary sector job holders are rewards for the employees' investment, and help tie the employees to employers so that the firms can recoup investments in training (Piore, 1979). Workers in the secondary labor market are seen as either unwilling to undertake training investments in themselves, or as unlikely candidates for training by prospective employers. This explanation for the existence of ILMs is basically an extension of neoclassical economic theory and, as will be seen, can be applied at a more micro or firm level as well. The main challenge to this view is that the division between the primary and secondary labor markets seems to be a social one (Piore, 1979).

A major limitation to viewing the genesis of ILMs from a macro perspective is that firms can, and do, chose whether to adopt an ILM (Osterman 1984b; Doeringer, 1967).

This element of choice leads to the conclusion that there are factors operating at the firm level which affect whether it will adopt an ILM or not.

2.3.b Firm Level Causes of ILMs

While the broad macro explanations for ILMs generally tend to view the firm as a black box, the category of explanations that takes a micro perspective seeks to look at the inner workings of the firm. These explanations can be roughly divided into non efficiency motivations, and efficiency or economic motivations.

2.3.b.1 Non-Efficiency Causes of ILMS

Many of the various non-efficiency reasons that have been proposed for the existence of ILMs can be accommodated together under the rubric of 'worker initiated'. The sociological explanation, for example, strongly emphasizes the view that "(t)he employment relationship is a social relation" (Baron, 1988:494). Workers are seen as affected by social and work norms. The design of organizations' employment relations is thus the result of "...(an) intense and ongoing contest within organizations, subject to the sway of political and customary forces" (Baron, 1988: 494). Workers use normative comparisons to assess what is fair, and thus in firms where a mix of ILMs exist, workers in a less optimum ILM subsystem would pressure their employer to upgrade their employment conditions.

Paralleling the sociological emphasis on work norms is Doeringer and Piore's (1971) notion of custom, one of the three factors they propose for the generation of an ILM in a firm. Custom "...is an unwritten set of rules based largely upon past practice or precedent" (Doeringer and Piore, 1971: 23). Doeringer and Piore (1971) echo the sociological viewpoint by emphasizing that custom is "...the product of the psychological behavior of groups" (p.23). Custom can either lead to the establishment of an ILM where one is not warranted by efficiency factors or can lead to the continuation of an ILM even when

workplace changes call for an externalization of HRM practices. In either case, the impact on firm efficiency is likely - although not necessarily - to be negative.

Some research suggests that another possible reason for the establishment of an ILM in a firm can be managerial perceptions of the costs and benefits of one (Bills, 1987). As with all managerial decisions, the belief systems of the managers involved are the filter through which determination of the costs are made, and hence the final decisions may not be wholly economically efficient. This explanation is most useful for clarifying why efficiency motivations for the establishment of ILMs are either not heeded or are misinterpreted by managers.

All these sociological factors may have a positive impact on efficiency when the effect of improved employment conditions on worker performance is taken into account. Baron (1988) points out the importance of the 'atmosphere' that an employment relationship conveys to workers, and emphatically states that it"...is decisive in its effects on employees" (p. 498). Doeringer and Piore (1971) also point out the importance of custom to perceptions of fairness, and the potentially negative effects of perceived unfair treatment. Osterman (1984b) comes at the same issue from the perspective of corporate culture, which in any particular firm may create an atmosphere of what is a fair employment pattern. Yet it is almost impossible to measure how much efficiency is gained from workers' perceptions of fair treatment versus how much is lost by instituting an ILM when it is not economically justified. Thus the safest conclusion is that such sociological factors as custom are best viewed as non-efficiency motivations for the establishment of ILMs.

2.3.b.2 Efficiency Causes for ILMs

The economic or efficiency incentives for establishing ILMs can be roughly divided into those that emphasize human capital factors, those that focus on control, and those

based on efficient contracts. All three categories concentrate on the efficiency gains to both the employer and the employee.

Becker's (1964) work most clearly sets forth the human capital rationale for ILMs. Firms and workers invest in training in order to raise productivity. There is general training, which "...increases the marginal productivity of trainees by exactly the same amount in the firms providing the training as in other firms" (Becker, 1964:26). Specific training, on the other hand, "...can be defined as training that has no effect on the productivity of trainees that would be useful in other firms" (Becker, 1964:26). An employee quit or firing only affects the return on investment when the employee has received specific training since with general training the improved skills are equally valuable to all firms. Assuming a firm is paying market wages, an employee with equal skills to those of the worker who leaves can be hired easily and for costs no larger than those borne by competitors (e.g. recruitment and selection costs). But turnover becomes costly to both employer and employee when specific training is provided as the employer cannot replace the quit with a hire with equal skills, and thus loses the investment in specific training. Likewise the employee cannot find a job that will compensate her for the specific skills since these are only useful to the employer who provided them. Becker's analysis points toward the efficiency gains of ILMs since they reward commitment to the firm by promoting from the internal labor pool.

Doeringer and Piore's (1971) landmark analysis of ILMs is a further development and refinement of Becker's ideas. They define the immediate factors which generate ILMs as: 1) skill specificity; 2) on-the-job training; and 3) customary law, which was discussed previously. The concept of skill specificity is derived from Becker's 1964 work. Doeringer and Piore modify Becker's definition slightly by specifying that "(a) completely specific skill is unique to a single job classification in a single enterprise: a completely

general skill is requisite for every job in every enterprise" (Doeringer and Piore, 1971:14). Almost every job involves some specific skills. The term job specificity refers to the way in which the job content determines what set of skills are required, and how many of the skills are specific. Obviously, as skill specificity increases, the cost of training to the firm increases because the skill is not prevalent in the labor market, and the employee does not have incentives to invest in skills that she cannot use elsewhere. This investment in specific skills in turn pressures the employer to reduce labor turnover through the use of an ILM so as to maximize returns on investments in training.

On-the-job training is the second factor that pressures firms to adopt an ILM. The process of on-the-job-training is often informal and usually involves the tutelage of co-workers. Co-workers' cooperation in providing on-the-job training is gained by decreasing their fears of being displaced by the newly trained employee. The ILM provides job security through long-term commitments that help decrease the fears of co-workers. The stability provided by an ILM leads workers to expect that promises regarding future rewards will be met, and hence their cooperation in on-the-job training as well as their willingness to undergo a period of specific skill training during which they receive lower than market wages are garnered.

Custom, the final factor Doeringer and Piore (1971) posit as important to ILM formation, was discussed previously. While custom could be seen as providing stability and thus efficiency benefits to the employer, because it is often imported from outside the firm to determine the structure of the ILM, its role as an efficiency factor is suspect.

Other writers support the idea that skill specificity and on-the-job training are important factors for the creation of an ILM. Stark (1986), for example, focuses on the uncertainty reduction benefit of an ILM,which allows employers and employees to recoup the cost of investment in specific training. Managers, for example, wish to reduce the

uncertainty associated with the possible quit of employees who have received specific training. Uncertainty reduction is thus very similar to Doeringer and Piore's emphasis on the benefits to be derived from creating greater stability by establishing an ILM.

Osterman (1983; 1984b) deviates from Doeringer and Piore's (1971) conceptualization in his arguments for the rise of ILMs. He points out that research shows that investments made by firms are rarely sufficient to outweigh the costs of an ILM (Ryan, 1977). "Only in very few cases is a firm's investment in training sufficiently large that it justifies the costs of an industrial system" (Osterman, 1983: 384). Thus the essentially human capital approach of Doeringer and Piore is insufficient as an explanation for the rise of ILMs since the costs of training are usually not large enough to warrant an ILM.

Osterman provides a useful framework for analyzing the forces that influence a firm to adopt an ILM for white-collar workers based on a typology of ILMs which is particularly relevant to the present study (Osterman, 1984b). ILMS for white-collar workers can be classified into one of three types: industrial, craft, and secondary subsystems (Osterman, 1984b). An industrial ILM subsystem closely resembles the description given earlier in this chapter, and may be seen as a classic or pure ILM, while both craft and secondary subsystems lack the same degree of internalization on such dimensions as job ladders and training. While long, Osterman's descriptions are presented here in their entirety as they will also be important in building the theoretical model tested in this study.

> In industrial subsystems employees have a limited number of ports of entry and progress along clearly marked job ladders. Well-defined procedures and company norms govern job security rules. Training is provided by the firm and can be on the job or take the form of brief courses. Limited ports of entry make interfirm mobility difficult. It is important to realize that these arrangements extend well beyond blue-collar work: managers work under industrial rules as do many technicians and professionals.

> Craft subsystems are characterized by greater mobility and more loyalty to the skill or profession than to the firm. The skills are not very firm specific, and hence workers have more market power than under industrial arrangements. Mobility, which is often penalized under industrial arrangements, is more commonly rewarded here. Examples of white-collar occupations that operate under craft subsystems are computer programmers and some high-level salesmen.
>
> Secondary subsystems contain jobs with few advancement opportunities. They lack career prospects, either within or between firms. These jobs tend to be low skilled and poorly paid, though this is not always the case. Most important, they lack clear linkages to future jobs. In white-collar employment examples include many clerical occupations and jobs such as mailroom staff and messengers (Osterman, 1984: 167).

Osterman goes on to make two important observations. First is that the greatest difference between these three subsystems is how much training is provided by the firm. The second, and a crucial addition to ILM theory, is that a firm can have a mix of subsystems, and can seek to change its mix if pressured to do so. Osterman posits that in general employers seek to further internalize a craft subsystem - that is, move it toward an industrial subsystem - while it is generally pressure from the workers in a secondary subsystem which leads to further internalization. The Osterman model states that workers in a secondary ILM subsystem seek to improve their working conditions by pressuring their employers to upgrade their employment relation to an industrial subsystem, which provides greater firm training and job promotion opportunities. On the other hand, because craft skills are usually learned outside the firm, the firm becomes subject to skilled labor shortages and corresponding large wage fluctuations. This leads to pressure on management to shift a craft subsystem toward an industrial subsystem. To ensure the availability of skilled labor and facilitate long-range planning, firms attempt to move a craft subsystem toward an industrial subsystem in which they control training and thus can ensure supply.

This is an important deviation from the Doeringer and Piore (1971) argument. That is, employers seek to make the skills of employees in craft markets less general in order to move the ILM toward an industrial subsystem. For example, by providing narrow training in the computer programming used by the firm to selected internal employees, a firm can replace the more widely trained computer programmers whose wages are often higher, who respond to fluctuations in the external labor market, and who are governed by a craft subsystem. The firm truncates the training of the people thus trained so that their skills remain as firm-specific as possible. In short, Osterman's model provides an interesting rationale for firm investment in specific skill training and the attendant desire to move a craft ILM toward an industrial ILM. The motivation is to gain greater control and predictability, and thus this model might best be called the controlled human capital model.

Osterman tested his model in twelve largely white-collar firms in the Boston area (1984b). Using both questionnaires and interviews, the ILM characteristics of the employment relationship concerning salespeople, low-level managers, computer programmers, and clerical workers were determined. He found that the job ladders operating in these groups largely followed the predictions he had made based on the descriptions of the various subsystems given above. Compensation, turnover rates, and expected duration of employment were also found to be as predicted by his analysis. With regard to skills required, the findings concerning the level of skills were as predicted. However, the skill specificity required was found to not differ significantly between the four groups. While the skill specificity for managers was found to be higher than for the other four groups, the differences were minimal. Osterman concludes that this may indeed indicate that the control concerns may override the human capital concerns of employers.

In sum, the human capital explanations for the rise of ILMs emphasize the gains that ILMs provide by ensuring adequate returns on the training investments of firms and

employees or by providing predictability in planning. These approaches, however, ignore other benefits of an internalized employment relation, specifically those concerning efficient contracts.

In contrast to the factors of skill specificity and on-the-job training as the direct efficiency determinants of ILMs, a recent stream of literature focuses on ILMs as employment contracts (e.g. Williamson, 1975, 1985; Williamson et al., 1975; Ouchi, 1980; Mosk, 1988). The goal of both employer and employee is to maximize economic gains by constructing the most efficient contracts possible. Largely based on the transaction cost analysis of contracts developed by Williamson (1975) based on Coase (1937), this view looks at ILMs as a way of structuring an employment contract, which in turn is seen as an exchange between two parties. By understanding what is involved in the exchange, the parties can decide the costs and benefits to them of various kinds of contractual arrangements.

There are two broad types of exchange arrangements: market and institutional. Using employment contracts as an example, hiring an accounting firm to do a company's bookkeeping is a market-mediated contract, while training an existing employee in accounting is an example of an internalized, firm-based contract. As Osterman's (1984b) categories of ILMs shows, however, there is not necessarily either a pure hierarchy or a pure market. While an industrial ILM subsystem is the most hierarchical, a craft or secondary ILM subsystem can be seen as less internalized hierarchies. In this sense Oserman's categories of ILMS refine the somewhat bipolar view of the employment relationship found in Williamson's writings.

The costs and benefits of a market versus firm based transaction can be assessed. In the employment contract, the transactions dimensions of interest are skill specificity and uncertainty. Higher levels of firm-specific skills lead to greater pressure to decrease

turnover and opportunism by internalizing the relationship. It is not simply that an employee deepens his skills through long tenure, such as becoming a better word processor. This skill is equally valued by both present and potential employers and can be called skill generalizability. But if the word processor also acquires knowledge concerning the particular filing system used in the firm, then that skill may be considered firm-specific, and it would be costly for the firm to replace that individual.

Another example, provided by Williamson (1985), concerns professional employees and is of particular relevance to the present study.

> ...skill acquisition is a necessary but not a sufficient condition for asset specificity to appear. The nature of the skills also matters. Thus physicians, engineers, lawyers, and the like possess valued skills for which they expect to be compensated, but such skills do not by themselves pose a governance issue. Unless those skills are deepened and specialized to a particular employer, neither employer nor employee has a productive interest in maintaining a continuing employment relation. The employer can easily hire a substitute and the employee can move to alternative employment without loss of productive value. (Williamson, 1985: 242)

Asset specificity obviously bears a great deal of similarity to skill specificity. The difference lies in the concept of opportunism. That is, while the human capital approach emphasizes the need of employers and employees to recoup the costs of investing in specific skills, the transaction costs approach focuses on the chance the acquisition of such skills gives to employees to behave in opportunistic ways. That is, once an employee has acquired a specific skill, she could, for example, use her monopoly position to bargain for a higher wage. By internalizing the employment relationship, the interests of the employee become tied to those of the firm, thus decreasing the incentive for opportunistic behavior based on the possession of specific skills.

The second aspect of the employment contract is uncertainty. Uncertainty is defined as the condition under which it is very costly, perhaps impossible, to describe the complete decision tree (Williamson, 1975). Uncertainty is seen as very similar to complexity. The uncertainty concept is based on the idea that almost all contracts take place over time, and except for the simplest of exchanges, involve a number of alternative outcomes or contingencies. Future events in a complex exchange are extremely difficult to specify ex ante. Obviously, given unlimited rationality (i.e. no limits on our knowledge, foresight, etc.), such complexity would not be a problem since there would be no limits to knowing and specifying all possible outcomes and consequences.

Williamson's definition of uncertainty with regard to employment contracts can be understood in at least two ways. On the one hand, Williamson states that uncertainty concerning future events external (i.e. environmental) to the employee will affect the job tasks of the employee. He refers to "...changing internal and market circumstances which require adaptations such as changes in employee's behavior or job tasks" (Williamson, 1975: 65). He goes on to say "(not) only are changing market circumstances (product demand, rivalry, factor prices, technological conditions, and the like) impossibly complex to enumerate, but the appropriate adaptations thereto cannot be established with any degree of confidence ex ante" (Williamson, 1975:65). Thus external environmental uncertainty can be labeled environmental changes. On the other hand, Williamson implies a behavioral definition of uncertainty. The firm is uncertain of the exact future behavior it will need of an employee and of whether the employee will be willing to perform. This interpretation is clearly operant in Williamson's discussion of invidualistic bargaining models and refers to future 'performance' (Williamson, 1975; 64).

These two types of uncertainty - environmental and behavioral - are closely related. Changes in the external environment, such as an unexpected rapid increase in product

demand, lead to the need for appropriate adaptations in the job tasks of employees, and thus to changes in their job behavior.

> An additional feature of these tasks...important to an understanding of the contractual problem associated with the employment relation is that the activity in question is subject to periodic disturbance by environmental changes...Successive adaptations to changes of each of these kinds (shifts in demand; factor price changes; technological changes) are typically needed if efficient production performance is to be realized (Williamson, Wachter, and Harris, 1975:257).

With regard to environmental uncertainty, Williamson specifies certain possible categories of external changes (product demand, rivalry, factor prices, technological conditions), but he does not address the issue of whether the uncertainty produced by changes in each category is qualitatively different. In the model used in this study, it is argued that the most important external change is that of technological conditions. This is because the group of employees to be studied is R&D engineers whose job tasks are directly influenced by the external technological environment. It is possible that if another group of employees were the object of this study that a different environmental condition would be of more importance in influencing their job tasks.

The influence of behavioral uncertainty on the transaction costs of the employment relationship only becomes important when the job tasks require firm-specific skills of the employees. That is, if employees need no firm-specific skills to carry out their jobs effectively, then a change in job tasks could be easily accommodated by simply replacing existing employees with new hires who had the new skills. Such a lack of firm-specific skills in a job can be termed job generalizability. Yet some jobs are idiosyncratic in the extreme, requiring high investments in on-the-job training by the firm and thus replacement is costly. The firm needs to retain present employees with firm-specific skills, and at the

same time ensure employee behavioral adaptations to changing environmental conditions. Because of the impossibility of establishing with any confidence ex ante the appropriate adaptations that will be required, firms gain employee commitment and willingness to adapt through implementation of an internal labor market structure (Williamson et al., 1975).

Williamson (1975) asserts that uncertainty always leads to pressures to internalize a transaction -- to replace a market with a hierarchy. An important departure from this blanket assertion is proposed by this study. The concept of behavioral uncertainty is posited to consist of two dimensions, and the different dimensions vary in their influence on internalization. Behavioral uncertainty is defined here as:

> the ability and willingness of the employee to perform his job tasks satisfactorily.

Williamson's implied view of behavioral uncertainty concentrates on the willingness aspect, which as described above is the necessity of ensuring that employees adapt to required changes in job tasks. Williamson indicates that it is difficult to assume the willingness of employees to actually do their jobs when their jobs are difficult to monitor. Both types of willingness can be garnered at lowered overall costs through internalization of the employment relationship.

Yet while an employee may be willing to perform his job, he may not be able to do so. This study asserts that ability to perform a job can be a very important source of uncertainty. If, for example, an employee's skills and knowledge are only suitable to jobs in one restricted job task area, then even if job tasks change as a result of environmental changes the employee will be unable to perform these new tasks. The firm and employee will have very high certainty about the employee's ability to perform the exact tasks for which she was hired, but low confidence in her ability to perform outside the restricted job

task area. This will translate into lower willingness on the part of the employee to make job adaptations required by environmental changes since she will have low confidence in her ability to perform. A concrete application of these concepts is provided in Chapter Three.

Based on the discussion in this section, definitions of three transaction costs concepts as used in this study are given as follows:

> Job generalizability: the ability of an employee to use her knowledge and skills in another company with relatively little loss in productivity, which implies a lack of skill specificity.
>
> Ability certainty: the perception of an employee and the firm she works for that her knowledge and skills (i.e. abilities) can be best utilized only in one area of the firm. An accountant, for example, would be certain of being able to perform in the accounting department, but not outside of it.
>
> Willingness certainty: the willingness and ability of an employee to work in other areas of the firm than the one she now works in, particularly in areas and jobs relatively remote in content from her present one.

2.3.b.3 Contrast of the Controlled Human Capital Model and the Transaction Costs Theory of ILMs

The transaction costs approach to the genesis of ILMS thus differs from the human capital approach in its focus on the attainment of an efficient employment contract. The reduction of the opportunism that skill specificity provides, as well as the reduction in behavioral uncertainty, are the primary forces that drive a firm to adopt an ILM.

While the Osterman and Williamson models are in some ways highly divergent, close examination shows that they can together provide an enriched view of the genesis of ILMs. Osterman's model emphasizes that employers typically attempt to move a craft subsystem toward an industrial subsystem in order to gain control and predictability. Yet his model also recognizes that this is not the only direction in which an employer can move. There are circumstances that pressure an employer to shift an industrial subsystem toward a craft subsystem, that is, to externalize the ILM. This occurs when there is a change in the product markets that rebound into the labor market. Osterman (1984b) gives the example of

banking in which traditionally commercial lenders managed a stable portfolio of loans and "...did not require extremely high skills or aggressiveness" (Osterman, 1984b: 179). Although Osterman does not explicitly say it, it can be assumed that for traditional commercial bank lenders the possession of specific skills or knowledge - knowledge of the bank's long time clients, other bank employees, bank philosophy and procedures, etc. - outweighed the need for general skills. With the deregulation of banking, lenders were required to have different skills such as an aggressive ability to seek out potential clients and an ability to be better salespeople. As a consequence, banks have moved the ILM subsystem governing commercial lenders from an industrial subsystem to a craft subsystem, which allows them to hire away lenders from other banks and to avoid the costs of training in what are essentially general skills. In short, changes in the product market affected the job tasks and requisite skills of commercial lenders, leading employers to externalize the employment relation.

The Williamson model through an analysis of the transaction costs associated with various employment contracts, leads to the same predicted outcome. First the lessening of the need for firm-specific skills reduces the need to guard against opportunistic behavior through an internalized employment relation. Second, behavioral uncertainty shifts from an emphasis on willingness to an emphasis on ability. That is, when the willingness of the employee to perform her job overrides concerns about her ability to perform, then the employer has strong motivation to institute an industrial subsystem. This encourages the employee to view her long-term interests as tied to those of the firm, which increases willingness to perform. It also allows the firm greater opportunity to monitor an employee's willingness to perform her job before promoting her to greater positions of responsibility. However, when the concern of the employer is focused on whether the employee can perform his job -- that is, has the skills and knowledge to produce and

continue producing -- then the employer will be more inclined toward a craft subsystem which permits not only the hiring of outsiders with proven track records, but also permits the eventual dismissal if the strategic direction of the firm changes. As discussed previously, it would not be expected that she could make the necessary job task changes.

Thus under some circumstances the Osterman and Williamson models lead to the same predicted outcome. There are several significant differences between the models, however. First, the Osterman model admits on the one hand that changes in the product market can lead to necessary changes in the job tasks of employees and thus the firm must hire individuals with the requisite skills, as in the case of commercial lenders. But as the example of computer programmers shows, Osterman also believes that at least in some cases firms can reskill the employees who perform the task. By reskilling, firms can use an industrial ILM subsystem and avoid the costs of a craft subsystem.

The transaction costs theory does not explicitly allow for the possibility of reskilling, although there is nothing that precludes such an approach. As stated in most writings, however, the skill specificity of an employee is accepted as a given, that is that the firm cannot change the degree of skill specificity. For the model utilized in this study, it is assumed that skill specificity is not controllable by the firm but rather is endogeneous to the job tasks required of the employee.

The second significant difference between the Osterman and the Williamson models lies in the area of motivation of an ILM. As stated earlier, Osterman posits that firms are looking for control, while Williamson believes that firms desire adherence to a contract, and want that adherence at the least cost to them.

This study utilizes the transaction costs framework to study changes in an employment relationship. It is argued that employers must be concerned not only with predictability of costs but also with the actual ongoing performance of employees. The

costs to employers of employees performing inefficiently over extended periods of time would in all probability lead to greater losses than those that would result from unpredicted wage increments. In sum, it is felt that transaction costs may have better predictive value than the controlled human capital approach because it focuses on the ongoing long term costs of ensuring appropriate employee behavior.

The transaction costs approach to the employment relationship presented here outlines the theory as originally set forth by Williamson (1975). Yet numerous writers have added to this conceptualization, particularly with regard to the various intermediate transactions forms that exist between a market and a hierarchy. One such form is the clan, which Ouchi (1980) asserts arises when there is high performance ambiguity and low opportunism. Like willingness certainty, the concept of performance ambiguity focuses on the difficulty of measuring performance, i.e. on how well the firm can monitor the employee's adherence to his tasks. However the clan concept is not applicable to the present study because Ouchi's conceptualization of performance ambiguity ignores the ability component of behavioral uncertainty. Ouchi also largely ignores the impact of asset specificity, focusing most directly on the factors of goal congruence and performance ambiguity.

Recently Boisot and Child (1988) added another possible form, the fief. In their conceptualization the degree to which information is diffused or codified influences the form of the transaction. While the need for information in a transaction is an important lens through which the employment relationship could be examined, it subsumes both asset specificity and uncertainty, and thus provides a less specified set of factors with which to study ILMs.

The present study draws on the three categories of ILMs described by Osterman. The governance forms of industrial and craft ILM subsystems represent a spectrum from

highly internalized to less internalized governance systems, and thus fit in well with the transaction costs framework. The industrial is the most internalized, while the craft represents movement toward the market. These categories are particularly useful because they so clearly specify the HRM systems that correspond to each governance form, and are thus helpful in operationalizing the construct of governance structure.

Based on the foregoing discussion, a framework outlining the transaction costs approach to the study of the employment relationship is given below. This framework begins with the idea that the environmental changes have an impact on the job tasks of some employees. The kind of core job tasks which an employee is required to perform in turn affects the transaction costs of managing the employees who perform the job. As described previously, the higher the job generalizability and the ability certainty of the employee and the lower the willingness certainty, greater the pressure on the firm to externalize the ILM subsystem, that is move it from an industrial to a craft subsystem when dealing with highly skilled or professional employees.

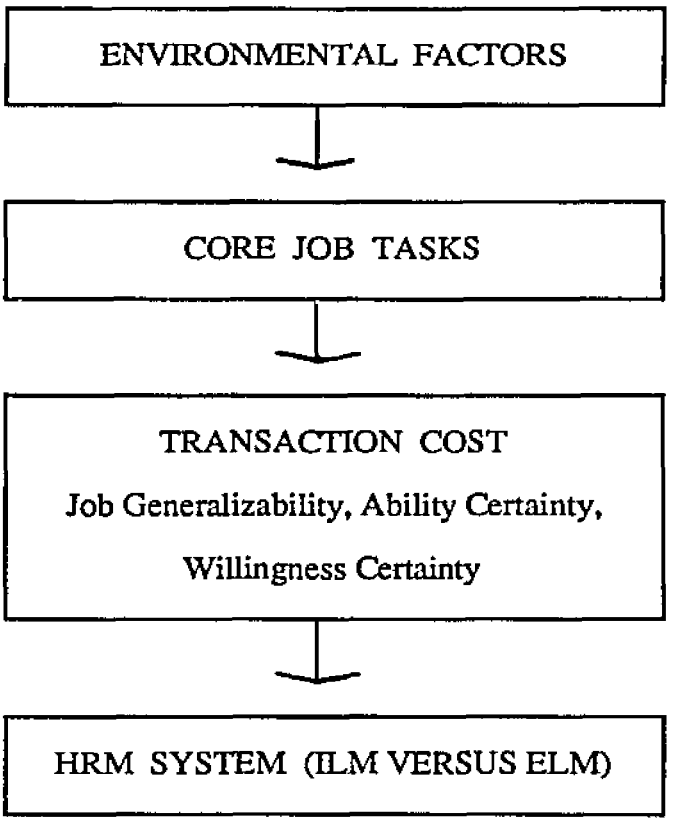

FIGURE 2.1

THE INFLUENCE OF ENVIRONMENTAL FACTORS ON HRM SYSTEM DESIGN

2.3.b.4 Critiques of the Transaction Cost Theory

Some writers have emphasized the undersocialized interpretation of man that the transaction costs approach represents. Granovetter (1988) argues that all economic relationships are embedded in structures of social relations. It is such relations that lead to trust and a decrease in malfeasance rather than an institutional arrangement. Granovetter's argument rests on the assertion that a pure atomized market does not exist anyway, and that there are networks of personal relations across firms which are crucial to carrying out economic activity: "the overlay of social relations on what may begin in purely economic transactions plays a crucial role [in economic life]" (Granovetter, 1988: 498). These social relations can convey information about employees that obviates the need for the hierarchy that Williamson asserts is necessary. Also, Granovetter critiques the presumed efficacy of hierarchies, particularly with regard to monitoring.

Granovetter's arguments point to the danger of assuming that a transaction costs analysis suffices to explain what type of governance structure is chosen for a particular transaction, and that the 'savings' that a particular structure represents is more presumed than known. Employees do not, for example, internalize the interests of the firm and suppress their own interests simply because they are governed by a hierarchy, as Williamson suggests. Yet while Granovetter asserts social structures have more impact on such costs as order and disorder, honesty and malfeasance, than the governance form utilized, his claim has not been tested in an empirical study which pits a transaction costs model against his own. It may be that it is some combination of the embeddedness and transaction cost approach that can provide more predictive power than either one can on its own. The present study assumes that transaction costs has sufficient explanatory power of

its own to be useful for the present research, an assumption which seems appropriate since there has not yet been a great deal of empirical work on the theory.

In addition to ignoring that economic relationships are embedded in social relations, transaction costs as an explanation for the employment relation has been criticized on other grounds. In particular, it is often seen as a tautology in that the governance structure which exists is assumed to be the one which best economizes on costs (Osterman, 1984a; Robins, 1987). Since there is no data on the costs and benefits of different governance forms, the one in existence is presumed to be the most efficient. In order to overcome this problem, "...proponents of transaction-costs analysis escape this sort of tautology by making the leap to causal explanation" (Robins, 1987: 72). Yet a causal explanation rests on the assumption of perfect markets, that is that the firm operates in an environment where all firms have the same level of profitability and only one organizational form is most efficient for all firms. These assumptions can rarely be met. "Transaction-costs analysis adopts a model that has clear meaning for organizations only in perfect markets and applies it to highly imperfect situations" (Robins, 1987:74). Yet while it may be dangerous to attribute a causal role for transaction costs, at the minimum they are useful tools for identifying the competitive advantages that accrue to a particular organizational form. And if it is assumed that sooner or later, in spite of imperfect markets, a firm functioning with a significantly less efficient organizational structure will be pressured to change it or perish, then studies based on transaction costs that take measurements over significant time periods can help establish the legitimacy of using transaction costs to specify the advantages of one organizational form over another. This is particularly important with regard to the employment relationship. It is argued that in cases where the skills required of employees are the same across firms for a particular group of employees, all firms employing such workers will be pressured to adopt similar employment relationships through the workings

of the labor market. When such skills are not endogeneous to the job but rather can be changed, as the reskilling concept of Osterman suggests is possible, then there will be less pressure for firms to converge toward a single employment relationship form. In short, firms operate in more perfect markets for labor when employee skill requirements are driven by the environment, as in the case of commercial bank lenders, than when they can control the skill requirements, as in the case of computer programmers.

Another criticism of the transaction costs approach is that it ignores efficiency-limiting aspects of internal market procedures (Osterman, 1984a). Transaction costs only focuses on the efficiency-maximizing aspects of a governance structure. Obviously any governance structure a firm adopts involves some trade-offs. Seniority based pay or promotion systems can, for example, lead to less efficient allocation of talent and skills. Yet like the argument concerning the tautological nature of transaction costs, it can be argued that the costs of a particular system are weighed against the efficiency benefits and the former must outweigh the latter in order for the firm to adopt and maintain a particular governance form.

2.3.b.5 Transaction Costs: Empirical Studies

There are few empirical studies of the transaction costs approach as applied to the employment relationship on the organizational level. One study, Bills (1987), incorporated transaction costs concepts into a broader model of the determinants of ILMs. Utilizing three case studies, he showed how economic and organizational factors interact with managerial decision making to influence the adoption and form of an ILM employment relationship. However, the study did not attempt to operationalize the constructs of uncertainty or skill specificity.

Wholey (1985) studied one aspect of ILMs -- the degree of lateral entry -- in large law firms. Using data from 80 law firms, Wholey tested hypotheses based in part on

Doeringer and Piore's (1971) model of ILMs. While not using transaction costs terms, the difference between firm and occupational skill specificity was clearly addressed. Some lawyers develop specializations that decrease the breadth of the problems they deal with, and these skills are "..general and transferable between firms" (Wholey, 1985: 322). This leads to the expectation that firms with greater differentiation would have higher lateral entry (i.e. be less of an ILM employment relationship). Hypotheses based on this conclusion were tested, but while statistical values were in the hypothesized direction, they were not significant.

The lack of empirical work at the organization level on employment relationships using a transaction costs approach lead to a wider search for relevant research. Two studies that utilized transaction costs concepts applied to organizational relationship are Walker and Weber (1985) and Jones (1987).

Walker and Weber (1984) applied a transaction costs approach to the make-or-buy decisions in a division of a U.S. automobile company. The transaction costs analyzed were uncertainty and supplier market competition (i.e. asset specificity). Other factors affecting the decision were also studied. Walker and Weber defined two types of uncertainty: volume and technological. Volume uncertainty is assessments of the fluctuations in the demand for a component. High volume uncertainty was hypothesized to lead to a make rather than a buy decision. Technological uncertainty refers to changes in component specifications. It was hypothesized that as technological uncertainty increases, the likelihood of a make rather than a buy decision also increases. Results only supported the hypothesis concerning the effect of volume uncertainty.

The Walker and Weber study is relevant if parallels between technological uncertainty and behavioral uncertainty are drawn. The resistance of employees in difficult-to-monitor jobs to make frequent adjustments to changes in job tasks is similar to the

resistance of suppliers to make frequent changes in components. This reluctance can best be avoided by internalizing the relationship. The lack of support in the Walker and Weber study for the effect of technological uncertainty is disappointing, although the parallel with behavioral uncertainty may not be totally appropriate.

Walker and Weber also asserted that the greater number of potential suppliers, the less specialized the buyer-supplier relationship would be (i.e. the lower the asset specificity). Consistent with Williamson (1975), greater supplier competition should lead to a buy decision. Results showed moderate effect in the hypothesized direction, although there may have been method bias. This finding lends support to the concept that as the need for firm-specific skills of employees decreases, the employment relationship should become more market oriented.

Jones (1987) applied transaction costs analysis to organization-client transactions. He specified that transaction uncertainty and performance ambiguity will lead to higher transaction costs, and that this in turn will lead organizations to bear the bureaucratic costs of hierarchical structures. Transaction uncertainty was defined as "...the degree [to which] organization-client transactions are unstandardized or unpredictable" (Jones, 1987:200). Performance ambiguity is the ability of clients to monitor and evaluate the performance of the other party, and to determine the value of the objects of exchange, such as medical advice. This latter concept of performance ambiguity is useful to the present study when applied to employee performance. It is actually easier for firms to monitor and evaluate the performance of employees hired for specific, specialized skills than that of employees whose jobs are idiosyncratic and require diffuse firm-specific skills.

Jones predicted that high levels of transaction uncertainty and performance ambiguity would lead to some form of hierarchical governance structure -- that is, to internalization of the transaction. The results of the research to test hypotheses based on

this prediction provided some support for performance ambiguity as a predictor of structure, although stronger support for the effect of transaction uncertainty was found.

In general, it is difficult to use the results of studies such as Walker and Weber (1984), and Jones (1987), to elucidate and support the transaction costs affecting the employment relationship. While these studies provide general support for applying a transaction costs framework to organizational transactions (client-organization, supplier-organization, employee-organization) they involve different types of asset specificity and uncertainty. These differences make comparisons difficult. Yet it can be concluded from this overview of studies based on the transaction costs approach that it can be a useful tool in analyzing exchange problems such as the employment relationship.

2.4 Summary

The phenomenon of ILMs has been an object of research for four decades. Of particular concern is the question of what gives rise to ILMS in the first place, with explanations ranging from those that emphasize the exploitation of workers to those that emphasize the role of custom to those that focus on efficient contracts.

While no one explanation is likely to be sufficient in any particular case, it has been demonstrated that a transaction costs framework provides an approach that may have sufficient explanatory power on its own to be useful. Particularly with regard to white-collar ILMs where such factors as unions are not very important, the transaction costs approach may prove to be of great utility. Transaction costs focuses on the long term behavioral aspects of the employment relationship which is arguably a very important consideration to employers. The paucity of studies testing the application of transaction costs to the employment relationship makes its use in the present study particularly significant.

CHAPTER THREE

INTERNAL LABOR MARKETS IN THE JAPANESE SETTING

3.1 Introduction

Internal labor markets exist in certain firms in industrialized nations throughout the world. It is estimated, for example, that 40 percent of men aged thirty and above in the U.S. "...hold jobs that will eventually last twenty years or longer" (Osterman, 1984a: 1). While the transaction costs framework for analyzing changes in ILM subsystems could be utilized in any advanced capitalist society, Japan was chosen as the locale for testing the framework proposed in this study. Several conditions in that nation led to this choice.

First, since World War II industrial ILMs have predominated in large Japanese firms, covering approximately 25-30 percent of the labor force (Rohlen, 1979). Thus there exists in Japan a large group of firms in which the human resource management (HRM) practices associated with an industrial ILM have prevailed for a significant amount of time. Second, Japanese style ILMs have fascinated Western scholars since their 'discovery' in the late 1950s. Since then considerable debate and research has centered on trying to explain the peculiar features of the system and whether it is uniquely Japanese or is a way of managing that is converging toward a 'rational' Western model. This study contributes to this debate by testing the applicability of a framework that is presumed to have utility in all market economies.

Third, a variable which has been argued to affect the desirability of an ILM, the technological environment, has been changing radically in Japan in recent years. As a consequence, some large Japanese firms are facing an extremely turbulent technological environment, as will be described later in this chapter. While the technological environmental turbulence affects various groups of employees in these firms, there is one group, research and development engineers and scientists, for whom it is argued the effects are significant. Moreover, there exists documentation of the HRM practices used with this

group in the past, which provides a baseline against which to compare present HRM practices.

This chapter traces the history of scholarship concerning the origin of Japanese ILMs, and shows that there is a place within this stream of research for an economic approach to studying the area. Following an analysis of the explanations for Japanese ILMs to date, this chapter examines the technological environment in Japan, how it has changed over the last 30 years, and what these changes mean for managing R&D personnel in large Japanese firms today. Finally, the literature concerning the particular group of Japanese employees to be studied, research and development engineers and scientists, will be summarized.

3.2 Japanese ILMs

Most of the studies of Japanese ILMs and their attendant HRM practices have focused on blue-collar rather than white-collar workers (e.g. Cole, 1971; Dore, 1973; Marsh and Mannari, 1976; Koike, 1988). Rohlen's (1974) study of the employment practices of a Japanese bank is a notable exception to this trend. The description of Japanese ILMs which follows, while focused on white-collar workers, draws on research concerning both blue- and white-collar workers to build a generic description of Japanese ILM practices in large firms. As will be seen, the particular variant of ILM which has predominated in large Japanese firms is an industrial ILM subsystem.

The general features of a Japanese white-collar ILM, particularly as prevails in manufacturing firms, can be summarized as follows (this description draws heavily on Pucik, 1984 and Clark, 1979). New employees are usually hired directly from the university and are assigned to either a technical or a managerial career path. Prior company work experience for white-collar workers is unusual. Employees are given the implicit promise of what is called 'lifetime employment', that is a job until retirement at age 55 or

60. Pay and promotion decisions are based heavily on seniority, particularly in the early years with the company. Merit or performance factors become more important as the employee progresses in the company's hierarchy. General pay levels are determined largely by industry levels, and an individual's salary is also affected by such personal characteristics as marital status and number of children. Lateral entry into the firm is rare, and even the top echelon of the firm's management is composed of employees who have risen through the ranks. Job rotations are at the discretion of the personnel department and are regular and frequent. These job rotations can also be fairly radical, such that it is not unusual to find an employee switched from a production area to sales or personnel. Such transfers can make the present knowledge base of the employee useless and require him to acquire a new expertise every few years. The degree of mobility is greater for administrators than for technical personnel (Pucik, 1984). Training, both initial and on-going, is extensive and is provided by the company.

Japanese ILM HRM systems differ from their U.S. counterparts in significant ways. First, the system is largely democratized such that the status and treatment of Japanese blue-collar workers is similar to that of white-collar workers (Mosk, 1989). Blue-collar workers, for example, are paid salaries and bonuses, and have fairly extensive job ladders (Koike, 1987). Second, because of the relatively heavy weight given to seniority, managerial control over wage determination is weak, as is the ability to use layoffs and firings. In return, however, managers have retained almost complete control over job assignments, as described above (Mosk, 1989). This control is made possible in part because the basic wage is attached to individuals rather than to jobs (Osterman, 1984a). In the U.S., management has retained greater control over layoffs and firings which provides the flexibility needed to meet economic downturns. Mosk argues that 'flexible control' over employees in Japan is as a consequence substantially higher, since

"...under changes in demand or technology American firms tend to lay off or fire, whereas Japanese firms tend to reassign workers to different jobs" (Mosk, 1989: 9). This leads to less resistance by workers to change, as well as less loss of skills to the firm.

In summary, the style of ILMs which has prevailed in large Japanese firms in the post-war period is a highly internalized system. While there are some distinctive features to the system, it can be regarded as an industrial ILM subsystem as described by Osterman (Osterman, 1984b).

Why did large Japanese firms almost uniformly adopt an industrial ILM system? As mentioned previously, there has been a great deal of debate over its origins. A simplified classification scheme of the explanations includes two categories: the cultural and the economic/historical (Shimada, 1983; Cole, 1971).

The culturally based explanations for the origins of the Japanese ILM system have their roots in the first major study of Japanese industrial relations by a Western scholar, The Japanese Factory by James Abegglen, published in 1958. In this view, the human resource management practices of large Japanese firms are continuations of traditional relationships in feudal Japan that were in turn formed by certain cultural values. Such cultural traits as loyalty and reciprocal obligation are seen as the driving forces behind this style of employment relationship, and most significantly are viewed as overriding economic considerations, as can be seen in the following quote from Abegglen:

> Loyalty to the group and an interchange of responsibilities--a system of shared obligation--take the place of the economic basis of employment of worker by the firm. (Abegglen,1958: 11)

Other researchers have also proposed a large role for cultural values in shaping Japanese employment practices, including Rohlen (1974), Dore (1973), and Ballon (1969). More recently, Lincoln and McBride (1987) have emphasized "...the limits to the capacity

of rationalist explanations to account for Japanese distinctiveness" (p. 290). In sum, in this view, Japanese employment practices may in fact be economically inefficient given the economic goals of the firm. It is believed that the industrial ILM system operating in large Japanese firms may be a drag on corporate performance, but one which is tolerated because of the imperative of conforming with cultural values. Firms are passive captives of the need to conform to the culturally based needs of their employees.

In contrast to this view, the economic/historical approach emphasizes the rationality of Japanese ILM practices. These practices are seen as the results of a combination of historical circumstances and economic goals. Taira (1970) traces the beginning of paternalistic employment practices to the labor shortages, particularly in the textile industry, in the early part of this century . He shows how after an initial effort on the part of employers to extract as much productivity at minimum cost from employees as possible due to high labor turnover, employers finally learned the rules of the labor market and switched to offering better employment conditions as a means of decreasing labor turnover. The system of nenko-joretsu (ranking by years of service and thus rewarding firm commitment) was instituted by some firms in the 1930s as a means of retaining employees with firm specific skills. Yet it was only in the post-war period of the 1950's, during a labor surplus, that the industrial ILM system described previously became entrenched in large firms. The unions sought and obtained job security for their members, offering in return job assignment flexibility and a willingness to share the burden of the firm's risks through adjustments in bonuses. This rational economic trade-off is also emphasized by Masahiro Aoki (1987). Aoki views post-war Japanese managers as mediators between the two groups of employees and stockholders, with the former group having as much right as the latter to the residual revenue of the firm. This changes managers' emphasis from share-

price maximization to higher sales growth, and is efficient in firms where the skill accumulation by employees aids the firm to better utilize its technology.

Koike (1987) has also underscored the economic efficiency of the system which was worked out in the 1950's. The democratization of the workplace and the provision of extensive career ladders for blue-collar workers led to what he terms the 'white-collarization of blue-collar workers' (Koike,1987). Extensive training in managerial level topics has pushed down such knowledge and skills to the shopfloor, resulting in better output from quality control circles and a greater ability of workers to solve unexpected workplace problems themselves. Besides enhancing the productivity of blue-collar workers, the Japanese industrial ILM system has led to greater firm specific skill acquisition for managerial and technical personnel, which has arguably been an important factor in increasing their job performance. In short, in this view historical circumstances led Japanese firms to adapt an industrial ILM subsystem with features peculiar to Japan, but the subsystem led to desired economic outcomes for the firm (Endnote 1).

The truth concerning the origins of the system in Japan probably lies somewhere between these two views (Cole, 1971). That is, Japanese firms adapted ILM practices when it was economically efficient for them to do so, and used traditional values such as loyalty to make the system more acceptable to employees. But the fact that earlier industrial employment relationships did not reflect an ILM orientation, combined with the fact that most medium and small size firms in Japan do not have ILM practices, makes it clear that cultural values are not the overriding determinant of the style of employment relationship which characterizes large firms in Japan today.

Accepting that economic motivations are the primary force shaping Japanese employment practices means that a transaction costs analysis may provide valuable insight into the nature of the Japanese employment relationship. Specifically, the transaction cost

approach facilitates the identification of important factors that can lead a firm to reconsider the economic rationality of its employment relationship. The strength of a transaction cost analysis lies in its ability to illuminate the influential connections between environmental conditions and internal firm requirements which affect the way in which firms manage employees. Traditional labor economic theory concentrates on environmental factors such as labor supplies, while human capital theory focuses on the internal job requirements of the firm. Transaction costs can and does encompass both external and internal factors at the same time. Thus its use in an analysis of Japanese ILMs adds significantly to prior efforts which have concentrated on external factors (e.g. Taira, 1970) or internal factors (e.g. Koike, 1987).

3.3 Changes in the Japanese Technological Environment and Effect on Corporate R&D

As mentioned previously, Japanese technological conditions are viewed as the most important source of environmental uncertainty for the purpose of this study. There are two main types of technological environments, both of which Japan has experienced in the post-war period. These technological environments are characterized by adaptive technology and innovative technology, respectively.

The technological environment is adaptive when the firm can adopt and adapt technology from external sources (Mansfield, 1988). There is an adequate supply of technology, circumstances permit its adoption, and major technological breakthroughs are not frequent. In contrast, a technological environment that is innovative is one in which technology is changing very rapidly and such considerations as first-to-market advantages make the production of radical technological innovations within the firm desirable for its long-term growth. It is argued here that these two different kinds of technological environments necessitate qualitatively different adaptations on the part of the firm and hence

different employee behavior. In order to apply these concepts to the Japanese situation, it is first necessary to examine the post-war technological environment in Japan more closely.

The post-war industrial success of Japan benefited in a number of ways from the international technological environment of the time. First, there was a vast global storehouse of technological knowledge upon which Japan could draw during the catch-up phase. Cut off from access by the war, Japanese industry had lost considerable technological ground during the late thirties and forties. Second, not only was there technology to be bought, but the political climate, particularly in the U.S., was one in which international access to knowledge as well as to markets was seen as one way of avoiding a recurrence of global wars. Cross-national interdependence was seen as contributing both to international economic efficiency and to decreasing the reasons for conflict between nations.

Japanese industry took full advantage of this climate. Over a period of about thirty years (1950's to 1970's), it was the most avid collector of technological developments in the world (Abegglen, 1985). As late as 1978 Japanese dependence on foreign technology was five to six times higher than the U.S. ratio (Lynn, 1985). Much of this tended to be technology either already in use or just coming on-stream in other countries. For example, in the steel industry, the creation of the BOF (Basic Oxygen Furnace) in the late forties in Austria was a significant turning point in steel production technology. Yet while U.S. industry hesitated in switching from open hearth to the BOF process, the Japanese steel industry began in the mid-fifties to put BOF into their steelworks. The result was that Japan "...far surpassed the United States in the percentage of its steel made by the BOF in every year after 1957: 11.9% compared to 3.4% in 1960, 55% compared to 17.1% in 1965..."(Lynn, 1982:23). This same pattern can be seen in other industries such as shipbuilding, car manufacturing, and semiconductors.

The technology adopted by Japan during this period was mostly for use in capital-intensive heavy industries. Japanese industry sought new technology useful in creating greater economies of scale and other production efficiencies such as quality control (Riggs, 1988). Government policies of this period supported both the adoption of this type of technology, and coordinated capacity and production increases to avoid severe 'bumps' while demand caught up with increased capacity (Yamamura, 1982).

Having adopted a new process (e.g. BOF) or a new product (e.g. rotary engine) technology, the strategy of Japanese industry was to slowly improve on the basic ideas, so that with each successive product or market development, it was able to produce a better and/or cheaper version to meet demand (Riggs, 1988). This pattern can be seen, for instance, in the microchip industry. Japan's initial entry was as a second-best producer of 4Kchips, but as the product developed, the Japanese perfected chip production technology so as to lead in the 256K chip manufacture. This catch-up strategy required that Japanese industry make incremental technological innovations, either in the product or process. Eventually, by piling up innovations, an industry or a firm gained leadership. As Okimoto and Saxonhouse note, "...the cumulation of incremental improvements in production technology is the surest and most direct way of achieving and maintaining competitiveness, especially for latecomers which choose to follow the difficult path of constructing an economy based on heavy, capital-intensive industries" (1983:14). The type of technological environment which has just been described can be termed an adaptive technological environment, and the technological improvements that result are incremental innovations.

Since the mid-1970's, however, the technological environment facing Japanese industry has changed (Lynn, 1986). Japan "...is seen as approaching the 'limits of followership' (Sakakibara and Westney, 1985:36). The supply of product and process

technology upon which Japan can draw has been severely depleted. In fact, since 1972 the net outflow of technology from Japan has exceeded the net inflow of technology, although the outflow is mostly of Japanese incremental innovations to less developed countries (Anderson, 1984; Okimoto and Saxonhouse, 1987). The characteristic pattern of import, adapt, improve, and apply can no longer be followed since there is simply less technology to import. In essence, since the mid-seventies, Japanese industry has been experiencing an important shift in its technological environment from that of adaptive technology to that of innovative technology.

In addition to the previously mentioned characteristics, an innovative technological environment has several features. While adaptive technology mostly centers on manufacturing, the new technology is largely focused on knowledge-based industries (Tatsuno, 1986). Second, the rapidity of change requires greater protection of technological knowledge to ensure maximum exploitation of innovations if corporate conditions are suitable (see Endnote 2). The first firm to patent a product or process, or to use it at all, is the one most likely to gain from it. In the new high technology fields of biotechnology, semiconductors, software, robotics, computers, telecommunications, pharmaceuticals, and new materials there is a reliance on radical product innovation to gain competitive advantage. In this new environment, "...high-tech companies look also to technology itself as an avenue to competitive advantage. The most powerful competitive strategy arises when an evolving technology intersects with an emerging customer need" (Riggs, 1986:66). Particularly in high technology industries where a product's life-cycle can be as short as three years, the typical lag time to imitate a new product of three years spells death to followers (Peck, forthcoming). Moreover, with the internationalization of markets, failure to be the first to market with a new product can lead to loss of the home market (Peck, forthcoming).

As a consequence of these pressures, R&D assumes a more central and changed function. Firms operating in an innovative technological environment usually

> ...start with the consideration of the firm's skills and technical knowledge as corporate assets. It leads to the breaking down of the previous linear relationship linking together markets, product range, manufacturing units, and laboratories under the unifying leadership of the market. According to the traditional perspective, R&D is treated as a cost, to be born, in order to provide the most suitable products for a given market. The new one envisages technology as an asset the gains from which must be captured from the widest possible area of applications (Delapierre, 1988:151).

At the same time, innovative technology is by its nature risky and extremely uncertain. Whereas in an adaptive technological environment incremental technological changes are very predictable both in direction and sequence (e.g. creating increasingly more powerful micro-chips), in innovative technology neither the direction of change nor the sequence is predictable or certain. In adaptive technology, it is mostly a matter of time and effort. In innovative technology, these are not necessarily sufficient ingredients. In emerging industries, "...products must be coaxed ...from scientists" ("Technology...", 1986). As opposed to the relative predictability in an adaptive technological atmosphere, in high-technology research "...you can't plan a breakthrough" ("Technology...",1986). Innovations can be characterized as 'radical', involving more basic research, higher costs, and 'leaps' rather than steps (Abernathy, 1978). Metaphorically, while researchers in an adaptive technological environment work on solving a technological puzzle, those working in an innovative technological environment are concerned with creating the puzzle whole-cloth. The basic research involved is probably not that which has as its goal pure understanding, but rather has goal achievement through basic understanding (Stokes, 1982). Yet this still represents a significant shift from the incremental technology stage

when research in Japan was applied rather than basic, and was focused on goal achievement through utilization of existing basic understandings.

A question arises, of course, as to why the past pattern of Japanese industry of adopt and adapt cannot be applied even in this new innovative technological environment. There are several reasons besides those of first-to-market advantages and speed of technological change mentioned above. First, the very success of Japan during the adaptive technological phase has led many nations to be both envious and antagonistic (Saxonhouse, 1986; Taylor and Yamamura, forthcoming; Johnson, 1988). Japan cannot, therefore, rely on continued easy access to technological innovations, particularly as firms in other countries respond to the necessity of maximizing first-to-market advantages of new ideas by demanding protectionism. Second, Japan is well aware that there is a growing crowd of nations not far behind who have the same skills as Japan to use the breakthrough radical technological innovations. South Korea's recent entry into car and computer manufacturing is a vivid reminder of this fact. Finally, the nature of the new technology itself makes the incremental improvement pattern very difficult (Okimoto and Saxonhouse, 1983:41).

The overriding reason, however, may be the felt need to ensure the economic survival of Japan. There is increasing awareness of the dynamic nature of comparative advantage and the central role played by technology in creating comparative advantage (Krugman, 1986; Itoh, forthcoming; Brander, 1986; Dosi et al., forthcoming). Not only does technology matter, but the direction of technological development is not determined a priori (Dosi et al., forthcoming). Countries can influence the direction of technological development. By ensuring that innovations are undertaken and technical skills are accumulated in strategic areas critical to tomorrow's competitiveness, Japan can help ensure its future economic position in the world. Having caught up with the developed countries

both technologically and economically, Japan has strong incentives to lead the technological race in key industries so as to control the direction in which these industries grow. Such technological leadership requires a commitment to producing radical innovations in key industries.

Given that the technological environment has changed, how can Japanese industry ensure that these radical innovations are produced? Where should the new type of R&D be carried out -- within existing firms, in newly-established R&D subsidiaries, in overseas R&D subsidiaries, in new start-up ventures, or in national universities?

For a variety of reasons, it is proposed that large firm based R&D will be the preferred location for producing radical innovations. Subsidiaries in Japan have an aura as 'dumping grounds' for employees whose performance is sub-standard (Aoki, 1984: 29). Overseas R&D subsidiaries, although in use by some pharmaceutical firms, face the difficulty of the mobile markets for scientific personnel that exist in other countries. This makes Japanese firms afraid of carrying out important research overseas where key researchers with critical information can and do quit often (Sakakibara, 1988). Financial market features in Japan inhibit the establishment of small, very innovative start-up firms so typical to the U.S. Start-up venture capital is relatively scarce in Japan, thus preventing entrepreneurial researchers from setting up their firms (Saxonhouse, 1984). Finally, university research has traditionally been held in low regard by Japanese business, and in addition universities have until recently been barred from accepting industrial contracts (Kumon, 1986; Inose et al, 1982; Anderson, 1984). It should be noted, however, that Sakakibara argues that the universities are the most appropriate locale for the basic research that Japan must do (Sakakibara, 1988).

The Japanese government, recognizing the restricted number of venues for producing radical innovations, has itself instituted basic research projects, both on its own

and in industry collaborations. However, the funding is relatively small, and these efforts are seen mostly as means of communicating fruitful research directions for industry to follow (Taylor and Yamamura, forthcoming). Thus it can safely be assumed that the majority of the R&D activity aimed towards creating radical innovation in Japan is to be found in large Japanese firms.

3.4 The Core R&D Job and Employment Relationship of Japanese R&D Engineers and Scientists in an Adaptive Technological Environment

Both the organization in general and the job tasks of R&D engineers and scientists in particular must undergo change as a firm moves from an adaptive to an innovative technological environment. This section will examine the job tasks of the incremental innovator in Japanese firms, and the employment practices most suitable to managing such personnel.

In the adaptive technological environment of the three decades following the end of the war, Japanese firms demonstrated a number of strengths in the area of organizational design which helped support the creation of incremental innovations. First, incremental technological innovations rely above all on the coordination of activities throughout the firm (Itami, 1988). This in turn rests upon communication between various parts of the company. Japanese firms, organized hierarchically with frequent personnel transfers, were able to decrease miscommunications. The homogeneity of personnel was helpful in increasing communication smoothness. These features enabled the firm to employ new technology in the most appropriate and efficient manner and to make incremental adaptations in the technology (Okimoto and Saxonhouse, 1987; Yonekura, 1988).

In addition to such organizational design features, the large size of firms was a key factor affecting firm success. Adaptive technology requires economies of scale for maximum exploitation, and thus the larger the firm the more it can take advantage of the

technology (Dosi et al., forthcoming). In addition, technology adaptation requires large capital outlays, and large firms have more resources. Finally, if the problems of information channeling and coordination mentioned above are overcome, bigger firms have a larger pool of employees from which to draw the information necessary for incremental innovations.

Particularly within the R&D sections of firms in an adaptive technology environment, size and communication were of great advantage. Since the technological 'puzzle' to be solved was based on developing step-wise improvements on basic ideas, the more heads attacking a technical problem the better. Although training and knowledge were important, coordination of effort and sharing of ideas were necessary in order to use the large pool of human resources most effectively. Consequently, attitudes and management practices encouraging sharing were of great benefit (Itami, 1988). Okimoto and Saxonhouse, for example, note that one characteristic of Japanese industrial R&D laboratories is the "...group-oriented, harmonious, and hierarchical organization dynamics" 1983:16). In addition, these laboratories are characterized as having 'open-channels of communication' with the production and marketing divisions of the firm. This helps the flow of information needed for solving the incremental technological puzzles faced by the R&D laboratory ("Maverick Managers...", 1988).

R&D engineers and scientists working in the adaptive technological environment characteristic of Japan's catch-up phase were concerned mostly with solving fairly predictable technological puzzles. Most work concerned 'downstream' research, that is the development of increasingly more efficient production processes or product adaptations (Okimoto and Saxonhouse, 1987). As was noted previously, in order to carry out these jobs well, communication and information are of paramount importance. Further, communication must be carried out with a very wide variety of people: production

personnel, suppliers, marketing division personnel, other research staff, technicians, manufacturing maintenance engineers, etc (Kono, 1988; Kanai, 1987). Teamwork is of great importance. Successfully carrying out these kinds of jobs thus requires people who are good communicators, get along well with many other types of people, have a good knowledge of several disciplines, and whose intellectual and emotional attachment to one technological area is not too deep (Jaikumar, 1986; Takagi, 1985; White, 1975). Further, because of the necessity of having technical expertise as widespread as possible in the company in order to capitalize on information and increase efficiencies wherever possible, the rotation of R&D personnel through several divisions and into management positions becomes desirable (Takagi, 1985; Kono, 1988). Engineers who are too attached to a research speciality are unlikely to welcome such rotations (Kono, 1988).

In summary, R&D engineers and scientists are expected to have wide but not necessarily deep knowledge of the technologies the firm deals with, to be able to gather and communicate information both from internal sources and market sources, and to be able to move into non-R&D positions where their expertise is of use. In addition, they are expected to work closely with other R&D personnel, and to keep abreast of the incremental changes in relevant technology. Given these job tasks, what kind of management practices were most suitable to managing Japanese engineers and scientists in the adaptive technological environment?

3.5 Application of Transaction Costs Theory to the Employment Relationship of Japanese R&D Scientists and Engineers

Using a transaction costs analysis, it becomes apparent that employment practices typical of industrial internal labor markets were most suitable. Japanese firms faced the necessity of ensuring that their R&D engineers could both produce incremental innovations, and, when no longer in R&D, could also adapt to using innovations produced

by others. The uncertainty affecting employment contracts, therefore, mostly centered on the willingness and ability of R&D engineers and scientist to make the required adaptations.

The firm needed these incremental innovators to be willing to be flexible regarding their jobs both while they worked in R&D and when required to move out of R&D and work in other parts of the firm. Within R&D, these employees could be assigned to a project as needed, regardless of their technical majors in university, because much of the technical work was in development and thus required less in-depth knowledge than basic research. What an engineer did not know he could often learn on the job and by studying on his own. In short, engineers and scientists were relatively fungible, and it was necessary to garner their cooperation to be so by ensuring them employment security through an industrial ILM subsystem.

Firms also faced in this environment fairly high skill specificity on the part of their R&D personnel. The value of an employee increased with increased knowledge concerning the firm. It was the knowledge of people, systems, corporate strategies, corporate culture, and procedures which enabled these employees to successfully carry out the wide variety of jobs they would hold during their career in the firm. This firm specific knowledge aided in the communication with other parts of the firm. But it also provided the possibility of opportunistic behavior on the part of employees, which could be overcome by internalizing the employment relationship. Once internalized, the problem of effort to perform was also overcome as the employee's interests were tied to those of the firm's in a long-term manner, which helped to ensure that sufficient effort was put forth to achieve adequate job performance (Aoki, 1987).

From the R&D engineer or scientist's point of view, an industrial ILM employment relationship was acceptable in this type of environment. In exchange for allowing the firm

to choose the exact future behavior it wanted from him, the engineer received employment security. Simple job security, however, was not a sufficient benefit even in the economically insecure 1950's when the system became entrenched. An engineer could ensure returns on his educational investment in this kind of employment relationship. The nature of adaptive technology meant that the engineer could be relatively sure that if he put in sufficient effort he could perform satisfactorily. He would be aware that his fungibility within R&D would mean that eventually his usefulness would diminish as the technology of the firm continued to advance and perhaps even change direction. However, such short-lived R&D usefulness was not a threat since his potential for management was developed by the firm, thus ensuring him a place elsewhere in the firm once his tenure in R&D was over. The combination of seniority and satisfactory performance would lead to promotion, and since rewards accrued to positions, the engineer would recover his educational investment over the span of the contract (Takagi, 1984).

In addition, the relative lack of alternative employment opportunities further encouraged the engineer to accept this employment arrangement. "This practice [of ILMs] particularly if it is followed by other enterprises to which the workers might otherwise turn for upgrading opportunities, ties the interests of the workers to the firm in a continuing way" (Williamson, 1975: 77). Finally, the perceived greater stability and growth potential of large firms made them attractive, and hence able to attract the top engineering and science graduates.

Thus the relative certainty about his ability to perform his job both within and without of R&D assured the R&D engineer that he could capture gains through seniority and promotion. This made an industrial ILM type of employment relationship attractive during the adaptive technological phase of Japan's post-war economic growth. What empirical evidence exists for this conclusion?

3.6 Empirical Studies of the Management of Japanese R&D Engineers and Scientists

There are three main studies in English concerning the management of engineers and R&D personnel in Japanese firms. All three confirm that the industrial ILM employment relationship was chosen by Japanese firms, and that an appropriate set of HRM practices for an industrial ILM subsystem was used.

Takagi's (1985) work was carried out in one firm which makes small electric appliances and lighting goods. His research was based on interviews, questionnaires, and the examination of personnel records. His subjects were twenty-seven engineers, not all of whom had worked in the R&D section. Takagi focused on the career development of his subjects, and tried to establish the sequence of jobs within the firm each had held. In addition, his study examined how the respondents had been motivated to perform their tasks in each job.

Some of Takagi's major findings can be summarized as follows. All engineers were hired as fresh college graduates. Assignment to R&D or any other job was based on company needs and did not take into much consideration the engineers' desires, such as interest in a particular technological area. Project topics were mostly assigned by the section manager although sometimes ideas were suggested by the engineer himself. Transfers were fairly common and frequent, occurring approximately every three to four years. These transfers "...often took engineers to jobs that required technological skills and knowledge out of their specialization fields...engineers had to master the new task competencies as quickly as possible after each transfer" (Takagi; 1985: 49). Results of performance evaluations were not communicated to the engineers, except indirectly through small differences in bonus or salary. This is understandable given that merit was not a criterion for reward. The results confirmed that Japanese engineers as "...hired not to fill

immediate, specific job slots but as a pool of resources to be shared in the organization and used as needed" (Takagi, 1985: 39).

Sakakibara and Westney (1985) examined only R&D engineers in six computer firms, three of them Japanese firms: Toshiba, NEC, and Fujitsu.
They had ninety-eight Japanese subjects, and performed interviews in addition to distributing questionnaires. Sakakibara and Westney's study confirmed Takagi's findings regarding the locus of responsibility for career development and the manner in which R&D engineers are managed. In addition, they found that engineers were expected to move into management positions eventually, and consequently were put through the same standardized training as that for managerial recruits. A great deal of on-going training was given to the engineers. The daily tasks of R&D engineers were "...less specialized than those of their U.S. counterparts" (Sakakibara and Westney, 1985: 21). Rewards accrued to positions rather than to individuals, thus making promotion more desirable than for U.S. engineers. Seniority seemed to be the main determinant of level of reward, as "...there is (so) little variation in salary or promotion rates to provide concrete indicators of how well one is doing" (Sakakibara and Westney, 1985: 23). The Japanese engineers felt that the presence of a dual career ladder (technical and managerial) was somewhat of a sham, and than in fact upward mobility meant moving into management. Finally, Japanese engineers did not see technical mastery as important for effective managerial performance as did their U.S. counterparts (Sakakibara and Westney, 1985: 25).

The third major study in this area was performed by Lynn, Piehler, and Zahray (1988). This comparative study of the careers of Japanese and U.S. engineers lends further support to the Takagi and the Sakakibara and Westney studies. The research covered 673 engineering graduates who received B.S. degrees between 1950 and 1987, the time when the research was conducted, from Tohoku University in Japan, as well as

respondents from Carnegie-Mellon in the U.S. Concerning who makes decisions about intrafirm mobility, nearly 70% of the Japanese engineers reported that their firm decided, while only 12.4% of the Americans replied in this way (Lynn and Zahray, 1988:29). Support was also found for provision of more training to prepare Japanese engineers for new positions than is provided to U.S. engineers.. This training was usually under the control of the firm rather than the individual engineer, as in the U.S. Furthermore, it was found that more Japanese engineers make a permanent move into management by their forties than the Americans. Finally, Japanese engineers are much more likely to have been assigned to work outside their area of functional specialty than the Americans (Lynn, Piehler, and Zahray, 1988: 43).

A very significant finding for the present research is that nearly half the Japanese engineers in the Lynn, Piehler and Zahray (1988) study had been sent to research/design/development sections for training, while fewer than 17% of the Americans had. This is consistent with the Japanese approach to management in an incremental innovation environment. By exposing half of the technical personnel in the firm to the R&D function before deploying them elsewhere in the firm, the communication between the marketing and production areas and R&D is facilitated. Knowledge about new technology can flow easily into other parts of the firm both through the transfer of the engineers themselves and because of the existence of a contact network built up between the R&D lab and other areas. At the same time knowledge about the market and the production area can flow backward to the R&D lab.

To summarize, Japanese firms during the catch-up period adopted employment practices characteristic of industrial ILMS vis a vis their R&D personnel because these were most suitable for the kind of technological environment they faced. That the firms actually adopted these practices has been confirmed by empirical research. The practices are:

lifetime employment; seniority based wage increases; rewards accruing to job or position rather than to individuals; control of career by the corporation rather than by the individual; extensive post-hiring training often concentrating on managerial skills; frequent transfers; and unclear performance evaluation standards and feedback.

3.7 Predicted Changes in Management of Japanese R&D Engineers and Scientists

Industrial ILM employment practices were appropriate in managing R&D personnel in an adaptive technological environment. However, as Japan moves into an innovative technological environment, will these same practices be useful? How must management practices change? Can Japanese R&D engineers produce radical innovations if they are managed using industrial ILM employment practices? This study posits that they cannot, and that in fact these practices will become barriers to success. This viewpoint can be understood within the transaction costs analytic framework.

While incremental manufacturing and product innovations are aided by information flow and coordination between all parts of the organization, innovative technology requires greater concentration of firm resources on the creation of new knowledge and totally new products (Sakakibara and Westney, 1985). Thus communication between the production division and the R&D laboratory, for example, takes second place to communication of R&D personnel with the technical environment outside the firm.

The management of the R&D function in a firm facing an innovative technological environment is particularly affected. Since radical innovations are likely to come from anyone in the R&D laboratory, design features such as hierarchy can be inhibiting. It has been suggested that an organic organizational structure is most appropriate for innovative technology (Hull, Hage, and Azumi, 1984). In an innovative technological environment, R&D engineers and scientists are required to produce radical innovations. The results cannot be predicted. Inspiration is apt to be born from the combination of two things:

extensive knowledge of a technological area, including leading-edge developments, and a certain amount of chaos that helps the engineer challenge basic assumptions or seemingly logical relationships (Hanke and Saxberg, 1985). "Stability is not necessarily conductive (sic) to innovation..." (Sakakibara and Westney, 1985: 34).

There are several aspects of this type of R&D that stand out. First, external communication with the relevant professional community acquires a great deal of importance. There is a need for a great deal of 'domain-specific' knowledge, which is most likely to be garnered through contact with other experts (Amabile, 1983). Second, the need for engineers to possess a high level of expertise in a particular technology mitigates against frequent transfers which require 'dropping' one technological area and picking up another (Takagi, 1985). Third, behavior that aids teamwork and harmony leading to maximum communication with diverse people becomes less important, while eccentric behavior and individual thinking become more valuable (Amabile, 1983; Shannon, 1981; Sakakibara and Westney, 1985; Hanke and Saxberg, 1985). "...(C)reactive personnel are not conformist, have strong individual core values, and are not loyal to the organization" (Kono, 1988: 109).

From the firm's point of view, what kind of employment contract will be most suitable to managing R&D engineers and scientists involved in creating radical innovations? Basically, a craft ILM employment relationship seems most suitable. This allows for more ports of entry, hiring of specialized personnel, and easier termination of employment relationships. The reason such an employment contract becomes more preferable lies in the kind of person the firm has to hire.

R&D engineers and scientists who are able to produce radical innovations and who have a deep knowledge of a particular subject must be more cosmopolitan (Gouldner, 1957: Badawy, 1988; Sakakibara and Westney, 1985). . A cosmopolitan outlook in this

context refers to a professional who identifies primarily with his discipline and professional community rather than with the place where he works. The standards and goals of his professional discipline will be more highly valued than those of the firm. Such a person is more likely to see the organization as "...a vehicle of professional advancement" (Saxberg and Slocum, 1968: B481). A local orientation, on the other hand, is when a professional identifies more with his immediate employer. A local orientation is obviously preferable if an engineer is to be transferred frequently within the firm and expected to direct his skills and knowledge towards whatever task the firm requires (Sakakibara and Westney, 1985). Cosmopolitan R&D engineers are required when the firm needs radical innovations because only they are likely to possess the depth of knowledge needed and are likely to resent transfers which destroy their competency in a special area (Shannon, 1981). These types of engineers are really scientists rather than engineers (Kerr, and Von Glinow, 1977).

With regard to the skills needed to do their jobs, these people require skills and knowledge which are more discipline specific than firm specific (Kono,1988). That is, in order to do his job well, a radical innovator has more need of knowledge pertaining to his area of expertise than to his company, since many of his ideas and advances in knowledge come not from customers, suppliers, or production, which often serve as sources of innovations (von Hippel, 1988), but from advances in the field made by scientists outside the firm (Badawy, 1988). Thus there is a drop in skill specificity, or to put it in opposite terms, a rise in skill generalizability. This research posits that this drop in skill specificity leads to a loss of monopoly power, and decreases the firm's incentive to offer a long-term contract in order to decrease opportunistic behavior.

In addition, a transaction costs analysis leads to the conclusion that the firm also experiences changes in the certainty regarding the R&D engineer or scientist's ability to do his job. Actual effort to do the job well is probably not much of an issue as this motivation

to perform comes from the employee's professional values and his desire to build a marketable professional reputation (Kono, 1988; Pelz and Andrews, 1976). The firm has higher confidence in the specialist's ability to be valuable in R&D over the long term than it does for the incremental innovator since the former's technical knowledge is deep (Kono, 1989). Thus it is possible for the specialist to keep pace with technical advances since he is not switching technical areas frequently. This certainty about the employee's long-term usefulness in R&D is tempered somewhat by a concern over his usefulness to the firm should the technological direction of the firm change drastically. For example, what would a steel firm that tried to diversify into semiconductors do with a specialist in the area if it was decided at some point that semiconductors was an unprofitable direction to continue to pursue? At the same time, the firm has less confidence in the flexibility of the specialist to make significant job shifts to areas outside of R&D.

In short, the value of a specialist lies not in his fungibility but rather in his contributions in a particular technological area within R&D. Having been hired for his skills and knowledge instead of his managerial potential and flexibility, there is less certainty about his ability to make the transition to another part of the firm. This decreases the flexible control of the firm, which in turn decreases its desire to institute a long-term contract which locks it into employing a person whom it cannot easily re-deploy to other jobs within the firm (Mosk, 1989).

The R&D specialist also perceives greater certainty about his ability to function over the long term in the R&D lab compared to the incremental innovator. His confidence comes from the possession of deep knowledge and specialized R&D skills that enable him to keep pace with advances in his field and thus continue to contribute to the R&D of his company. This higher confidence in his ability to be useful in R&D is matched by his

lower confidence in his ability to work in non-R&D positions, which leads him to be less willing to be transferred outside R&D or into management (Kono, 1988).

The specialist's lack of confidence in his non-R&D skills lowers his belief that effort will result in satisfactory performance and rewards outside of his specialized area. Furthermore, it is only by staying in R&D that he can continue to develop his special technical expertise which gives him market power. At the same time, his increased monopoly power, combined with the possibility of termination should the technological direction of the firm change, makes him more likely to demand an employment contract in which rewards are not deferred. The desirability of a more externalized employment contract under which the specialist can receive greater payment for present performance and skills is increased.

In conclusion, for both the firm and the R&D specialist working in an innovative technological environment, the industrial ILM employment relationship has become less attractive. An innovative technological environment has produced changes in the kind of individual firms need, and in their skill specificity and behavioral uncertainty.

What type of HRM policies are likely to accompany a shift toward a craft ILM subsystem to govern the employment relationship between firm and R&D personnel? First, the 'lifetime' commitment between firm and employee is likely to be weakened as the firm becomes more willing to hire specialists with prior work experience, and as specialists become more willing to change employment in order to better their work conditions. This may result in more of a 'half-lifetime employment' commitment (Rumblings in the Workplace,1988). Promotion and compensation systems will emphasize the criterion of performance more than seniority, both because the firm is more concerned with present output than with the future potential of the employee, and because the employee is more concerned with recognition of present performance (Dyer, 1981). "In Japanese

corporations, ...to encourage creative activity, it is necessary to promote faster and to pay more those who have creative abilities, instead of regulating promotion and pay by length of service" (Kono, 1988:136). The research specialist also becomes more involved in management of his own career, particularly with regard to the projects to which he is assigned (Kono, 1988b). This control is necessary in order to ensure that he can continue to deepen his technical knowledge and thus maintain his marketability to other firms. The amount of training provided by the firm decreases as the returns on this investment become less certain (Becker, 1964). At the same time, the content of the training provided becomes more focused on enhancing the present research productivity of the employee and less concentrated on developing his managerial skills and knowledge. The number of transfers between projects decreases, as well as the number of transfers to areas outside of the R&D laboratory. Finally, the performance appraisal system becomes more standardized, objective, focused on research results, rather than on product development or communication with customers and suppliers. Emphasis is placed on results that reflect research contributions such as conference papers or journal publications (Kanai, 1987).

3.8 Conclusion

This chapter has traced the history of scholarship concerning the origin of Japanese ILMs, and showed that there is a place within this stream of research for an economic approach to studying the area. In particular, the ability of transaction costs theory to connect the firm's external and internal environments provides a way to make a valuable analytical contribution. This chapter then provided an example of this connection which revolves around the subject group used in this research, Japanese R&D engineers and scientists. The following chapter will draw on the ideas elaborated here to develop a set of testable hypotheses concerning the management of R&D engineers and scientists in Japan.

CHAPTER FOUR

HYPOTHESES

4.1 Hypotheses

Based on the theoretical analysis of the employment relationship in Japan developed in Chapters Two and Three, fourteen hypotheses were developed. The model presented in Chapter Two is reproduced in Figure 4.1 at the end of this chapter. To this model has been added the hypotheses for the connections between the different parts of the model.

Transaction costs theory suggests that the technological environment can be a major influence on the job task of a corporate researcher, a view which Osterman's (1984b) analysis also supports. That is, the technological environment surrounding a firm can be extremely uncertain because of the newness and frontier-nature of the technology upon which the industry is based. In addition, products change often, and major technological breakthroughs are expected and lead to industry shake-ups. The general environment is also very turbulent. Due to these uncertainties, the radicalness of the R&D task increases. This leads to the first hypothesis:

Hypothesis 1.0. Technological, product, and general environmental changes will be positively related to the level of radicalness of the core R&D job.

Transaction costs theory further suggests that the type of task to be carried out by an individual will influence the degree to which she needs knowledge and skills specific to the corporation in which she works. For a researcher whose task is becoming more radical, it is argued that there is more need for skills and knowledge specialized to her field or discipline rather than to the firm. This is because the task of producing radical innovations requires a deep knowledge of a field in contrast to the more general research skills and knowledge which an incremental innovator possesses. These types of skills can

be used independently of the specific firm in which the researcher works, and hence are generalizable. The second hypothesis is:

Hypothesis 2.0: The radicalness of the core R&D job will be positively related to the level of job generalizability.

As discussed in Chapter 2, Williamson specifies that the transaction costs surrounding the behavior of the employee mostly focuses on whether the employee will put forth the required effort. In this study, it is argued that the radical innovators have increased confidence in their ability to work in R&D (i.e. increased ability certainty) compared to incremental innovators. At the same time, radical innovators have less confidence in their ability to work in non-R&D areas, and hence less willingness to do so (i.e. decreased willingness certainty). This leads to two further hypotheses:

Hypothesis 3.0: The radicalness of the core R&D job will be positively related to the level of ability certainty.

Hypothesis 4.0: The radicalness of the core R&D job will be negatively related to the level of willingness certainty.

The transaction costs of a relationship will affect the decision of whether to internalize the relationship or not. In general, higher levels of job generalizability will lead to pressures to externalize a relationship. Moreover, it has been argued that the transaction cost of ability certainty can lead to a pressure to externalize the employment relationship. This is because the skills of the researcher are specialized to only one area of the firm, the R&D laboratory, thus making it difficult to utilize the individual in other parts of the firm.

Thus the firm becomes less willing to undertake the long-term commitment to the employee that an internalized transaction entails. At the same time, the employee's willingness to be transferred to other parts of the firm decreases. In sum, the changes in the transaction costs of job generalizability, ability certainty, and willingness certainty will lead to the use of employment practices that are more typical of externalized employment contracts, as discussed in Chapters Two and Three. The remaining hypotheses center on the changes in human resource management practices that are predicted to accompany the changes in transaction costs of the employment relationship.

There is a general model for these remaining hypotheses of a positive relationship between the transaction costs of job generalizability and ability certainty and the use of each HRM practice, with willingness certainty having a negative relationship. Only Hypotheses 6.0 and 11.0 run counter to this model.

The first HRM practice to be studied is the selection of new employees to work in the R&D laboratory. As described in Chapter Three, the practice in Japan has been for a professor to play the role of placement officer, often with little consideration for the wishes of the recruit. It is proposed that as more college graduates are hired for their specialized knowledge and skills they will want to become more active in choosing the place of their employment in order to maximize the return on their investment. In short, they will insist on greater freedom to choose the company they want to work for.

Hypothesis 5.0: Job generalizability and ability certainty will be positively related to the level of freedom to choose a company. Willingness certainty will be negatively related to levels of freedom to choose a company.

The second HRM practice to be studied is the length of the initial training provided to new recruits. In the post-war period in particular, it has been common to offer extensive training to new recruits that exposes them to all aspects of the business as well as socializes them so that they form a cohesive sense of group. This facilitates their job performance throughout their long careers in the company. However, it is proposed that as recruits are sought for their present specialized research skills and knowledge, less extensive training will be provided as it is not as necessary to carrying out their jobs either now or in the future.

Hypothesis 6.0: Job generalizability and ability certainty will be negatively related to length of initial training. Willingness certainty will be positively related to length of initial training.

In addition to providing a less extensive training period, it is proposed that the initial training provided to new recruits will be more focused, emphasizing content which is directly applicable to their jobs in the R&D laboratory. Subsequent training will also be more focused on improving research knowledge and skills because these employees are seen as spending their careers mostly within the R&D area.

Hypothesis 7.0: Job generalizability and ability certainty will be positively related to the research orientation of initial training. Willingness certainty will be negatively related to the research orientation of initial training.

Hypothesis 8.0: Job generalizability and ability certainty will be positively related to the research orientation of ongoing training. Willingness certainty will be negatively related to the research orientation of ongoing training.

As firms hire employees for their specialized knowledge, those with skills that are more uncommon will be able to command a higher wage. In addition, firms will need to reward excellent performance by these employees in order to motivate them to continue using their expertise as effectively as possible. As a consequence, greater differentiation in salary will be found between recruits hired at the same time.

Hypothesis 9.0: Job generalizability and ability certainty will be positively related to the level of salary differentiation. Willingness certainty will be negatively related to the level of salary differentiation.

It will become necessary to motivate specialists who are performing well to continue their high performance by rewarding them with faster promotions and significant salary increases. In order to provide this greater individualization in promotion and salary decisions, the basis of such decisions will shift from the predominant emphasis on seniority to an emphasis on individual results and performance.

Hypothesis 10.0: Job generalizability and ability certainty will be positively related to the use of performance and research results as criteria in promotion and salary decisions. Willingness certainty will be negatively related to the use of performance and research results as criteria in promotion and salary decisions.

As a consequence of the greater use of individual results and performance as the basis for salary and promotion decisions, firms will find it necessary make the performance appraisal of employees more objective in order to ensure a sense of equity.

When the basis of such decisions was mostly determined by seniority, greater subjectivity of performance was of less concern to employees.

Hypothesis 11.0: Job generalizability and ability certainty will be negatively related to the subjectivity of the performance appraisal. Willingness certainty will be positively related to the subjectivity of the performance appraisal.

In addition to influencing the objectivity of the performance appraisal system, the content of the performance appraisal will be changed. Greater emphasis will be given to individual results, particularly research results such as published papers or conference presentations, as these are more indicative of successful achievement of the core R&D task of producing radical innovations than such criterion as the ability to get along with people.

Hypothesis 12.0: Job generalizability and ability certainty will be positively related to the use of research results as the main criterion in performance appraisal. Willingness certainty will be negatively related to the use of research results as the main criterion in performance appraisal.

As firms hire more specialists to carry out the R&D work, it will become more difficult to find a use for such individuals within other parts of the firm. In addition, the specialists themselves, seeing their individual skills and knowledge as saleable goods on an external market, will not be very willing to undertake jobs outside of R&D. Consequently, a greater need for a strong dual career path will be felt.

Hypothesis 13.0: Job generalizability and ability certainty will be positively related to separation of career paths for technical and administrative personnel. Willingness

certainty will be negatively related to separation of career paths for technical and administrative personnel.

Finally, specialists will feel that because their skills and knowledge are potentially utilizable in other firms should they become dissatisfied with their present jobs, they will want to continue within one speciality and deepen their skills and knowledge. Hence they will feel a need to have greater control over their careers, particularly over the kind of research projects to which they are assigned.

Hypothesis 14.0: Job generalizability and ability certainty will be positively related to the level of career management control by the researcher. Willingness certainty will be negatively related to the level of career management control by the researcher.

Appendix F presents the model and hypothesized linkages. Table 4.1 presents the hypothesized relationships with the expected signs. Chapter Five describes the research approach employed to test the hypotheses, while Chapter Six is a description of the research results.

TABLE 4.1

HYPOTHESIZED RELATIONSHIPS AND EXPECTED SIGNS

	RCJ*	JG	AC	WC	FCC	LIT	ROIT	ROOT	SD	RSPD	SPA	BPA	SCP	CMC
TC	+													
PC	+													
GEC	+													
RCJ		+	+	-										
JG					+	-	+	+	+	+	-	+	+	+
AC					+	-	+	+	+	+	-	+	+	+
WC					-	+	-	-	-	-	+	-	+	+

*EXPLANATIONS OF ABBREVIATIONS ARE GIVEN ON NEXT PAGE

TABLE 4.1 CONTINUED

EXPLANATIONS OF ABBREVIATIONS USED IN TABLE 4.1

TC	=	TECHNOLOGICAL CHANGES
PC	=	PRODUCT CHANGES
GEC	=	GENERAL ENVIRONMENTAL CHANGES
RCJ	=	RADICALNESS OF CORE R&D JOB
FCC	=	FREEDOM TO CHOOSE COMPANY
LIT	=	LENGTH OF INITIAL TRAINING
ROIT	=	RESEARCH ORIENTATION OF INITIAL TRAINING
ROOT	=	RESEARCH ORIENTATION OF ONGOING TRAINING
SD	=	SALARY DIFFERENTIATION
RSPD	=	RESULTS IN SALARY AND PROMOTION DECISIONS
SPA	=	SUBJECTIVITY OF PERFORMANCE APPRAISAL
BPA	=	BASIS OF PERFORMANCE APPRAISAL
SCP	=	SEPARATION OF CAREER PATHS
CMC	=	CAREER MANAGEMENT CONTROL

CHAPTER FIVE
RESEARCH METHODS

5.1 Research Approach

The central foci of the theoretical model, developed in this study, is the transaction costs of the employment relationship. As discussed previously, there has been very little empirical work on this concept. One reason for this paucity of research could be the difficulty of operationalizing the concept of transaction costs. The precise manner in which transaction costs manifest themselves may depend on the kind of employee and job involved in the employment relationship. Thus one of the first tasks facing the researcher was to determine how the transaction costs of the employment relationship could be operationalized. The resolution of this problem is presented in the questionnaire development section.

A second challenge was to determine how best to capture sufficient variance in the transaction costs of the employment relationship such that related variance in HRM practices could be ascertained (Mohr, 1982). Drawing data from a wide variety of firms was felt to be the best approach to providing sufficient variance in the transaction costs of the employment relationship. Consequently, a survey design, which permits this wide casting of the measurement net, was chosen.

Finally, the research approached the employment relationship as a contract between the firm and each individual employee. It is assumed that while there are organizational constraints on the employment contract negotiated with each employee, as employment relationships are externalized the market valuation of the employee, which is idiosyncratic, leads to greater individual tailoring of contracts. Since the research is concerned with the movement of the employment relationship from internal to external labor markets, it was determined that an individual level of analysis was most appropriate.

The remaining sections of this chapter present the sample, data collection, and the research methods utilized to test the hypothesized relationships.

5.2 Sample

The sample of 540 researchers and R&D managers were drawn from 17 business units in Japanese firms picked from a variety of industries. Table 5.1 is a summary of the main characteristics of the participating firms. All the participating firms are considered major corporations in Japan with the exception of Hayashibara. However, Hayashibara is a well-known firm in its field and is considered an extremely innovative company. Only one of the firms contacted, a large automobile firm, declined to participate.

TABLE 5.1
FIRM CHARACTERISTICS

FIRM	NUMBER OF EMPLOYEES	MAIN PRODUCTS
CANON	35,498	cameras, business machines, optical products
HAYASHIBARA GROUP	1,404	food ingredients & additives, pharmaceutical and chemical materials, reagents & diagnostics, photosensitizing dyes, consumer products
HITACHI	77,741	power systems & equipment, consumer products, information & communication systems and electronic devices, industrial machinery and plants, wire & cables, metals, chemicals
KYOCERA	12,034	fine ceramics, communication equipment, optical equipment
KAO	6,697	personal care products, laundrycleansing products, hygiene products, chemical products
KYOWA HAKKO	5,226	pharmaceuticals, chemicals,fertilizers, foodstuffs, alcoholic spirits, sake
MATSUSHITA	134,186	video equipment, audio equipment, home appliances, communication & industrial equipment,

TABLE 5.1 CONTINUED

		energy & kitchen-related products, electronic components
MITSUBISHI ELECTRIC	73,536	space development, communication & information-processing systems, electronic devices, energy, transportation, building equipment & systems, industrial equipment, home electronics
NEC	101,227	switching equipment, transmission & terminals equipment, radio products, information processing equipment, semiconductors, electronic components, home electronics
NTT	298,000	telecommunications services & related businesses (telex, telegrams, etc.)
NIPPON STEEL	61,423	steelmaking, titanium, engineering & construction, new materials, electronics & information communications, bio-technology
SONY	44,908	video equipment, televisions, audio equipment
SUMITOMO METALS-(OLD & NEW)	25,620	steel products, engineering, titanium, electronics, chemicals and energy, new materials, information equipment and services
SUNTORY	N.A.	distilled spirits, beer, wine, pharmaceuticals, foods & non-alcoholic beverages
TORAY	10,143	fibers & textiles, plastics, chemicals, engineering & construction
TOSHIBA	71,404	datacommunications systems, electronic devices, heavy electric machinery, consumer electronics

The diversity of firms was targeted at two issues. One was to provide a sufficient diversity of employment relationships such that the required variance in transaction costs could be provided. Second, the variety of firms targeted the issue of generalizability of research results.

5.3 Special Problems of Obtaining the Sample

While the selection of the firms participating in this study attempted to provide businesses in a wide variety of industries, to some degree the selection was determined by the personal contacts the researcher had developed.

The firms were contacted in a variety of ways depending on the nature of the researcher's relationship with the firm. For instance, the researcher had previously worked in the central research laboratory at Sumitomo Metal Industries, and was able to contact personnel both at the laboratory and at the head office directly. Other methods used to contact the firms included letters of introduction from the head of an engineering department at the researcher's home educational institution; telephone calls and letters of introduction from Japanese professors at the researcher's institution of affiliation in Japan; chance meetings of employees of firms at various social events and conferences in Tokyo; and contacting former Japanese MBA students from the reseacher's home institution who had returned to Japan.

5.4 Data Collection

To test the hypothesized relationships a research design was chosen which utilized a survey instrument as the main approach. In addition to the reasons discussed at the beginning of this chapter for choosing a survey design, this approach was deemed appropriate because the phenomena of interest, the transaction costs and human resource management (HRM) practices of various employment relationships, are best observed in the real world. Furthermore, a survey permitted the accumulation of information concerning a large population, one of the significant advantages of survey research. The survey data was used for testing the hypotheses.

To highlight the data gathered by the survey method, a field research approach was also utilized. This data aided in the interpretation of the results from the survey research phase rather than serving as a separate test of the hypothesized relationships.

The individual first contacted in the firm was usually a middle to upper level manager, most often in either the personnel department or the research laboratory. After an initial explanation of the project was given verbally to the contact, a packet of materials was sent to provide greater detail. This included a ten-page summary of the dissertation proposal; a one page description of the exact nature of the requested participation; and a copy of the cover letter and questionnaire to be used in the project. Often the contact person had to obtain higher level authorization before agreeing to participate.

Each participating firm was requested to pass out the questionnaire to R&D engineers and scientists working in the firm's most fundamental research areas. The decision of which research the firm considered most fundamental was left up to each firm. Each firm was requested to find thirty R&D engineers and scientists and two R&D managers to volunteer to participate. The participants were guaranteed anonymity in a cover letter and questionnaires were not distinguished from each other in any way (i.e. by numbering). While most firms were able to find the requested number of participants, some provided fewer and two provided more than the requested number. Table 5.2 summarizes the number and kinds of participants from each firm.

TABLE 5.2

NUMBER AND KINDS OF QUESTIONNAIRE RESPONDENTS PER FIRM

FIRM	RESEARCHERS	R&D MANAGERS
CANON	30	2
HAYASHIBARA	30	2
HITACHI	34	2
KAO	30	2
KYOCERA	37	6
KYOWA HAKKO	28	2
MATSUSHITA ELEC.	28	3
MITSUBISHI ELEC.	30	2
NEC	30	3
NTT	23	1
NIPPON STEEL	30	2
SUMITOMO STEEL-OLD	30	0
SUMITOMO STEEL-NEW	30	10
SONY	32	0
SUNTORY	29	2
TORAY	28	1
TOSHIBA	29	2
TOTAL	508	42

The R&D managers surveyed at Sumitomo Metals-New and Sumitomo Metals-Steel did not designate on their questionnaires which part of the organization they belonged to, and hence all were categorized as Sumitomo-Steel R&D managers.

After completing the questionnaire, each respondent returned it to a central contact person in the firm. This person delivered the packet of questionnaires to the researcher either through the mail or in person when the researcher went to the research laboratory to conduct the interviews.

A total of 89 interviews were conducted with researchers and R&D managers who had completed the survey instrument. Upon receipt of the completed questionnaires, the researcher arranged for interviews with a subset of the respondents. While 45 minute interviews with five of the researchers and one of the R&D managers was requested, the number of interviews granted varied widely. Table 5.3 summarizes the number and type of interviews carried out at each firm. The selection of the interviewees was left up to each firm, and the interviews were carried out at the research laboratory of each firm. The researcher took brief notes during the interviews and taped each one if permission was granted by the interviewee. More extensive notes were written up as soon after each interview as possible, usually the next day.

TABLE 5.3
INTERVIEWS: CHARACTERISTICS

Firm	Number of Researchers Interviewed	Number of Managers Interviewed	Approximate Length of Interview
Canon	5	1	45 min.
Hayashibara	4	1	40 min.
Hitachi	4	1	45 min.
Kao	5	1	45 min.
Kyowa Hakko	5	1	30 min.
Matsushita	4	0	45 min.
Mitsubishi Elec.	5	1	45 min.
NEC	3	0	45 min.
NTT	4	0	35 min.
Nippon Steel	5	1	45 min.
Sumitomo-Old	5	0	45 min.
Sumitomo-New	6	1	45 min.
Sony	3	2	45 min.
Suntory	6	1	45 min.
Toray	6	2	45 min.
Toshiba	4	2	30 min.
TOTAL	74	15	

5.5 PROCEDURE

5.5.1 QUESTIONNAIRE CONSTRUCTION

A questionnaire was developed to collect data related to the various constructs in the model. These measures are outlined in Table 5.4 and are drawn from the questionnaire in Appendix A. The questionnaire item number is listed next to each measure in Table 5.4 for reference. For example, 2.6 refers to question 6 of Section 2 of the questionnaire. The questionnaire was designed to collect data concerning environmental changes, core R&D job, job generalizability, ability certainty, willingness certainty, and HRM practices (see Appendix B for an English translation).

TABLE 5.4

MEASURES

Variable	Measure
Environmental Changes	
1. General	Changing marketing strategy (Marketing) (5.9) Fast product obsolescence (Product ob.) (5.10) Unpredictable competitor behavior (Competitor) (5.11) Unpredictable consumer behavior (Consumer) (5.12) Frequent changes in production format (Production) (5.13)
2. Technological Changes	Frequent technological innovations (Innovations) (5.5) Large number of breakthroughs expected (Breakthroughs) (5.6)
3. Product Changes	Sales of newly developed products < 1% (Sales < 1%) (5.7) Sales of newly developed products > 5% (Sales > 5%) (5.8)
Core R&D Job	
1. Basic Research	Create incremental innovations (Incremental) (4.10) Create radical innovations (Radical) (4.13)

TABLE 5.4 CONTINUED

	Basic research - product development scale (B-D scale) (4.24)
	Lab members seldom understand his research (Understand) (4.2)
	Focus on solutions to rather easy technical problems (Easy) (4.4)
	Knows exactly order in which to proceed in research (Proceed) (4.9)
2. Impact of R&D	Think up important technological innovations (Think up) (4.1)
	Create breakthroughs that change the flow of technology (Flow) (4.7)
	Create technology that leads to new markets (Markets) (4.3)
	Research results strongly impact company (Impact) (4.8)
Job Generalizability	Could use technological know-how in another company (Know-how) (3.2)
	Expert knowledge is valid in another company (Expert) (3.4)
	Could use knowhow as is in another company (Company) (3.3)
	Could become 100% effective quickly in another company (100%) (3.7)
Ability Certainty	Present expertise useful to company in next 5 years (5 years) (2.2)
	Expert knowledge useful to company in next 10 years (10 years) (2.4)
	Research knowledge is of constant use to company (Constant) (2.1)
	Can create technological innovations that company needs (Needs) (2.5)
	Can repeat research success in future (Repeat) (2.6)
Willingness Certainty	Doesn't mind transfer to production (Transfer) (2.18)
	Doesn't mind non-R&D management position (Non-R&D) (2.16)
	Can move smoothly to non-R&D job (Move) (2.14)
	Is willing to do any assigned work (Willing) (2.20)
	Doesn't begrudge doing work outside assigned area (Begrudge) (2.19)

TABLE 5.4 CONTINUED

Selection Criterion	Selection of company greatly influenced by professor (1.8)
Initial Training Length	Length of initial training (in weeks) (1.13)
Type of Initial Training	Same as that received by non-technical track employees (Same) (1.14) Focused on research-related knowledge (I-Research) (1.15)
Type of Ongoing Training	Training taken at own volition (Volition) (1.16) Training is research related (O-Research) (1.17) Training is mostly taken outside company (Outside) (1.18) Attends conferences in own specialist field (Specialist) (1.19)
Salary Differentiation	Initial salary higher than for others (Initial) (1.12) Present salary higher than for others (Present) (1.24)
Promotion and Salary Criteria	Salary raises mostly due to performance (Raises) (1.25) Salaries of researchers due mostly to performance (Perform) (2.25e) Salary only determined by continuous years of service (Years) (1.27) R&D results important in promotion decisions (Results) (1.30) Age important in promotion (Age) (1.28) Promotion necessary for salary increase (Promotion) (1.31)
Performance Appraisal - Subjectivity	Performance appraisal based on boss' subjective evaluation (2.25b)
Performance Appraisal - Basis	Performance appraisal based on researcher's research results (2.8)

TABLE 5.4 CONTINUED

Career Management Control	Can choose technological conferences (Conferences) (1.20)
	Can choose research projects (Projects) (1.21)
	Wishes taken into consideration in project assignment (Wishes) (1.23)
	Superiors decide on participation in projects (Superiors) (1.22)
Dual Career	There are sharply separated career paths for researchers and non-technical track employees (1.33)

An R&D engineer and an R&D manager at a U.S. high technology firm were consulted concerning the clarity of the items and their ability to capture the constructs of interest. After suggested improvements were made, the questionnaire was field tested by 15 R&D engineers at one local high technology firm and 12 R&D scientists at a local biotechnology firm. A feedback form provided to the respondents resulted in further modifications of items. The questionnaire was then translated into Japanese and further feedback on the clarity and appropriateness of the items was provided by the following people: the R&D director of a major Japanese firm known for its innovativeness; 2 research scientists working at the firm's central laboratory; the academic advisor to the researcher at the Japanese university with which she was affiliated while in Japan; a graduate student in business administration at the same Japanese university; and a mid-level personnel manager of a very large Japanese company. Each person provided suggestions on how to phrase items to make them more comprehensible to the Japanese respondents. Towards the end of this process two of the firms participating in the study insisted on immediate receipt of the questionnaire and were sent the almost finalized version. The final version of the questionnaire, which was developed shortly afterward, differed only in some minor wording. However, items that were different between the two versions were

subjected to tests of differences after the questionnaires had been completed and returned. No significant differences due to wording between the two versions were found.

As a final check on the questionnaire a back translation was performed by a professional translator totally unfamiliar with the research. No significant differences were found between the Japanese version and the English translation.

The first construct, environmental changes, was measured by three sets of items that capture its multi-dimensional nature. The first set is a measure of general environmental changes or uncertainty taken from Miller (1983, 1986). These are items 9 to 13 of section 5. The scale from the Miller studies has been changed from a seven point to a six point scale to be consistent with the format of the other measures of the study. This measure has been validated and found to have high interrater reliability (Miller and Droge, 1986). The second set of items related to environmental change were developed from descriptions appearing in Hambrick (1983). These are items 5 and 6 in Section 5 and were written to measure how radical are the technological changes facing the firm. Finally, items 7 and 8 of section 5 were intended to measure the degree of product change the firm experiences.

The construct of core R&D job was developed based on a general literature review following the guidelines for survey measurement development outlined by Fowler (1984). The researcher first read relevant literature on radical versus incremental innovations and on the innovation process (e.g. Tushman and Anderson, 1986; Delbecq and Mills, 1985; Amabile, 1983). Based on what seemed to be the most important differences between creating radical and incremental innovations, a series of questions were developed. These were used as a basis for interviews with an American R&D manager, Japanese and American engineers, and an engineering professor with extensive experience in Japan. The

information gained was then incorporated, along with the ideas from the literature, into the questionnaire items.

Core R&D job was conceptualized as having two main dimensions. The first dimension is called impact of R&D and refers to the degree to which the researcher feels his job and the R&D function influence the performance of the firm. The items written to measure impact of R&D are items 1, 3, 7, and 8 of Section 4. The other dimension of core R&D job was the amount of basic research. As discussed previously, the increasing frontier nature of corporate research in Japan has led to calls for more basic research (Japan Economic Institute, 1989; Okimoto and Saxonhouse). The basic research component of core R&D task was seen as leading to a focus on producing radical innovations and engaging in research that is difficult for other researchers to understand. The items written to measure this dimension of core R&D task were items 2, 4, 9, 10, 13 and 24 of Section 4. Item 24 was taken from the research on management of R&D engineers and scientists from Pelz and Andrews et al. (1976). This item utilized a 5 point Likert scale as this was the way it was originally written by Pelz and Andrews. For the data analysis, the item was converted to a 6-point scale to be consistent with the other items (1 was set equal to 1.5, a 2 was set equal to 2.25, etc.)

A scale to measure the construct of job generalizability was developed. A previously developed measure of this variable (Osterman, 1984b) was valuable as an indication of how to develop this measure, but it was felt that further items could help more completely capture the construct as presented in Williamson (1975, 1986), Williamson et al. (1975), and Doeringer and Piore (1971). The central purpose of these items was to tap the degree to which R&D engineers and scientists feel their knowledge and skills are useful only in their present company versus how easily they could use them in another firm. The items written to measure this construct are 2, 3, 4, and 7 of Section 3.

Items to measure the construct of ability certainty were written by the researcher based on the analysis of the transaction costs theory presented in Chapter Two. The intent of these items was to ascertain to what degree researchers feel their knowledge and skills are only useful within the R&D section of their firm. Items 1, 2, 4, 5 and 6 of Section 2 were utilized.

Willingness certainty was measured by items 14, 16, 18, 19, and 20 of Section 2 of the questionnaire. The focus of these items is the willingness of researchers to move into positions within their firms outside of the R&D area, and their belief in their ability to do so.

The human resource management practices which were measured covered the areas of selection criteria, training length and type, salary and promotion criteria, salary differentiation, subjectivity of the performance appraisal, basis of the performance appraisal system, career management control, and career path separation. The items were developed based on the knowledge of past HRM practices used vis a vis R&D personnel in large Japanese firms as portrayed by Takagi (1986), Sakakibara and Westney (1986), and Pucik (1984). In addition, the three years of experience of the author of this study training R&D personnel in a large Japanese firm provided valuable knowledge. The items were also intended to capture changes in the HRM practices that would accompany a move toward a more externalized employment relationship as specified by such researchers as Osterman (1984b) and Kono (1988).

The selection criterion was measured by item 8 of Section 1. Japanese university professors have often been very influential in controlling the placement of their students in jobs, a practice which more cosmopolitan specialists would be expected to reject as they would want placement in companies most suited to their research interests and goals. The length of initial training was measured by item 13 of Section 1. Initial training could be

expected to shorten for specialists hired to work almost entirely in R&D, since general knowledge of the firm becomes less important for performing their jobs. Concurrently, the research knowledge content of the initial training could be expected to increase, and this was measured by items 14 and 15 of Section 1. The same could be expected of ongoing training, and this was measured by items 16, 17, 18, and 19 of Section 1. While in the past great value was placed on experience within the firm and this was rewarded through emphasis on seniority in promotion and salary decisions, specialists would be more valued for their skills and research results, leading to more of a focus on performance in such decisions. Promotion and salary criteria were measured by items 25, 27, 28, 30 and 31 of Section 1, and item 25e of Section 2. This greater emphasis on performance in salary and promotion decisions could be expected to lead to greater differentiation in salaries which was measured by items 12 and 24 of Section 1. As more research specialists are hired with the intention of working only within the R&D lab, there is a greater need for a strong dual career path system to maintain a sense of equity. This was measured by item 33 of Section 1. In the past the performance appraisal process has been rather subjective, relying to a large degree on the opinions and perceptions of the researcher's supervisor. Specialists would be expected to demand more objective measures such as number of papers published to ensure accuracy in the evaluation of research results which affect promotion and salary decisions. Subjectivity of performance appraisal was measured by item 25b of Section 2. Finally, the basis of the performance appraisal could be expected to move more towards research results, and this was measured by item 8 of Section 2.

All the items used a 6 point Likert scale except item 13 of Section 1, which measured length of training in number of weeks, and item 24 of Section 3. A 6 point scale was used to force respondents away from choosing a neutral mid-point, which might be a tendency to be expected of Japanese respondents. Where appropriate, items were reversed

when entering the data into the computer so that a higher score on any item reflected higher agreement with the scale.

5.5.2 Interview Questions

The questions used in the interviews were developed to probe behind the answers given on the questionnaire, particularly with regard to HRM practices. Not every question was asked of every respondent due both to time limitations and a desire to further investigate interesting answers. The questions are listed in Appendix C.

The interview questions were written by the researcher based upon the questions asked in the questionnaire combined with knowledge gained from readings concerning the management of R&D personnel in large Japanese firms (Takagi, 1986; Westney and Sakakibara, 1988). For most questions the intent was to gather information concerning how the researchers are actually managed, the work they do, and their motivations for performing their work. The objective was to gather information that taken together might reveal patterns of researcher motivation and management that would aid in elucidating the findings from the hypotheses tests.

The first four questions (questions 1-4) elicited factual information and were designed to both put the interviewee at ease and to gain a sense of the kind of research in which he was involved. Question 5 probed behind the questionnaire item concerning the degree to which the researcher's professor had influenced his choice of company. In particular the question was designed to gain insight into the cosmopolitanism versus localism of the researcher. Those whose answers were more concerned with company resources and research opportunities could be seen as more cosmopolitan, while those who viewed themselves more as locals would give answers focused on opportunities for advancement in the company or other non-research reasons.

Questions 6, 7, and 8 also probed into the cosmopolitanism versus localism issue. Questions 9 and 10 were also concerned with this issue. Question 11 was intended to gain further information concerning whether the interviewee is a specialist or not. Questions 12, 13, and 14 probed the extent to which a dual career path is actually in place. Question 15 looked at the issue of career management control. Questions 16, 17, 18, and 19 were aimed at understanding the basis and clarity of the performance appraisal system. Question 20 was an attempt to determine whether the company was perceived as moving toward more externalized employment contracts. Question 21 looked at the construct of job generalizability, that is the degree to which firm specific knowledge is necessary for successfully carrying out research in the firm. Questions 22 and 23 also attempted to look more closely at the issue of job generalizability.

The nature of the training the firm provides, both initial and ongoing, was the focus of questions 24 and 25. Questions 26 and 27 built on the concept of career management control. Questions 28 and 29 looked at how researchers may gain knowledge about employment opportunities in other firms, thus helping the externalization of employment. The final two questions, questions 30 and 31, probed the degree to which employees felt there was a clear separation of career tracks for researchers versus management employees.

5.6 Data Analysis

Factor analysis was used on constructs for which there were multiple items written. A principal factoring method with varimax rotation was used. Factor analysis was utilized in order to reduce the data and determine the number of underlying factors. Factors with an eigenvalue >1 were retained following standard procedure. In addition to facilitating the data analysis process, factor analysis contributed toward the assessment of construct validity of the scales (Crocker and Algina, 1986).

Items loading heaviest on each factor were used to create composite scales. Composite scales were created by using a simple additive approach. A minimum number of items for each scale had to have been answered in order for the responses of an individual respondent to be used. For scales with 5 and 4 items, a retention criterion of 3 of the items answered was set. For 3 item scales, a minimum of two items had to have been answered.

In order to ascertain the dependability of the scales each of the scales was submitted to internal consistency estimates of reliability using Cronbach's coefficient alpha (Cronbach, 1951).

To establish whether the independent variables used in the regressions are measuring truly distinct dimensions, Pearson product-moment coefficients were obtained for the pairs of independent variables. The correlations were examined to determine if there are high correlations that may be cause for concern with regard to multicollinearity.

Finally, a series of multiple regressions were performed to test the hypothesized relationships between the variables. Regression analysis was felt to be an appropriate approach to testing the hypotheses as it was necessary to make the distinction between dependent and independent variables, which correlation does not permit (Pedhazur, 1982). Since there was no reason to feel that there was any causal ordering among the independent variables, all variables were entered on the first step. The regression models used to test the hypotheses were as below. Due to the multi-dimensional nature of core R&D job, two regressions were run to test Hypothesis 1.

Hypothesis 1:

1.1 Impact of R&D = c + B1 General Environmental Changes + B2 Technological Changes + B3 Product Changes.

1.2 Basic Research = c + B1 General Environmental Changes + B2 Technological Changes + B3 Product Changes.

Hypothesis 2:

Job Generalizability = c + B1 Radicalness of Core R&D job

Hypothesis 3

Ability Behavioral Certainty = c + B1 Radicalness of Core R&D job

Hypothesis 4

Willingness Behavioral Certainty = c - B1 Radicalness of Core R&D job

Hypothesis 5

Freedom to Choose Company = c + B1 Job Generalizability + B2 Ability Behavioral Certainty - B3 Willingness Behavioral Certainty

Hypothesis 6

Length of Initial Training = c - B1 Job Generalizability - B2 Ability Behavioral Certainty + B3 Willingness Behavioral Certainty

Hypothesis 7

Research Orientation of Initial Training = c + B1 Job Generalizability + B2 Ability Behavioral Certainty - B3 Willingness Behavioral Certainty

Hypothesis 8

Research Orientation of Ongoing Training = c + B1 Job Generalizability + B2 Ability Behavioral Certainty - B3 Willingness Behavioral Certainty

Hypothesis 9

Salary Differentiation = c + B1 Job Generalizability + B2 Ability Behavioral Certainty - B3 Willingness Behavioral Certainty

Hypothesis 10

Results Criteria in Promotion and Salary = c + B1 Job Generalizability + B2 Ability Behavioral Certainty - B3 Willingness Behavioral Certainty

Hypothesis 11

Subjectivity of Performance Appraisal = c + B1 Job Generalizability + B2 Ability Behavioral Certainty - B3 Willingness Behavioral Certainty

Hypothesis 12

Results Criteria in Performance Appraisals = c + B1 Job Generalizability + B2 Ability Behavioral Certainty - B3 Willingness Behavioral Certainty

Hypothesis 13

Career Path Separation = c + B1 Job Generalizability + B2 Ability Behavioral Certainty - B3 Willingness Behavioral Certainty

Hypothesis 14

Career Management Control = c + B1 Job Generalizability + B2 Ability Behavioral Certainty - B3 Willingness Behavioral Certainty

Finally, the survey data gathered from the R&D managers were utilized to tests for differences in perception between them and their subordinates, the researchers. The reason for conducting these tests was to help establish the reliability of the measures across samples. The answers of the R&D managers were aggregated and a oneway analysis of variance using Scheffe's test was used to test for significant differences from the

researchers. A Scheffe's test was used as this is the appropriate test when the comparison groups are of unequal size (Berenson, Levine, and Goldstein, 1983).

The information gathered in the interviews was reviewed by the researcher and comments and opinions expressed by the interviewees were selected to aid in the interpretation of the results of the questionnaire. The validity of the questionnaire results could also receive support to the degree that both approaches produced similar results.

Chapter Six presents the results of the data analysis of the survey portion of the study.

CHAPTER SIX
DATA ANALYSIS RESULTS

6.1 Introduction

This chapter presents the results of the data analysis outlined in Chapter Five. Only the results of the analysis of the data from the questionnaire data are presented as this was the method used to test the hypotheses. As stated previously, the interviews will be utilized to aid in the interpretation of the results, and thus information from them will be incorporated into the concluding chapter.

6.2 Descriptive Statistics

6.2.1 Survey respondents

There were 508 engineers and scientist (researcher) respondents, and 42 R&D manager respondents. The researcher respondents were asked to indicate their present age, age at which they joined their company, highest educational degree achieved, how long they had been working in the R&D laboratory, and whether they had previously worked in another company. The results are summarized in Table 6.1.

TABLE 6.1

CHARACTERISTICS OF RESEARCHER RESPONDENTS

CHARACTERISTIC	MEAN	STANDARD DEVIATION
AGE	33	5
AGE UPON JOINING CO.	25	3.2
YEARS WORKING IN THE R&D LAB OF COMPANY	7.5	4.8

NUMBER WITH PREVIOUS WORK EXPERIENCE = 44

NUMBER WITH B.S. DEGREES	=	113	(22.2%)
NUMBER WITH M.S. DEGREES	=	294	(57.9%)
NUMBER WITH PH.D DEGREES	=	97	(19.1%)
NO ANSWER	=	4	(.8%)
		508	100.0%

In general, the researcher respondents were a fairly representative sample. They had attained a range of educational levels, and represented a fairly youthful group as would be expected of personnel who had not yet been promoted to manager. Only a small number had previous work experience, as would be expected (e.g. Lynn, 1988; Pucik, 1984). There does not appear to be much that is unusual about this group of respondents when compared to previous studies of Japanese R&D personnel (e.g. Lynn, 1988; Sakakibara and Westney, 1987; Takagi, 1986). However, while the high number of M.S. degree holders is in line with trends predicted by Japanese government sources (Kagaku Gijitsu Hakusho, 1984), the relatively large number of Ph.D. holders contradicts the statement that "(t)he very low demand for Ph.Ds by private industry is noticeable" (Kagaku Gijitsu Hakusho, 1984: 27). Except for the pharmaceutical industry, demand for Ph.D. holders hovers around 10% (Kagaku Gijitsu Hakusho, 1984). There are two possible explanations

for the relatively high number of Ph.D. holders found among the sample (19% of total). First is that while Japanese companies do not usually seek to hire Ph.D. holders, they are not adverse to present researchers obtaining this degree since the process in Japan is not difficult and it may enhance the reputation of the firm. Alternatively, since the present study requested that the questionnaire be distributed to researchers working in fundamental research, it is not unexpected that a fair number of Ph.D. holders would be found in the sample since they are most likely to be involved in basic research.

These questions were not asked of the managers as the purpose of the questionnaire they filled out was to obtain answers reflecting the entire group they managed.

6.3 Questionnaire Factor Analysis Results

After the first factor analysis of the data, seven of the questionnaire items were dropped since they did not load heavily on any one factor (see Appendix D). Forty-four of the items were retained. These were factor analyzed again in four factor analyses using varimax rotation.

The first factor analysis, Factor Analysis A, presented in Table 6.2, utilized all of the items pertaining to environmental changes. Factor Analysis B analyzed all the items pertaining to core R&D job, and is presented in Table 6.3. All the transaction costs measures - job generalizability, ability certainty, willingness certainty - were entered into Factor Analysis C, which is presented in Table 6.4. Finally, all the items related to HRM practices that are multi-dimensional were entered into factor Analysis D, presented in Table 6.5. Only factors with an eigenvalue > 1.00 were retained (Bagozzi, 1980).

TABLE 6.2

FACTOR ANALYSIS A (ENVIRONMENTAL UNCERTAINTY VARIABLES)

Initial Statistics

Factor	Eigenvalue	% of Variance	Cum %
1	3.399	37.8	37.8
2	1.420	15.8	53.5
3	1.348	15.0	68.5

Factor Loadings (>.3 only)

Variable	Factor 1	Factor 2	Factor 3
Consumer	.749		
Product ob.	.724		
Competitor	.714		
Marketing	.670		
Production	.615		
Breakthroughs		.892	
Innovations			.887
<1%			.923
>5%			.900

TABLE 6.3

FACTOR ANALYSIS B
(CORE R&D JOB VARIABLES)

Initial Statistics

Factor	Eigenvalue	% of Variance	Cum. %
1	3.263	46.6	46.6
2	1.447	20.7	67.3

Factor Loadings (>.3 only)

Variable	Factor 1	Factor 2	
Think up	.836		
Impact	.789		
Flow		.787	.304
Markets	.786		
Incremental		.801	
Radical	.495	.761	
B-D Scale		.686	

TABLE 6.4

FACTOR ANALYSIS C
(TRANSACTION COSTS VARIABLES)

Initial Statistics

Factor	Eigenvalue	% of Variance	Cum. %
1	5.146	42.9	42.9
2	2.245	18.7	61.6
3	1.065	8.9	70.5

Factor Loadings (>.3 only)

Variable	Factor 1	Factor 2	Factor 3
Know-how	.890		
Expert	.864		
Company	.721		
100%	.678		
5 Years	.344	.827	
10 Years		.824	
Needs		.763	
Constant	.328	.724	
Non-R&D			.856
Transfer			.840
Move			.815
Willing			.690

TABLE 6.5

FACTOR ANALYSIS D
(HRM PRACTICES VARIABLES)

Initial Statistics

Factor	Eigenvalue	% of Variance	Cum %
1	3.132	19.6	19.6
2	2.194	13.7	33.3
3	1.834	11.5	44.8
4	1.408	8.8	53.6
5	1.081	6.8	60.3

Factor Loadings (>.3 only)

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Raises	.791				
Years	.770				
Results	.764				
Perform	.686				
Age	.591				
Projects		.848			
Wishes		.766			
Superiors		.742			
Conferences		.668			
Volition			.799		
Research			.787		
Outside			.634		
Admin				.861	
Research				.836	
Initial					.758
Present					.754

Factor Analysis A explained 68.5 percent of the variance and produced 3 terminal factors with an eigenvalue > 1.00. The factors produced were as expected. Factor Analysis B explained 67.3 percent of the variance and produced the 2 terminal factors of impact of R&D and basic research which had been expected. The close connection

between these two dimensions is reflected in the relatively high loading of item 13, Section 14 ("radical") on the impact of R&D factor. It was decided to retain the factors as they are since they conformed with how they had been conceptualized. Factor Analysis C explained 70.5 percent of the variance and produced 3 terminal factors which were as expected.

Factor Analysis D produced an extracted solution that explained 60.3 percent of the total variance. The solution extracted 6 factors: type of initial training, type of ongoing training, promotion and salary criteria, salary differentiation, and career management control. The factor solution for Factor Analysis D is presented in Table 6.5.

Reliabilities were calculated for each scale using Cronbach's coefficient alpha. A cutoff criterion of .6 was deemed appropriate (Nunnally, 1967). The results are given in Table 6.6. Because of the low reliability of the salary differentiation scale, it was dropped from use in further analysis of the data. The salary differentiation scale measured one aspect of compensation practices. The other was measured by the promotion and salary criteria scale. Thus the loss of the salary differentiation scale meant that the compensation aspect of the employment contract could be only partially measured. While eliminating the ability to test one of the hypotheses (Hypothesis 9), it was felt that there were more than a sufficient number of HRM practices that were reliably measured to provide interpretable results.

TABLE 6.6

RELIABILITIES OF MEASURES

Measure	Alpha
Technological Changes	.80
General Environmental Changes	.77
Product Changes	.84
Impact of R&D	.82
Basic Research	.67
Job Generalizability	.86
Ability Certainty	.86
Willingness Certainty	.83
Nature of Initial Training	.62
Nature of Ongoing Training	.62
Salary Differentiation	.32
Promotion and Salary Criteria	.78
Career Management Control	.75

Table 6.7 presents some descriptive statistics concerning the scales used in testing the hypotheses. The mean, standard deviation, and range for each are included. As can be seen from this table, there does not seem to be a problem of range with regard to this group of respondents. The ranges tend to be quite broad and the standard deviations relatively large, thus indicating there is probably sufficient variance in responses for statistical analysis.

TABLE 6.7
DESCRIPTIVE STATISTICS

Variable	Mean	Std. Deviation	Range
General Environmental Changes	3.88	.86	4.8
Technological Changes	3.85	1.04	5.0
Product Changes	4.32	1.34	6.0
Basic Research	3.30	1.02	5.0
Impact of R&D	4.23	.96	5.0
Job Generalizability	4.56	.82	4.0
Ability Behavioral Certainty	4.52	.77	5.0
Willingness Behavioral Certainty	3.31	1.07	5.0
Freedom to Choose	3.86	1.62	5.0
Initial Training	9.37	11.04	104.0
Type of Initial Training	2.92	1.27	5.0
Type of Ongoing Training	2.33	1.00	5.0
Promotion & Salary Criteria	3.45	.78	5.0
Subjectivity of Performance Appraisal	3.27	1.03	5.0
Basis of Performance Appraisal	3.96	.98	5.0
Career Management Control	3.14	.89	
Dual Career Track	4.72	1.397	5.0

In order to assess the degree to which the independent variables measured distinct constructs, Pearson product-moment coefficients (r's) were computed for each of the unique pairs of the environmental changes scales, impact of R&D, basic research, and transaction costs variables. The correlations are presented in Table 6.8.

TABLE 6.8
PEARSON CORRELATION COEFFICIENTS

	General Env. Changes	Techno-logical Changes	Product Changes	Basic Research	Impact of R&D	Job General.	Ability Cert.	Willing. Cert.
G.E.C.								
T.C.	.352***							
P.C.	.310***	.206***						
B.R.	.039	.249***	-.058					
I.R.D.	.137***	.293***	.069*	.514***				
J.G.	.023	.134***	.013	.267***	.351***			
A.C.	.079**	.174***	.046	.270***	.424***	.612***		
W.C	-.063*	-.106***	-.022	-.137***	-.076**	-.279***	-.243***	

*** p<.01
** p<.05
* p<.10

While many of the correlations of the pairs are significant, in most cases this does not present a reason for concern. In the case of the environmental change variables, for instance, the correlations between the variables are not unexpected since they are all measuring distinct but not necessarily orthogonal dimensions of one general construct. The same reasoning applies to the correlations between the basic research and impact of R&D scales. The relatively high correlation between job generalizability and ability behavioral certainty is not unexpected based on the close connection between these two transaction costs specified by the theory. Confirming this interpretation is the fact that willingness behavioral certainty correlated negatively with both job generalizability and ability behavioral certainty as would be expected from the discussion of transaction costs in Chapter Two.

The relatively high correlation between job generalizability and ability behavioral certainty does produce a concern for multicollinearity. Multicollinearity can lead to larger standard errors which can result in a finding of non-significance for regression coefficients compared to the case of where there is no multicollinearity (Schroeder et al, 1986: 72). However, since the model of the influence of transaction costs on HRM practices does not pretend to be a fully specified model, the most important concern is with determining whether the overall hypothesized relationships exist rather than with ascertaining the contribution of a particular independent variable to the variance in the dependent variable. Hence no steps were taken to correct for this possible multicollinearity because of the interrelated nature of the model.

6.4 Hypotheses Tests

Tests were conducted to test the hypothesized relationships between the variables. Because of the low reliability of the salary differentiation scale, it was not possible to test Hypothesis 9.

The results of the hypotheses tests are presented in Tables 6.9 through Table 6.22. A summary of the hypotheses and results is given in Table 6.23.

TABLE 6.9

RESULTS OF MULTIPLE REGRESSION ANALYSIS OF ENVIRONMENTAL CHANGES WITH IMPACT OF R&D AS THE DEPENDENT VARIABLE (N=466)

	BETAS	STD ERROR	F
General Environmental Changes	.051	.055	.857
Product Changes	-.003	.034	.006
Technological Changes	.257	.044	33.306***
Constant	3.101		
Adjusted R^2	.080		
Overall F	14.487***		

***p < .001

TABLE 6.10

RESULTS OF MULTIPLE REGRESSION ANALYSIS OF ENVIRONMENTAL CHANGES WITH BASIC RESEARCH AS THE DEPENDENT VARIABLE (N=466)

	BETAS	STD ERROR	F
General Environmental Changes	-.090	.059	2.299
Product Changes	-.071	.036	3.798
Technological Changes	.170	.048	12.760***
Constant	3.304		
Adjusted R^2	.028		
Overall F	5.400***		

***p<.001

As can be seen from these tables, Hypothesis 1.1 was partially supported, although weakly. Only technological changes was found to be significantly related to the impact of R&D aspect of the core job task. Hypothesis 1.2 was also only partially supported. Again, only technological changes was found to be significantly related to basic research.

TABLE 6.11

RESULTS OF MULTIPLE REGRESSION ANALYSIS OF CORE JOB TASK (IMPACT OF R&D AND BASIC RESEARCH) WITH JOB GENERALIZABILITY AS THE DEPENDENT VARIABLE (N=501)

	BETAS	STD ERROR	F
IMPACT OF R&D	.271	.037	54.018***
BASIC RESEARCH	.044	.036	1.482
CONSTANT	3.280		
ADJUSTED R^2	.121		
OVERALL F	35.608***		

***p < .001

Only partial support was found for Hypothesis 1. Of the two aspects of core job task, only impact of R&D was found to be related to job generalizability.

TABLE 6.12

RESULTS OF MULTIPLE REGRESSION ANALYSIS OF CORE JOB TASK (IMPACT OF R&D AND BASIC RESEARCH) WITH ABILITY CERTAINTY AS THE DEPENDENT VARIABLE (N=501)

	BETAS	STD ERROR	F
IMPACT OF R&D	.230	.367	66.410***
BASIC RESEARCH	.061	.040	2.412
CONSTANT	3.024		
ADJUSTED R^2	.180		
OVERALL F	55.552***		

***P < .001

Hypothesis 3 was also only partially supported. Once more, impact of R&D related positively to the transaction cost of ability certainty.

TABLE 6.13

RESULTS OF MULTIPLE REGRESSION ANALYSIS OF CORE JOB TASK (IMPACT OF R&D AND BASIC RESEARCH) WITH WILLINGNESS CERTAINTY AS THE DEPENDENT VARIABLE (N=501)

	BETAS	STD ERROR	F
IMPACT OF R&D	-.038	.051	.547
BASIC RESEARCH	-.116	.050	5.404
CONSTANT	3.855		
ADJUSTED R^2	.012		
OVERALL F	4.123**		

** $p < .05$

Hypothesis 4 received only weak support. Neither of the individual regression coefficients were significant.

TABLE 6.14

RESULTS OF MULTIPLE REGRESSION ANALYSIS OF TRANSACTION COSTS (JOB GENERALIZABILITY, ABILITY CERTAINTY, AND WILLINGNESS CERTAINTY) WITH FREEDOM TO CHOOSE COMPANY AS THE DEPENDENT VARIABLE (N=500)

	BETAS	STD ERROR	F
JOB GENERAL.	-.126	.112	1.260
ABILITY BEHAVIORAL CERTAINTY	.016	.118	.018
WILLINGNESS BEHAVIORAL CERTAINTY	.034	.018	3.636*
CONSTANT	4.064		
ADJUSTED R^2	.005		
OVERALL F	1.909		

* $p < .10$

Hypothesis 5 was not supported at all.

TABLE 6.15

RESULTS OF MULTIPLE REGRESSION ANALYSIS OF TRANSACTIONS COSTS (JOB GENERALIZABILITY, ABILITY CERTAINTY, AND WILLINGNESS CERTAINTY) WITH LENGTH OF INITIAL TRAINING AS THE DEPENDENT VARIABLE (N=498)

	BETAS	STD ERROR	F
JOB GENERAL.	2.120	.762	7.746**
ABILITY BEHAVIORAL CERTAINTY	-1.652	.802	4.245**
WILLINGNESS BEHAVIORAL CERTAINTY	.222	.121	3.339*
CONSTANT	5.293		
ADJUSTED R^2	.015		
OVERALL F	3.513**		

**p<.05
*p<.10

Hypothesis was weakly supported. However, job generalizability was found to be positively related to length of initial training rather than negatively as expected. Ability certainty was found to be negatively related, and willingness certainty was found to be positively related to length of initial training, which were as expected.

TABLE 6.16

RESULTS OF MULTIPLE REGRESSION ANALYSIS OF TRANSACTION COSTS (JOB GENERALIZABILITY, ABILITY CERTAINTY, AND WILLINGNESS CERTAINTY) WITH TYPE OF INITIAL TRAINING AS THE DEPENDENT VARIABLE (N=496)

	BETAS	STD ERROR	F
JOB GENERAL.	-.099	.088	1.246
ABILITY BEHAVIORAL CERTAINTY	.049	.093	.284
WILLINGNESS BEHAVIORAL CERTAINTY	.017	.014	1.405
CONSTANT	2.099		
ADJUSTED R^2	.001		
OVERALL F	.972		

Hypothesis 7 was not supported.

TABLE 6.17

RESULTS OF MULTIPLE REGRESSION ANALYSIS OF TRANSACTION COSTS (JOB GENERALIZABILITY, ABILITY CERTAINTY, AND WILLINGNESS CERTAINTY) WITH TYPE OF ON-GOING TRAINING AS THE DEPENDENT VARIABLE (N=496)

	BETAS	STD ERROR	F
JOB GENERAL.	-.060	.070	.733
ABILITY BEHAVIORAL CERTAINTY	.012	.073	.893
WILLINGNESS BEHAVIORAL CERTAINTY	.010	.011	.028
CONSTANT	2.453		
ADJUSTED R^2	-.002		
OVERALL F	.654		

Hypothesis 8 was not supported.

TABLE 6.18

RESULTS OF MULTIPLE REGRESSION ANALYSIS OF TRANSACTIONS COSTS (JOB GENERALIZABILITY, ABILITY CERTAINTY, AND WILLINGNESS CERTAINTY) WITH PROMOTION AND SALARY CRITERIA (N=501)

	BETAS	STD ERROR	F
JOB GENERAL.	-.116	.054	4.680**
ABILITY BEHAVIORAL CERTAINTY	.130	.056	5.319**
WILLINGNESS BEHAVIORAL CERTAINTY	-.004	.009	.174
CONSTANT	3.418		
ADJUSTED R^2	.001		
OVERALL F	2.089		

**p<.05

Hypothesis 10 was not supported.

TABLE 6.19

RESULTS OF MULTIPLE REGRESSION ANALYSIS OF TRANSACTION COSTS (JOB GENERALIZABILITY, ABILITY CERTAINTY, AND WILLINGNESS CERTAINTY) WITH SUBJECTIVITY OF PERFORMANCE APPRAISAL AS THE DEPENDENT VARIABLE (N=500)

	BETAS	STD ERROR	F
JOB GENERAL.	-.116	.071	2.666
ABILITY BEHAVIORAL CERTAINTY	.123	.075	.042
WILLINGNESS BEHAVIORAL CERTAINTY	-.002	.011	2.726*
CONSTANT	3.254		
ADJUSTED R^2	.000		
OVERALL F	1.11		

*p<.10

Hypothesis 11 was not supported.

TABLE 6.20

RESULTS OF MULTIPLE REGRESSION ANALYSIS OF TRANSACTION COSTS (JOB GENERALIZABILITY, ABILITY CERTAINTY, AND WILLINGNESS CERTAINTY) WITH BASIS OF PERFORMANCE APPRAISAL AS THE DEPENDENT VARIABLE (N=501)

	BETAS	STD ERROR	F
JOB GENERAL.	.048	.065	.537
ABILITY BEHAVIORAL CERTAINTY	.249	.069	13.007***
WILLINGNESS BEHAVIORAL CERTAINTY	-.027	.010	6.684**
CONSTANT	2.85		
ADJUSTED R^2	.060		
OVERALL F	11.213***		

***p<.001
**p<.05

Hypothesis 12 was partially supported, with both ability certainty and willingness certainty having the hypothesized relationship with basis of performance appraisal.

TABLE 6.21

RESULTS OF MULTIPLE REGRESSION ANALYSIS OF TRANSACTION COSTS (JOB GENERALIZABILITY, ABILITY CERTAINTY, AND WILLINGNESS CERTAINTY) WITH SEPARATION OF CAREER TRACKS AS THE DEPENDENT VARIABLE (N=472)

	BETAS	STD ERROR	F
Job General.	.054	.101	.290
Ability Behavioral Certainty	.136	.104	1.707
Willingness Behavioral Certainty	.004	.016	.051
Constant	3.829		
Adjusted R^2	.004		
Overall F	1.566		

Hypothesis 13 was not supported.

TABLE 6.22

RESULTS OF MULTIPLE REGRESSION ANALYSIS OF TRANSACTION COSTS (JOB GENERALIZABILITY, ABILITY CERTAINTY, AND WILLINGNESS CERTAINTY) WITH CAREER MANAGEMENT CONTROL AS THE DEPENDENT VARIABLE (N=501)

	BETAS	STD ERROR	F
JOB GENERAL.	.084	.057	2.189
ABILITY BEHAVIORAL CERTAINTY	.382	.060	40.475***
WILLINGNESS BEHAVIORAL CERTAINTY	.008	.009	.845
CONSTANT	.969		
ADJUSTED R^2	.145		
OVERALL F	29.300***		

***p<.001

Hypothesis 14 was partially supported, with only ability certainty having a relationship with career management control.

TABLE 6.23

SUMMARY OF HYPOTHESES AND RESULTS

Hypothesis	R^2	Significance
1.1 Technological, product, and general environmental changes will be positively related to the impact of R&D.	.08	<.001
1.2 Technological, product, and general environmental changes will be positively related to basic R&D.	.03	<.001
2.0 The radicalness of the core R&D job will be positively related to the level of job generalizability.	.12	<.001
3.0 The radicalness of the core R&D job will be positively related to the level of ability certainty.	.18	<.001
4.0 The radicalness of the core R&D job will be negatively related to the level of willingness certainty.	.01	<.05
5.0 Job generalizability and ability certainty will be positively related to the level of freedom to choose a company. Willingness certainty will be negatively related to the level of freedom to choose a company.	.01	<.10
6.0 Job generalizability and ability certainty will be negatively related to length of initial training. Willingness certainty will be positively related to length of initial training.	.02	<.05 **
7.0 Job generalizability and ability certainty will be positively related to the research orientation of initial training. Willingness certainty will be negatively related to the research orientation of initial training.	.00	NS
8.0 Job generalizability and ability certainty will be positively related to the research orientation of ongoing training. Willingness certainty will be negatively related to the research orientation of ongoing training.	.00	NS
9.0 Job generalizability and ability certainty will be positively related to the level of salary differentiation. Willingness certainty will be negatively related to the level of salary differentiation.	Not Tested	

TABLE 6.23 (CONTINUED)

10.0 Job generalizability and ability certainty will be positively related to the use of performance and research results as criteria in promotion and salary decisions. Willingness certainty will be negatively related to the use of performance and research results as criteria in promotion and salary decisions.	.00	NS
11.0 Job generalizability and ability certainty will be negatively related to the subjectivity of the performance appraisal. Willingness certainty will be positively related to the subjectivity of the performance appraisal.	.00	NS
12.0 Job generalizability and ability certainty will be positively related to the use of research results in performance appraisal decisions. Willingness certainty will be negatively related to the use of research results in performance appraisal decisions.	.06	.001
13.0 Job generalizability and ability certainty will be positively related to separation of career paths for technical and administrative personnel. Willingness certainty will be negatively related to separation of career paths for technical and administrative personnel.	.00	NS
14.0 Job generalizability and ability certainty will be positively related to the level of career management control by the researcher. Willingness certainty will be negatively related to the level of career management control by the researcher.	.15	.001

**Significant results were not entirely as expected. See text.

6.5 Results of Scheffe's Tests

Scheffe tests were performed to test for significant differences between the R&D managers and the researchers on all the variables used in this study. This was done in order to establish the reliability of the perceptions of the researchers. Because of the large number of tests performed, only the significant results are presented in Table 6.24. The results of the comparisons between the groups which produced no significant between groups differences are given in Appendix E.

TABLE 6.24

RESULTS OF ONEWAY ANALYSIS OF VARIANCE BETWEEN R&D MANAGERS AND RESEARCHERS ON ALL MEASURES: SIGNIFICANT RESULTS ONLY

R&D Managers N= 42
Researchers N=501

Variable	F	R&D Managers: Mean	Researchers: Mean
Impact of R&D	11.113***	4.76	4.23
Freedom to Choose	5.408**	3.26	3.86
Length of Initial Training	4.762**	13.64	9.37
Type of Initial Training	6.33**	2.53	2.02
Promotion and Salary Criteria	38.04***	4.21	3.44
Subjectivity of Performance App.	26.75***	4.11	3.27
Basis of Performance App.	41.26***	4.95	3.96

***p<.001
** p<.05

The results of the regression analysis and Scheffe's tests are discussed in the next chapter, Chapter Seven.

CHAPTER SEVEN
DISCUSSION OF RESEARCH FINDINGS

7.1 Introduction

This chapter critically discusses the statistical results of the research presented in the preceding chapter and, based on these and the data from the interviews, examines probable explanations for the results.

7.2 Hypotheses Tests

The model of the theoretical relationships tested in this research, Figure 7.1, and the summary of the main findings from the hypotheses tests, Table 7.1, which is a replication of the summary provided in the previous chapter, are given below here to serve as a guide in the following discussion of the results.

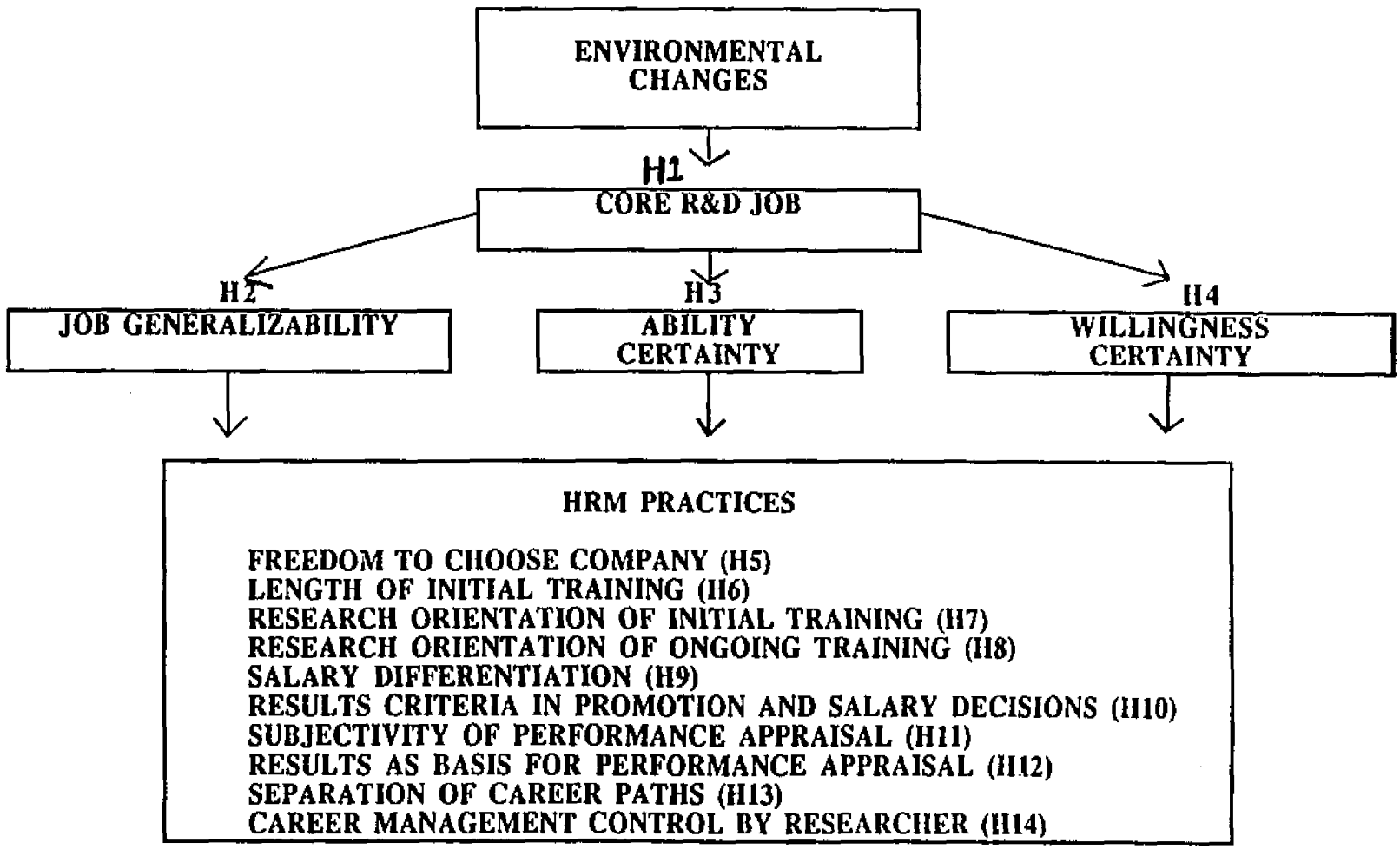

FIGURE 7.1
MODEL OF INFLUENCE OF TRANSACTION COSTS ON HRM PRACTICES

TABLE 7.1
SUMMARY OF HYPOTHESES AND RESULTS

Hypothesis	R2	Significance
1.1 Technological, product, and general environmental changes will be positively related to the impact of R&D.	.08	<.001
1.2 Technological, product, and general environmental changes will be positively related to basic R&D.	.03	<.001
2.0 The radicalness of the core R&D job will be positively related to the level of job generalizability.	.12	<.001
3.0 The radicalness of the core R&D job will be positively related to the level of ability certainty.	.18	<.001
4.0 The radicalness of the core R&D job will be negatively related to the level of willingness certainty.	.01	<.05
5.0 Job generalizability and ability certainty will be positively related to the level of freedom to choose a company. Willingness certainty will be negatively related to the level of freedom to choose a company.	.01	<.10
6.0 Job generalizability and ability certainty will be negatively related to length of initial training. Willingness certainty will be positively related to length of initial training.	.02	<.05 **
7.0 Job generalizability and ability certainty will be positively related to the research orientation of initial training. Willingness certainty will be negatively related to the research orientation of initial training.	.00	NS

TABLE 7.1 (CONTINUED)

8.0
Job generalizability and ability certainty will be positively related to the research orientation of ongoing training. Willingness certainty will be negatively related to the research orientation of ongoing training.

.00 NS

9.0
Job generalizability and ability certainty will be positively related to the level of salary differentiation. Willingness certainty will be negatively related to the level of salary differentiation.

Not Tested

10.0
Job generalizability and ability certainty will be positively related to the use of performance and research results as criteria in promotion and salary decisions. Willingness certainty will be negatively related to the use of peformance and research results as criteria in promotion and salary decisions.

.00 NS

11.0
Job generalizability and ability certainty will be negatively related to the subjectivity of the performance appraisal. Willingness certainty will be positively related to the subjectivity of the performance appraisal.

.00 NS

12.0
Job generalizability and ability certainty will be positively related to the use of research results in performance appraisal decisions. Willingness certainty will be negatively related to the use of research results in performance appraisal decisions.

.06 .001

13.0
Job generalizability and ability certainty will be positively related to separation of career paths for technical and administrative personnel. Willingness certainty will be negatively related to separation of career paths for technical and administrative personnel.

.00 NS

14.0
Job generalizability and ability certainty will be positively related to the level of career management control by the researcher. Willingness certainty will be negatively related to the level of career management control by the researcher.

.15 .001

**Significant results were not entirely as expected. See text.

7.2 Tests of the Links in the Model

7.2.1 Tests of the Environment-Core R&D Job Link

The influence of changes in the environment on the job tasks of employees is a major underpinning idea of the transaction costs model utilized in this study, one which is supported by Osterman's (1984b) and Doeringer and Piore's (1971) writings. It was assumed that as Japan's technological environment becomes more uncertain, with the direction of technological development more difficult to discern than in the immediate post-war period, Japanese R&D personnel are experiencing a shift in their job tasks toward more basic, radical research. Their research can have a great impact on the firms for which they work. Hypothesis 1 was written to test the validity of this assumption, and utilized three kinds of environmental changes - general, technological and product - as the main influences on the core job of R&D personnel.

Core R&D task was conceptualized as having two dimensions: basic research and impact of R&D. Thus, the influence of environmental changes on core job task was tested by two rather than one test. In both cases only technological changes was found to be a statistically significant determinant of greater radicalness in the related to more radical R&D core job. Thus it appears that as the expected frequency of radical technological change in the environment surrounding the firm increases, there is a corresponding increase in the emphasis placed on producing radical innovations that impact strongly on the company. Since in Japan the majority of research is carried out by corporations it is more likely that greater technological changes would lead to this change in corporate researchers' core R&D job task. In other countries such as the U.S. it is possible that increased radicalness of research would be encouraged in universities instead, through contracting or through political pressure for increased public funding of basic research.

The lack of support for the influence of general environmental changes is unexpected but comprehensible. With regard to general environmental changes, it may be that the wide diversity of environmental changes measured by this scale may be too far removed from R&D to influence the way in which it is conducted. Moreover, the diversity of environmental changes can necessitate other corporate responses than an increase in the radicalness of the core R&D job. Changes in the technological environment, on the other hand, are logically those most closely related to the work carried out in corporate research laboratories.

The lack of support for the product changes is also comprehensible. When the frequency of product changes is perceived as high, any influence on the core R&D job is likely to be on the applied end. Consequently, since the measures of core R&D job used in this study focused on the radicalness of the R&D task, it is perhaps not surprising that product changes did not seem to have an effect on it. What is perhaps of greatest interest is the apparent equal effect that product changes has on both those with a more radical core R&D job and those without. The interviews suggested that researchers engaged in producing radical innovations rather than in applied research felt as much pressure from their firms to keep the eventual commercial implications of their work always in mind. At one firm known for its innovativeness, for example, several researchers engaged in very long term, upstream research mentioned their frustration over the bottom-line attitude taken by top management in response to their announcements of progress in their research projects. At another innovative firm several radical innovators complained that all the special prizes and recognition were given to those who made product innovations. One example of the emphasis on product innovation even at basic research laboratories was given by a specialist holding a Ph.D. He described how the bulletin board for announcing important events put all announcements of new products by other companies on the upper,

eye-level portion of the board, while announcements of major scientific or technical breakthroughs not directly leading to new products are placed below and are rather inconspicuous. In short, the pressure from rapid change in products appears to be diffused across radical and incremental innovators alike.

7.2.2 The Core R&D Job-Transaction Costs Link

The study proposed that as the radicalness of the core R&D job increased, the transaction costs of the employment relationship would undergo changes. Specifically, it was argued that job generalizability would increase (i.e. asset specificity would decrease), ability certainty would increase, and willingness certainty would decrease. Three hypotheses were written to test this linkage (Hypotheses 2, 3, and 4).

Hypothesis 2 was partially supported, although weakly. Impact of R&D was found to be related to greater levels of job generalizability, while basic research was not. This finding presents an interesting challenge to the assumptions underlying this study. That is, it was assumed that as researchers became responsible for creating more important technological breakthroughs that this would lead to greater emphasis on basic research. The kind of specialized knowledge and skills required to carry out basic research was thought to lead to a greater ability to transfer between firms since the knowledge and skills are specific to a field rather than to a firm. However, it appears that while job generalizability does increase as expected with an increased sense of the importance of their research, it is not necessarily because there is a corresponding shift toward basic research. This may be because while researchers are working within increasingly narrow technological areas and are increasingly specialized in order to produce important breakthroughs, and hence are increasingly able to transfer across firms, this does not necessarily mean they are involved in basic radical research, at least as is commonly defined.

Borrowing D. E. Stokes' (1982) approach to the definitional problem, the interviews suggested that the respondents to the questionnaire conceive of basic research in the classical sense of an activity which enhances pure understanding without seeking to meet a social need. Stokes' figure, which is produced below, shows that Japanese researchers are probably experiencing a shift from pure goal achievement to goal achievement through basic understanding. That is, there is a shift from Quadrant III to II rather than to I.

IF THE RESEARCH IS

	APPLIED	NOT APPLIED
BASIC	II. GOAL ACHIEVEMENT THROUGH BASIC UNDERSTANDING	I. PURE UNDERSTANDING
NOT BASIC	III. PURE GOAL ACHIEVEMENT	IV.

FIGURE 7.2

THE MOTIVES OF SCIENTIFIC RESEARCH

Reproduced from D. Stokes, "Perceptions of the Nature of Basic and Applied Science in the United States", in A. Gerstenfeld, ed., Science Policy Perspectives: USA-Japan. New York: Academic Press, 1982.

If, as the interviews suggested, the Japanese respondents interpreted the concept of basic or radical research in the classic sense of pure understanding, then this could have led

them to reject this as an accurate description of their activities. Several R&D managers questioned whether there was really any basic research going on at their laboratories. The reservation most commonly expressed was that all the research in the lab had a goal, and thus even if it involved working with very fundamental research in order to reach the goal, there was no basic research conducted for its own sake. The measures used in this study did not make this distinction between goal directed and pure understanding. It is possible that job generalizability would vary with basic research were it defined this way, and if Japanese researchers were found to be engaged in true basic research.

Hypothesis 3 tested for the effect on the transaction cost of ability certainty of increased radicalness of the core R&D job. It was argued that as researchers experienced increased radicalness of the core R&D job that they would also experience a corresponding specialization that would lead to greater confidence in their ability to work for a long time in the R&D laboratory. As with Hypothesis 2, partial support was found. Again only impact of R&D was found to have a statistically significant effect. Again, it may be that the interpretation of the concept of basic research lead the respondents to reject its application to themselves. Based on the results of this test, it suggests that as the radicalness of the job task increases there is a greater need for research specialists, i.e. those who see their contribution to a firm as taking place within the R&D laboratory. The impressions gained from the interviews tend to support this finding. That is, those who saw their research as having the potential of affecting their firm in important ways, and who had a strong commitment to being researchers, tended to feel that their research expertise and skills would be best utilized within the R&D laboratory. They were also the ones most likely to quit if transferred to a job outside of R&D or were made to work on research projects of absolutely no interest to them.

Hypothesis 4 tested the opposite side of this proposition. That is, as researchers perceive their usefulness to the firm as restricted to the R&D function, they experience a corresponding decrease in their willingness and ability to function as non-researchers in areas outside of the R&D laboratory. Support for this viewpoint was found, although it was very weak. While the overall regression coefficient was found to be statistically significant, neither of the regression betas was found to be so. This may be due in part to the problem of multicollinearity discussed in Chapter Six. However, it is interesting to note that the signs of the beta coefficients were negative as expected. In sum, it seems that there is somewhat of a drop in the willingness of the researchers to transfer out of R&D and take on non-research duties as the radicalness of the core job task increases, and that there is less of a sense that they have the ability to do so.

Interviews suggested that while the degree of radicalness of the core R&D job is a factor, there are apparently other factors influencing the willingness certainty of researchers. For example, the rewards for non-researcher (i.e. administrative track) employees are perceived as still greater than those for researchers. This would lead researchers to ignore their ability to produce more within the R&D laboratory in favor of gaining access to the non-R&D management track which holds the possibility of greater rewards. Moreover, some researchers mentioned a desire to be part of the transferral team which would take the results of their R&D into the production stage, a desire to participate in all parts of the technology creation process. This could be another reason why willingness certainty was found to be so weakly related to the radicalness of the core R&D job.

The remaining hypotheses tested whether there was a link between changes in the transaction costs of the employment relationship and the HRM practices used to manage the researchers.

7.3 The Transaction Costs-HRM Practices Link

Hypothesis 5 looked at the impact of transaction costs on the freedom of the researcher to choose his place of employment. As discussed previously, Japanese technical personnel have traditionally been recruited directly from university, and their professors have wielded an enormous influence on the choice of company (Westney and Sakakibara, 1988). This system ensured an adequate supply of technical personnel at reasonable wages to Japanese firms during the high growth period during which high demand could have led to bidding wars between firms. The professors gained increased power and prestige as a consequence of their role in the process. It was expected that as researchers become more specialized and hence the transaction costs of their employment relationship change that one HRM practice that would be transformed was the freedom of the researcher to choose the firm for which he will work. Because the researcher would want to utilize to the fullest extent his specialized technical knowledge, he would want to ensure that he would work for a company with a strong interest in his area.

The overall regression coefficient was not statistically significant. There are several reasons that can be postulated for this non-significant finding. First, as a number of interviewees mentioned when queried on the reason for choosing to work for their firm, the resources available at the firm was a crucial factor. Thus more than the opportunity to work within one particular technological or scientific area, the researchers seemed more concerned with adequate support for R&D. Support appeared to be equated with the size and prestige of the firm. Thus it can be deduced that if a professor can ensure employment in a well-established firm with adequate resources, many new graduates are indifferent to the exact firm in which they work. Such an attitude would help explain the continuance of this way of placing new technical graduates. Support for the existence of this attitude was found in a survey which found 43% of the respondents said they had chosen their firm

because of either "the future prospects of the company" or "working conditions" ("Younger Workers...", 1986).

In addition, the universities and professors themselves may be loath to give up a source of power, and companies in declining industries also have a strong interest in supporting a system which continues to supply them with technical recruits who might otherwise shun them. The strength of the vested interests in the system was illustrated recently when an investment firm in Tokyo broke tradition by directly approaching new graduates in computer science of a prestigious technical university and hiring far more than their 'quota' for the year. The university threatened to cut off 'supply' entirely to the firm the next year unless the company agreed to abide by the established system, which the company agreed to do (Sakakibara, 1988). Thus at least in this case, the interests of the university prevailed and the system remained intact. It is also possible that beyond a resistance to giving up a source of power that the system as it exists produces informational efficiencies for both firms and recruits that both sides are reluctant to give up.

There is another factor that might explain the statistically non-significant finding in this area. Interviews showed that the system of professors' placing students varies by both professor and by the technical or scientific area. Some professors are apparently indifferent to the placement question and choose to exert no control or direction. Some areas, such as the life sciences, have had a much stronger tradition of professors controlling the placement of students than many areas of engineering. Finally, in scientific or technological areas which are just emerging, such as biotechnology, professors exert little control because they have not built up networks of contacts (often former students) within firms and are not that much more knowledgeable about employment opportunities than their students.

It is also possible that insufficient change had occurred in the system when the researchers in this sample joined their present firms. Present trends indicate that with three job openings per each college graduate, there is a greater tendency among college students to ignore the power of the letter of recommendation from their university or professor by reneging on oral agreements to join one firm if another makes a better offer later (Hasegawa, 1988). The situation has changed so much that one observer claims that the power of the professors and universities to place students as they please has become "...a dead letter" (Hasegawa, 1988: 61).

In short, the statistically non-significant finding regarding freedom to choose company may be due to a combination of indifference on the part of recruits with the deep entrenchment of the system itself; to the inability to ascertain the degree to which the attitude of the individual professor and the major of the recruit influences the finding; or finally to the fact that the system had not changed much for the respondents to this survey because they joined their firms on average seven years ago. The large number of potential explanations suggested by both the interviews and the literature indicates that the item used to measure this link may not have been adequate for capturing the underlying dynamics.

Training was another HRM practice which it was predicted would be affected by the changes in transaction costs. Hypothesis 6 postulated that as researchers were hired more for their specialized knowledge and skills the firms hiring them would have less incentive to put them through lengthy initial training programs. Because specialists would be seen as requiring less training in management skills and general knowledge of the firm than prior recruits, the length of the initial training would be negatively related to increased job generalizability and ability certainty, and positively related to willingness certainty.

The hypothesis was partially supported. Both ability certainty and willingness certainty were found to statistically affect the length of initial training as hypothesized.

However, job generalizability was found to be statistically significantly related to length of training but in the positive direction, opposite from what was hypothesized.

This finding, while unexpected, may be more comprehensible when the transaction costs are considered more closely. Ability certainty refers directly to the belief of the researcher that he will be able to continue working in research for a considerable amount of time, and willingness certainty to a lack of confidence in his usefulness in the non-R&D areas of the firm. Both of these measures are directly connected to the researcher's perception of his specialization to R&D, and it is this aspect that is most likely to lead to a decrease in the firm's investment in wider and lengthier training. Job generalizability would also be expected to influence the firm if it was felt that the researcher would indeed put his perception of easy inter-firm mobility into practice. However, since actual inter-firm mobility of R&D personnel is still relatively low, as evidenced by the fact that only 9% of the present sample had worked in other firms previous to joining the present one, it is not unexpected that the transaction cost of job generalizability would be related less directly to a decrease in length of initial training. It is likely that as inter-firm mobility grows in Japan a stronger relationship will emerge between this transaction cost and shorter initial training.

The interview data suggested two other possible factors influencing the length of initial training. One factor is whether the researcher is a mid-career hire (i.e. has worked in another company or institute previous to joining his present firm). Many of the mid-career hires interviewed stated that they received no formal training at all upon joining their present firm. Indeed, one interviewee had just made his first visit to a company plant and he had already been working for the firm for six months. There may be an insufficient number of such mid-career recruits, and the timing of their joining may be too erratic, to justify setting up an alternative initial training program. Another explanation is that

companies that are highly diversified may find it less attractive to provide lengthy initial training. One R&D manager at a highly diversified firm stated that only two weeks of factory experience (genba jisshu) is provided because, given the diversity of products, there is no guarantee it will have any relevance to the research the employee will do. In short, another factor that may affect the length of the initial training provided to new employees is the degree to which the firm is diversified. These potential influences may have as much effect on the length of initial training provided to researchers as the degree to which they are specialists.

In addition to length of training, changes in the transaction costs of the employment relationship were hypothesized to be related to changes in the type of training received by the researchers, both upon joining the firm and later on in their careers. Specifically, it was hypothesized that the research content of the training would increase and that more would be training outside the firm. Due to increasing technological innovation, "...Japanese companies ...will increasingly emphasize training outside of the company" ("Industries...", 1986: 9). Hypotheses 7 and 8 tested for these relationships, but no statistically significant findings were found.

There are several explanations for these findings. One possible explanation is that the knowledge that research specialists require is so specialized that it is difficult for the company to provide it. Several R&D managers and researchers at one firm commented that it was difficult to provide these special courses internally because internal courses are usually taught by older, experienced researchers. For many specialists, there is no one in the firm in their narrow discipline area so there is no one already in the firm who can provide training. Interviews suggested that a great deal of self-study is undertaken by researchers on their own time, and it may be that specialists keep up with advances in their fields in this way. Alternatively, it may be that these specialists bring sufficient knowledge

with them when they join the company that they do not need much extra training in their specialities. In short, firms either cannot or do not need to provide more research oriented training to radical innovators. Unfortunately, the interviews did not provide sufficient information to determine which of these two explanations is the most likely.

Another HRM practice hypothesized to be influenced by changes in the transaction costs was the basis for making promotion and salary decisions. It was hypothesized that as the transaction costs changed the criteria used for making these decisions would shift from an emphasis on seniority to a focus on performance and results. This is because specialists hired for their skills and knowledge would be more desirous of being rewarded for their use than researchers hired for non-specialized skills. Scientists in corporations have a high need for recognition (Pelz and Andrews, 1976). By basing salary raises and promotions on individual contribution over which the researcher has control rather than on age over which he does not, the firm would be responding to the greater need for recognition of specialists as opposed to non-specialists. In addition, specialists can expect to be recompensed for the accumulation of expertise.

The hypothesis written to test this relationship, hypothesis 10, produced no statistically significant results. This was confirmed by the results of the interviews. According to a R&D manager at one firm, the maximum salary difference between cohorts is about 5%. At another company it was stated that the maximum differentiation between researchers in salary increases was equal to 20% of the increase. In fact, the director of a special research institute set up within one of the firms had been hired with the express mandate to create an American-style research environment which his more than a decade of R&D management in the U.S. had given him the expertise to carry out. However, as one way of increasing the recognition of the individual efforts of researchers he attempted to convert the twice yearly bonus into a reward for performance and results of the individual

rather from an automatic payment with extremely small performance differentials. In spite of the organizational separation of the institute from the main firm, the personnel department vetoed his planned changes in awarding of bonuses, asserting that it would result in too much disruption of the sense of egalitarianism. In sum, the actual differences in salaries for employees who are age cohorts still appears to be quite small. This is in spite of increasing emphasis on performance and merit in salary determination in Japanese companies. One recent survey, for example, found that 54% of the participating companies indicated that "...wage differentials between employees hired at the same time were widening more rapidly than before" ("Rumblings...", 1988:59).

In fact, this study indicates that resistance to using salary as a motivator may be quite strong. One R&D manager stated that if a high performing researcher were being headhunted by another firm, his company would rather let him go than entice him to stay through a salary increase. This manager felt that increasing his salary would severely undermine the lifetime employment system by destroying the cherished sense of internal equity that the system provides. Moreover, he felt that the loyalty of the person would be questionable. This sentiment was echoed in various ways by the R&D managers at other firms, as well as the researchers themselves. Interviewees suggested that salary differences could lead to a decrease in the egalitarian spirit that they feel is necessary for teamwork. In short, the heavy emphasis on seniority in allocating rewards is felt to be the cornerstone of the present employment relationship between the firms and employees, and hence there is a strong reluctance to tamper with it. Changes in this part of the HRM system were felt to have potentially severe repercussions throughout the company and could not be instituted as easily as other changes. Several R&D managers also mentioned the question of union resistance to changes in any part of their firm's salary system.

However, at almost all the firms there was a clear indication that the promotion system has been modified to allow for a significant promotion earlier in a researcher's career, as well as for faster promotions later. The reason given was a desire to retain high performers by giving them the greater authority and higher salaries that go along with promotion earlier than used to be possible. It is interesting that companies feel compelled to do this even as they are experiencing a decrease in the number of upper level positions in the company as a whole due to the aging of the population ("Japan Cuts...", 1989).

Closely connected to the basis of promotion and salary decisions is the type of performance appraisal used by the firm. It was hypothesized that as the transaction costs of the employment relationship change towards a more externalized system, the specialists' desires for recognition and rewards for their individual job performance would result in the performance appraisal system becoming more objective and emphasizing results. Subjectivity of evaluations would be less acceptable because of the changed basis of rewards from seniority and performance. Two hypotheses were written to test for these changes, Hypotheses 11 and 12.

Hypothesis 11 attempted to discern any relationship between changes in transaction costs and an increase in objectivity in the performance appraisal system. No statistically significant results were found for this hypothesis test. This finding was supported by the negative responses of many interviewees to the question of whether they receive direct feedback on the evaluation of their performance. Since clear feedback would be expected to increase with greater objectivity in the performance appraisal, this finding confirms the lack of support for this hypothesis.

It is understandable that since the basis of rewards has not yet changed to one emphasizing individual results that the performance appraisal system would not have been transformed to provide a clearer system for communicating the evaluation of performance

back to researchers. The lack of objectivity in the performance appraisal thus simply accompanies the lack of individual results used in promotion and salary decisions. There also appear to be other reasons for the lack of clarity and feedback on performance. One R&D manager mentioned that he felt it was best to be unclear as this kept the researcher guessing and presumably striving to achieve more. Moreover, as one R&D manager noted, effort is the most important attribute, and that is impossible to quantify and evaluate clearly. There is also a cultural aversion to praise which may be at work here. In Japan, only children are seen as needing clear praise for achievements (Kageyama, 1989).

Interestingly enough, however, Hypothesis 12 did receive partial support, although it was weak. Both ability certainty and willingness certainty were found to be statistically significant determinants of results as the basis of performance appraisal. The fact that job generalizability was not found to be a statistically significant determinant of the basis of performance appraisal is perhaps similar to the explanation of the findings of Hypothesis 6. The perception of the possibility of inter-firm mobility has not yet resulted in a sufficient amount of movement to influence HRM practices. Of greatest interest, however, is that while basis of performance appraisal does seem be influenced by the transaction costs of the employment relationship, the promotion and salary decisions which are based on performance appraisal results do not yet seem affected. Why this change in performance appraisal basis if it is not used in promotion and salary decisions?

One possible explanation is that these are the perceptions of the researchers and they have a desire to see themselves as evaluated on their individual contributions more than they really are. However, the tests of differences with the R&D managers showed a statistically significant difference on this measure, but one in which the researchers were understating the degree to which they are evaluated on individual results. Thus this explanation does not seem valid. Another possibility is that this is an anticipatory change,

that is one that can be enacted in advance of major changes in HRM practices without much disturbance to the present system. Alternatively, it may be that R&D managers have become more desirous, with the increased number of specialists, of knowing who is contributing more research results in order to find other ways to recognize their achievements than compensation and thus keep them motivated.

Interviews suggested that the primary motivation for the change is as an anticipatory move. Interviews with researchers confirmed that, in so far as they know the criteria on which they are actually evaluated, they perceive a recent shift towards more quantifiable and individual results such as conference papers and reports. Interviews with R&D managers confirmed this trend as well, and it was given as an example of the way in which the HRM system is being change to respond to the increasing number of specialists. Yet there still seems to be a great reluctance to actually use the more individualized criteria to make salary and promotion decisions. Interviews suggested that researchers perceive middle managers as the major stumbling block to enactment of changes in HRM practices. Even when given the tools by upper management to manage in new ways, it was strongly suggested that middle managers are too comfortable with the old system to use them.

Along with changes in selection, training, compensation, and performance appraisal, it was proposed that as the transaction costs of the employment relationship of R&D personnel changed there would be an increased emphasis on a dual career ladder. This would come about because of the necessity of providing a means for R&D personnel who see themselves as research specialists to remain in research and be rewarded in a manner which is equal to those who switch to an administrative post. Without a clear and functioning dual career track, researchers would experience pressure to transfer out of R&D in order to obtain the same rewards as administrative track employees.

The hypothesis written to test this relationship was hypothesis 13. No statistically significant results were found. This is somewhat surprising in light of the comments of many of the R&D managers interviewed who expressed strong support for the necessity of increasing the attractiveness of the technical ladder. Indeed, at one firm a very detailed dual career track system was not only in place but all the researchers interviewed at that firm felt that the technical ladder was truly an option. However, overall the interviews with researchers confirmed the lack of statistically significant results. Most interviewees at most of the firms felt strong skepticism about the equality of the technical and the non-technical tracks, while at the same time they supported the R&D managers' belief that a stronger dual career track should exist. In short, little seems to have changed since Sakakibara and Westney's (1988) study which showed strong disbelief on the part of Japanese engineers in the the equality of the tracks.

The final HRM practice examined in this study was career management. As described previously, it was proposed that as the transaction costs of the employment relationship changed, R&D personnel would demand greater control over the direction and content of their careers. There were at least two reasons for believing this would be true. First, because of the greater specialization of these employees, they desire to work within the technical area in which they have expertise. They have a strong attachment to their discipline of study, and this motivates them to want to continue working on technical problems closely connected to their expertise. Second, the awareness of their greater potential for mobility between firms than that of R&D personnel hired as incrementalists imbues them with a desire to retain their specialized knowledge so that they can change companies if they so desire. Given the increasingly fast pace of change in industrial structure in Japan, combined with tighter labor markets and more labor mobility, it was

assumed that these R&D specialists would want to avoid becoming R&D generalists and hence want to retain career control.

The hypothesis written to test for this relationship was partially supported. Of the three transaction costs measured, only ability certainty proved to be statistically significant. Thus it appears that as researchers see themselves as specialized to the R&D section, they become more desirous of having control over the kinds of projects to which they are assigned. From the firm's perspective there may be several reasons for allowing the researchers greater control over research project assignment. One reason indicated by one R&D manager is that in order to retain good researchers in an increasingly competitive labor market it is necessary to begin taking the interests of the researchers into account when making assignments and modify the practice of transferring people at will.

Interviews with R&D managers indicated that another factor may be that this is an HRM practice that can be changed with relatively little effect on the company-wide HRM system or on the sense of egalitarianism. Hence one way that management can adjust the employment relationship relatively easily in response to changes in transaction costs is to provide research specialists with greater career control. This does not, however, address the question of why job generalizability and willingness certainty were not significantly related to increased career control. This question may not be resolvable without further research, particularly interviews, to elucidate the possible reasons. Moreover, interviews suggested that another factor that can affect career management control is whether the researcher has attained the status of senior researcher. Obviously more research in this area is necessary.

7.4 Summary of Results

As Figure 7.3 at the end of this chapter shows, the links of the model were supported only in part or not at all. The general conclusion that can be drawn from the

results of the statistical analysis is that there is support for the first two links in the model but not for the third. That is to say, environmental changes do lead to changes in core R&D job, and these changes in turn affect the transaction costs of the employment relationship. There was very little support for the link between changes in transaction costs and changes in HRM policies.

Furthermore, the support that was obtained for the first two links in the model was partial and/or weak. The only environmental change that appears to affect changes in core R&D job is technological uncertainty. The only part of the core R&D job that affects transaction costs is impact of R&D. The link between changes in core R&D job and willingness certainty is weak at best.

In spite of the partial support the model received, the signs of the regression coefficients were in almost all cases as predicted. There is reason to believe, therefore, that the model tested in this research provides a sufficiently sound theoretical approach to warrant further testing. Moreover, the results of the interviews tended to confirm the statistical analyses, thus lending further support to the usefulness of the model. Given the partial nature of that support and the relatively low amount of variance explained, it is obvious that further refinement and testing of the model is necessary, as is discussed in the following chapter, Chapter Eight.

7. 5 Differences Between Researchers and R&D Managers

A series of Scheffe's tests was conducted to determine the differences of perception between the R&D managers and researchers on the measures used in this study. For ten of the variables there was no statistically significant difference between managers' and researchers' perceptions, indicating a high level of reliability for these measures. Statistically significant differences occurred on seven variables: impact of R&D, freedom to choose company, length of initial training, type of initial training, promotion and salary

criteria, subjectivity of performance appraisal, and basis of performance appraisal. Obviously, the use of linear regression means that only overstatements by researchers is a methodological concern, except in the case of length of initial training and subjectivity of performance appraisal. Thus, as can be seen from Table 6.24 in Chapter Six, only freedom to choose, length of initial training, and subjectivity of performance appraisal suggested that certain measures must be carefully tailored to the sample being investigated. The Scheffes' tests, in addition to contributing to the reliability of the measures, also indicate potentially fruitful areas for future research, which will be discussed in the following chapter, Chapter Eight.

The discussion of the results in this chapter have suggested several fruitful areas for future research. The following chapter discusses the implications of the results of this study as well as its limitations and directions for future research.

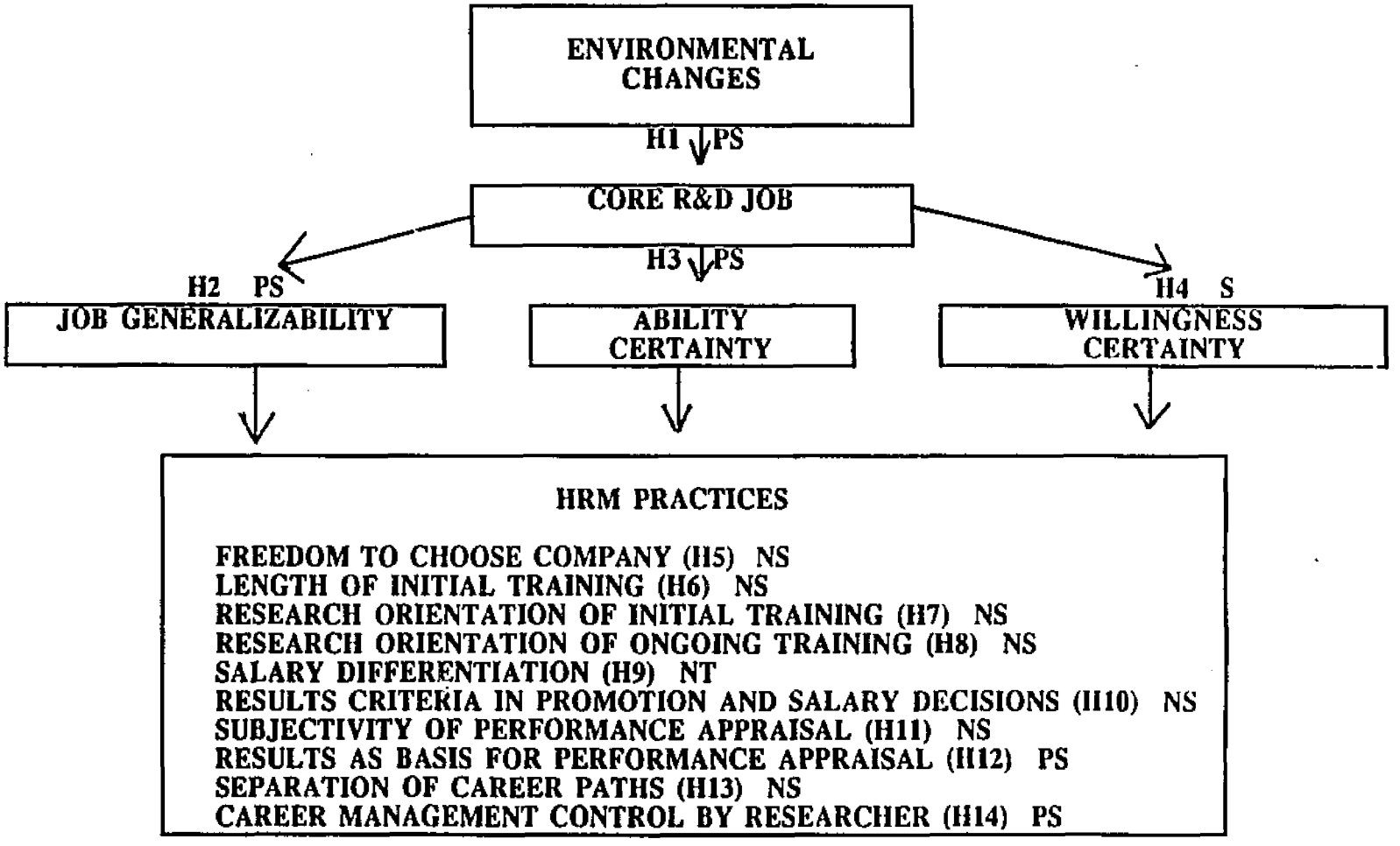

FIGURE 7.3
MODEL OF INFLUENCE OF TRANSACTION COSTS ON HRM PRACTICES
SUMMARY OF RESULTS

S = SUPPORTED
PS = PARTIALLY SUPPORTED
NS = NOT SUPPORTED
NT = NOT TESTED
SO = SUPPORTED BUT OPPOSITE SIGN(S) FROM EXPECTED

FIGURE 7.3 CONTINUED

CHAPTER EIGHT

IMPLICATIONS, LIMITATIONS, AND FUTURE RESEARCH

8.1 Introduction

The purpose of this study was to investigate whether changes in the transaction costs of an employment relationship lead to changes in the personnel system used to manage employees. A model was created postulating that changes in the environment surrounding a firm can lead to changes in the job tasks of employees, and that these changes in turn affect the transaction costs of the employment relationship and the HRM practices used to manage the relationship.

The particular group of employees studied in this research was Japanese R&D engineers and scientists working in large Japanese firms. It was hypothesized that changes in the technological environment would lead to a shift toward more radical or basic research in the core job of these researchers. More specifically, it was proposed that since Japan now finds herself technologically on par with the most advanced countries, it has become necessary for her to produce more of the radical scientific and technological breakthroughs required of a nation working at the frontiers of knowledge. It was hypothesized that as the core job of corporate R&D engineers and scientists focused on producing more radical innovations that this would lead to a need for more specialists, and change the nature of the transaction costs of the employment relationship.

The transaction costs of ability certainty, willingness certainty, and job generalizability were proposed to be affected. Ability certainty is the certainty that the skills and knowledge of the researcher are of use mainly in the R&D laboratory, which would increase the more the researcher perceived herself to be a research specialist. Willingness certainty is the willingness and ability of the researcher to work in areas other than the R&D lab, which would decrease with an increase in specialization. Job generalizability is the

belief of the researcher that he can easily use his knowledge and skills in another company, which would be higher for research specialists.

A change in the transaction costs should lead to changes in the nature of the employment relationship. It was argued that Japanese corporations would feel pressure to externalize the employment relationship, that is, to move it from an internal labor market toward an external labor market. Changes in HRM policies associated with such a shift include an increased emphasis on individual performance and results in promotion decisions, the provision of dual career tracks with equal rewards, and provision of less training with more specific focus on the research skills and knowledge of the researcher. The model representing the various hypothesized links is reproduced below. This model also shows which of the links were supported by the data gathered through questionnaires to test the hypotheses.

The remainder of this chapter will examine the implications of the results of this study for theory and practice, the limitations of the research, and suggest directions for future research.

8.2 Implications for Transaction Costs Theory

One of the contributions to transaction costs theory of this study is the refinement of the concept of uncertainty as used within the employment relationship. Williamson's (1975; 1986) use of the term suggested that uncertainty influences the employment relationship in two ways. First, great environmental uncertainty surrounding the firm can result in a pressure on employees to adapt to new job tasks and/or new technology. Second, uncertainty refers to the willingness of employees to fulfill the employment contract. The firm is uncertain about the employee's willingness to provide the required effort. In this study the first kind of uncertainty was seen as closely connected to technological environmental uncertainty and was subsumed under this concept. The

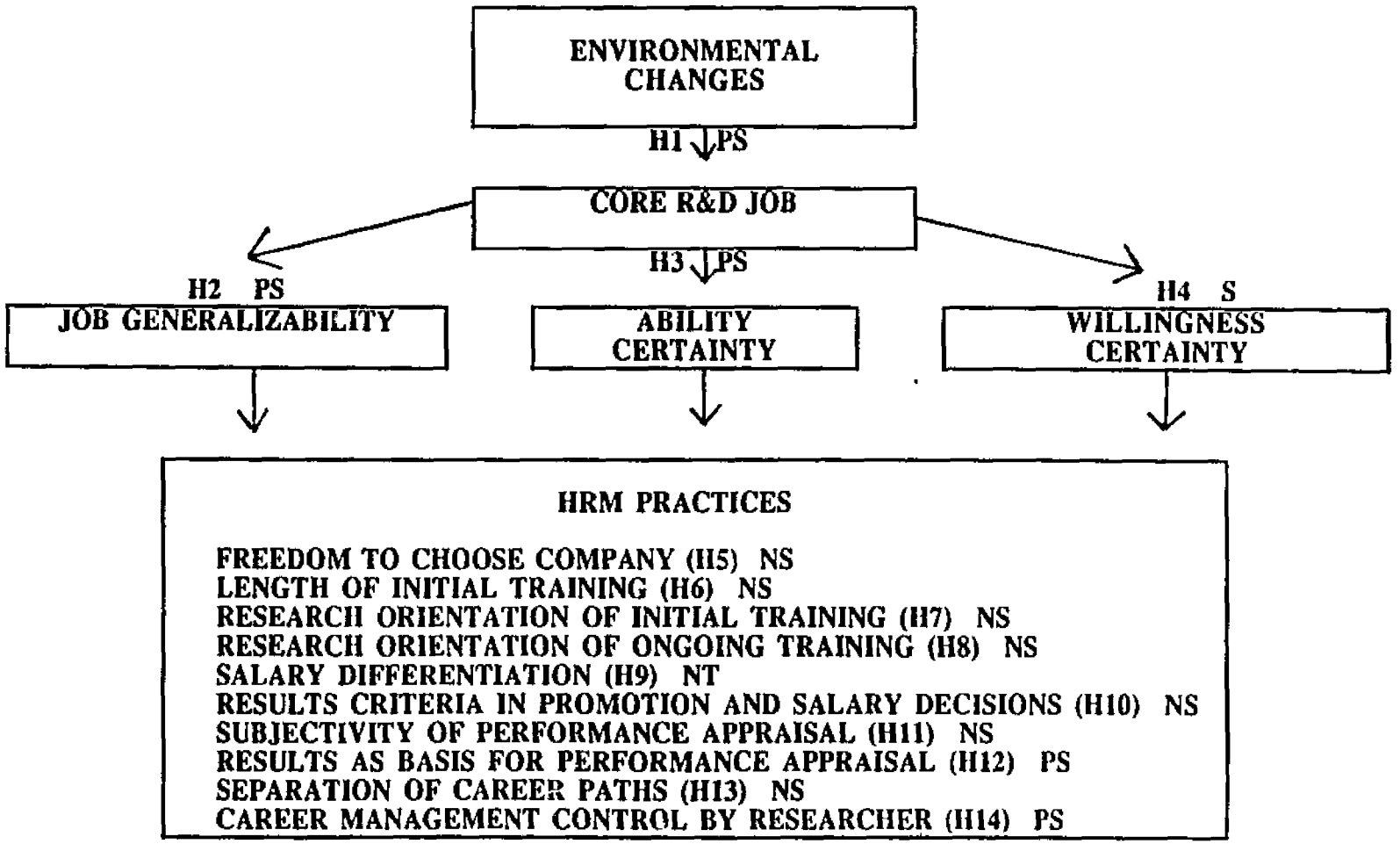

FIGURE 8.1
MODEL OF INFLUENCE OF TRANSACTION COSTS ON HRM PRACTICES
SUMMARY OF RESULTS

S = SUPPORTED
PS = PARTIALLY SUPPORTED
NS = NOT SUPPORTED
NT = NOT TESTED
SO = SUPPORTED BUT OPPOSITE SIGN(S) FROM EXPECTED

FIGURE 8.1 CONTINUED

employee behavioral aspect of uncertainty, however, was seen as having two distinct faces. The first was ability certainty, that is the degree to which employees feel that they can continue to use their specialized skills within only one area of the firm, and willingness certainty, the degree to which employees feel they can and are willing to work in areas outside of their specialization. Rather than uncertainty over the employee's willingness to put forth sufficient effort, the firm is uncertain about the employee's ability and willingness to work in other than the R&D area. It was proposed that this would lead to a decrease in the flexibility of the employee to adjust to changes in the firm's competitive directions, and hence decrease the willingness of the firm to commit to a long-term employment relationship such as embodied in an ILM structure.

This conceptualization of the transaction cost of uncertainty received some support from the results of this study. The two faces of uncertainty, ability certainty and willingness certainty, were found to be negatively correlated with each other, as would be expected. Both were found to be statistically significant determinants of the core R&D job, although willingness certainty was only weakly significant. In short, there does seem to be some justification, when examining the employment relationship of professionals, for defining the uncertainty aspect of the employment relationship as related more to ability and willingness rather than effort. It is likely that the effort component of behavioral uncertainty is of less importance because the professionalism of the researchers leads them to put forth this effort. Professionalism in this context refers to the specific characteristic of commitment to the work and the profession, of having a 'calling' (VonGlinow, 1988). The sense of 'calling' and commitment to the profession elicits sufficient effort that the firm does not have to be greatly concerned about this source of uncertainty. In sum, this study argued that the definition of the transaction cost of uncertainty is dependent on both the kind of transaction and the parties involved in the transaction. This research has provided

support for the idea that when the transaction involves compliance through job performance it is necessary to examine the kind of behavior that is required and the source of the uncertainty concerning its provision.

In addition to providing support for a conceptualization of uncertainty in the employment relationship somewhat different from that proposed by Williamson (1975; 1986), the results of this study indicate that the transaction costs theory can be a tool for studying transactions in the real world. This research provides support for the link between differences in the core job and varying levels of transaction costs. An important component of the model utilized in this research is the proposed link between what employees must do in their jobs - their core job tasks - and the kinds of transaction costs associated with these tasks. In this study, it was hypothesized that as the core R&D job of researchers became focused on more upstream research activities, emphasizing radical breakthroughs, that the transaction costs of ability certainty, willingness certainty, and job generalizability would be different than for researchers focusing on producing incremental innovations. The results of this study support this link, although the connection between the radicalness of the R&D job and willingness certainty received only weak support. This suggests that with an understanding of the transaction costs associated with an exchange, the parties to it can become more aware of the kind of contract that is appropriate. Consequently, the confirmation of the existence of varying levels of transaction costs associated with different core R&D jobs is an important contribution to theorists and practitioners alike. For theorists the present study has provided a clearer specification of the elements of transaction costs that are important when studying employment relationships than previously available. It is thus an addition to the growing number of studies that have successfully applied a transaction costs approach to studying exchanges of various kinds, some of which were discussed in Chapter Two.

For HRM practitioners the results of this study provide encouragement to take the transaction costs of an employment relationship into account when designing the HRM system. It is clear that transaction costs do vary with the type of employee and core job of the employee. The implications of the existence of different levels of transaction costs on the potential mobility of employees and on the firm's ability to deploy them is an important consideration for HRM practitioners. It should help in determining what HRM policies are best suited to managing employees by giving a clearer understanding of how the employees see their exchange relationship with the firm.

In light of the previous statement, it is unfortunate that the results of this study did not offer much support for variations in transaction costs leading to different governing mechanisms. It was proposed that different levels of transaction costs would result in the adoption of different HRM policies to govern the employment relationship. With the exception of career management control and basis of performance appraisal, there was no support for the expected relationships between transaction costs and HRM practices. In short, there was no real evidence that the governing mechanism changes with a change in transaction costs. Thus an important link in the model, and an important part of the transaction costs theory, did not receive support from the results of this study.

Some of the possible reasons for these lack of statistically significant results have been discussed in the previous chapter, Chapter Seven. The central idea in these explanations is that the governing mechanism will change in response to the changes in transaction costs, but it may require some time before this occurs. This has implications for transaction costs theory in that it is important to recognize that the governing mechanism in place at any particular time may not be the one best suited to the present transaction costs of the exchange. That is, the nature of an exchange may evolve over time, thus significantly modifying the transaction costs, but the contract governing the exchange may

not change immediately in response. Some short term inefficiencies may occur as a result. In the present study, for instance, one possible inefficiency is provision of lengthy, general initial training for researchers who will not need the knowledge to effectively carry out their jobs.

There are several implications of this finding of a lag time in adjustment of the HRM system for transaction costs theory. First this suggests that while the tasks and transaction costs of an exchange may be modified by changes in the conditions surrounding the exchange, the mechanism governing the system may be resistant to change. Granovetter's (1985) ideas concerning the social embeddedness of transactions may provide some light on this phenomenon. Social embeddedness is "...the argument that the behavior and institutions to be analyzed are so constrained by ongoing social relations that to construe them as independent is a grevious misunderstanding" (Granovetter, 1985:482). Granovetter asserts that quite apart from the institutional arrangements that are instituted to deal with the transaction costs of an employment relationship are "...concrete personal relationships and the obligations inherent in them" (1985:489). Granovetter is most concerned with the transaction costs that can arise from a breach of trust and from malfeasance. What Granovetter's argument elucidates in the present context is that it may not be that employers and employees place total reliance on the institutional arrangement to ensure fulfillment of the employment contract under a certain set of transaction costs. Instead, it may be a combination of a social network and an institutional framework that gives both parties a sense of security that the employment contract will be carried out. In the present study there may be tremendous pressure to change the institutional form, to move toward an externalized HRM system, due to changes in transaction costs, but an inability on the part of employers in particular to give up a known system of personal relations which they feel has been a critical buttress to the institutional arrangement. This

study suggests that the social relations in place to support one institutional arrangement may serve as a drag on switching to another institutional arrangement.

Research in the future should attempt to operationalize Granovetter's (1985) concepts of breach of trust, malfeasance, and the benefits of social networks for ensuring that a transaction is carried out. These should be measured along with perceptions of changes in the transaction costs of an employment relationship to determine whether social embeddedness theory has explanatory power for the lack of predicted changes in the governing mechanism of a transaction.

A second implication of the lack of adjustment in the HRM policies concerns the testing of the transaction costs theory. It shows that tests of the transaction costs of an exchange must take into account that measurement at one point in time may be insufficient. That is, multiple measurements over time are probably necessary in order to ensure that the governance mechanism appropriate to a certain set of transaction costs has been instituted. Such multiple measurements would also provide indications of the time required for adjustment in different firms and industries, and if other phenomena such as social embeddedness and managerial beliefs were also measured, could provide valuable information on the factors that affect how much transaction costs influence institutional arrangements.

8.3 Implications for ILM theory

The theoretical model utilized in this study was based in part on the idea that the nature of an employee's core job can be influenced as a result of changes in the firm's external environment. As described in Chapter Two, both Osterman (1984b) and Williamson (1975; 1986) argued that these changes in core job could in turn lead to pressure on the firm to change the way in which it manages employees, such as to move an industrial ILM toward a craft ILM.

Based on the evidence from this study, it appears that there is an influence of changes in the external environment on the core job of employees. In this research it was found that the greater the perception of technological uncertainty in the external environment, the more the researcher perceived his core R&D job to be one of producing significant innovations that affect the firm strongly. Thus a key component of ILM theory as proposed by Osterman (1984b) was supported.

Does a firm move an industrial ILM toward a craft ILM due to changes in transaction costs, as predicted by the model? Or does a firm retain an industrial ILM that is already in place but make changes to accommodate the changed transaction costs? It is too early to determine which of these will be the final outcome. Interviews strongly supported the notion that changes will occur, but there was great uncertainty concerning the extent and kind of changes most likely to occur. In particular the compensation and promotion system seemed the least likely to be radically changed in the near future, although greater emphasis on merit in salary determination was often mentioned as evidence of change. The compensation and promotion system is seen as the backbone of the present industrial ILM system and the basis of the egalitarian culture that inhibits strong destructive interpersonal conflict in the R&D laboratory and elsewhere in the firm. Tampering extensively with the present industrial ILM system may result in unwanted consequences, a fact that many R&D managers mentioned. As a consequence, they were uncertain about how far they could go in changing the present industrial ILM system toward a craft ILM. Future research must determine how ultimately the system was adjusted.

A central controversy in ILM theory, described in Chapter Two, is whether the impetus for implementing an ILM is mainly economic in origin or not (Osterman, 1984a; Kerr, 1954; Braverman, 1974; Williamson, 1975). The results of this study do not provide any clear support for either side in this debate. The fact that no clear evidence of

changes in HRM practices were found makes it impossible to draw any conclusions concerning this point. Moreover, the cultural versus economic determinism controversy over the origin of Japanese management practices cannot be moved closer to a resolution by the results of this research. If this study is repeated in a few years, after sufficient time for changes in HRM policies has passed, then more of a definite contribution to settling these controversies can be made.

8.4 Implications for HRM theory and practice

The results of this study have some clear implications for R&D managers and personnel managers, as well as for HRM theorists.

For HRM theorists there is a contribution from the research findings to the recent theoretical and empirical work being carried out regarding the link between corporate strategy and HRM practices (Fombrun, 1984; Schuler and MacMillan, 1984; Schuler and Jackson, 1988). Recent work in this area has focused on the intermediate link of employee behavioral characteristics which exists between corporate strategy and HRM practices (e.g. Schuler and Jackson, 1988). The present research contributes to this body of work by providing evidence that employees' perceptions of their core job, and hence presumably their behavioral characteristics, vary with perceived changes in the technological environment surrounding the firm. Changes in technological environment often affect corporate strategy (e.g. Hambrick, 1983). Thus some confirmatory evidence for theories proposing a strategy-HRM link is provided by the fact that the researchers in this study felt that, as the technological environment becomes more uncertain, their core job becomes more focused on producing research that has a strong impact on their firms.

For HRM practitioners and R&D managers, particularly Japanese HRM practitioners and R&D managers, there are at least two implications of the results of this study. This study provides evidence that researchers who are performing different core

jobs have different perceptions of the transaction costs of their employment relationship. Of particular interest in this regard is the fact that researchers who perceive their core R&D job as having a strong impact on the firm they work for also perceive that their skills and knowledge are mostly of utility only in the R&D laboratory. Moreover, these same researchers have a stronger perception of their ability to change jobs and work in the R&D lab of another firm. In short, these researchers view themselves as specialists with a restricted usefulness to any particular firm but a usefulness that can be utilized in many different firms.

This perception of having greater inter-firm mobility presents several challenges to those who manage researchers. First, there is the greater possibility that research specialists who are dissatisfied with their work conditions may actually move to another firm now that the exit option is more viable (Mowday, 1982; Hirschman, 1970; Hasegawa, 1988). It is interesting in this regard that many of the researchers interviewed said that if they were to quit it would be because of assignment to a research project or work area that they did not like or that they felt did not use their skills and knowledge. Given the increasing willingness of employees of large Japanese firms to change jobs, the perception of research specialists that they can move to another firm presents the challenge to managers to ensure the job satisfaction of researchers. Second, as discussed by Mosk (1989), one of the trade-offs of providing permanent employment to employees in the past was the flexibility of job assignment retained by the firm. Flexibility in employee deployment was an important way to contain the labor costs associated with a restricted ability to lay off or fire workers. The results of the present study suggest that researchers view themselves as less flexible with regard to job assignment. Consequently, the prior trade-off may no longer be feasible, and it may be necessary to re-think the long-term employment commitment to researchers embodied in the present HRM system. In short, if

Japanese firms can no longer count on the ability of researchers to fit in where they are needed in the firm, then the firm's ability to forego the right to lay off or fire may be decreased.

8.5 Limitations of the study

The research was limited in some respects. First, there were very few prior empirical studies of the transaction costs of the employment relationship upon which to draw in formulating the study's design and creating the research questionnaire. As a consequence the majority of the measures used to test the research hypotheses were developed for this study. While good reliabilities were obtained, further refinement and validation of the measures are necessary, particularly in light of some of the relatively high intercorrelations between the variables that were observed. The large number of measures that were found to be generalizable to the sample of R&D managers does provide some indications of the reliability of the measures.

A second limitation is that the research relied almost exclusively on questionnaire and interview data to answer the research questions. Archival data such as personnel records and company personnel manuals would have been very helpful in measuring some of the constructs more completely, such as HRM practices. The limited time and resources of the researcher were some of the reasons why archival data were not utilized. In addition, there is usually a decrease in willingness to participate in a study when archival data are requested.

Third, the interview data may have suffered from interview bias as well as from the non-native status of the researcher. With regard to bias, the researcher could not cross-check the interview data with each interviewee because the interview notes were written up in English, which many interviewees could not read easily. In addition, the sheer number of interviewees made such cross-checking infeasible. However, the audio tapes of the

interviews did provide the researcher with a way of checking the information. The non-native status of the researcher was also a concern. It is possible that this may at times have led to mis-interpretations or an inability to capture subtleties.

The research project contributed valuable insights, both theoretical and practical. While the generalizability of these insights may be somewhat restricted by the limitations discussed above, they offer fruitful suggestions for areas of future research.

8.6 Future research

There are a number of future research questions suggested by the results of the present study. Perhaps the most fruitful area for further exploration are the transaction costs of the employment relationship. The results of this study strongly indicate that there is a connection between the core job of an employee and the transaction costs of job generalizability and ability certainty. Further research is needed to investigate why the transaction cost of willingness certainty did not have the predicted influence within the model. Further interviews with a subset of the questionnaire respondents could contribute firm conclusions as to why all employees, regardless of the differences in their core job tasks, seem to have equal certainty about their willingness and ability to work elsewhere in the firm. On the other hand, it is possible that further measurement refinement would enable researchers to capture this hypothesized relationship. The relatively high correlation between ability certainty and willingness certainty suggests that measurement refinement may be a fruitful avenue for future work.

In addition to determining why one of the transaction costs was not found to vary as expected, future research should investigate the generalizability of these transaction costs concepts to other groups of employees. For example, is job generalizability affected as much by differences in core job for other employees as it is for R&D researchers? Is ability certainty likewise equally affected? Does willingness certainty vary more for other groups

of employees than was found for the R&D setting? Or does the specification of the transaction costs of the employment relationship vary across groups of employees such that the measures developed for this study do not apply except to R&D researchers? Both quantitative and qualitative research will be needed to pursue the answers to these questions. One setting in which the generalizability of the transaction costs concepts could be tested is the Japanese financial industry, which is undergoing considerable change due to the liberalization and internationalization of the market. There has been a scramble to hire individuals with the appropriate skills who can work with the new kinds of financial instruments. Another sample of interest might be the international division of large Japanese firms, which due to the increasing globalization of Japanese industry need a different type of employee from those in previous periods.

Another aspect of the transaction costs that requires further investigation is identification of factors which affect the level of transaction costs beyond the core job of the employee. Neither Williamson (1975, 1986) nor previous empirical studies of the transaction costs of the employment relationship (e.g. Bills, 1987; Wholey, 1985) examined the effects of personal factors on the level of transaction costs such as age, educational level, and field of specialization. For example, younger employees may perceive higher levels of job generability because they have not yet been with their firms long enough to specialize their knowledge and skills to the firm. In the course of the investigation of this study factors such as those discussed above were suggested as additional contributors to the level of transaction costs, in addition to the core jobs of the employees. Questionnaire data was gathered on most of these factors and will provide a way of determining the degree of in-sample variance along these dimensions. These possible effects were not investigated in the present study as the model that served as the basis of the research did not specify their potential influence. However, it is quite likely

that age, for instance, may have an influence on an employee's perceptions of the transaction costs of the employment relationship, particularly with regard to job generalizability. Thus there are a number of factors suggested by this study that I intend to explore using the data gathered in the present study that may provide an enriched model of how transaction costs influence the employment relationship.

As mentioned previously, a further transaction costs area worthy of further investigation is the identification of the factors that hinder changes being made to existing employment contracts. The research found few changes being made in employment contracts as a result of changing levels of transaction costs. What are the reasons for this apparent 'stickiness'? Possible reasons include the previously discussed factor of social embeddedness (Granovetter, 1985). Prior research also suggests that one possible reason may be managers' beliefs about the desirability of a particular HRM system sometimes overrides efficiency determinants of the system (Bills, 1987). Interviews with some of the R&D managers undertaken for the present study lend some support to this view. It is possible that simple organizational inertia is responsible for some of the lack of response. Alternatively, it may simply be a delay while the best kind of a new HRM system is sought. The personnel director at one R&D lab, for example, was sent on a fact-finding trip to the U.S. to determine how R&D management and HRM systems are designed to fit the more ELM employment contract which prevails in that country. Finally, the size of the unit affected by the changes in transaction costs may be a factor. That is, the R&D section of most firms may simply not be of a sufficient size relative to the size of the rest of the organization. It was not possible, due to time and resource limitations to gather data in the present research concerning the reasons why changes in transaction costs may not be accommodated quickly in the form of a new HRM system. After gathering further data

from the companies that participated in this study concerning the possible sources of 'stickiness', I will be able to provide answers to this question.

In addition to the apparent 'stickiness' of HRM systems, a question raised by the results of this research is whether HRM systems are changed piecemeal or in their entirety, at one time. The results of the study suggest that there may be some 'tinkering' with parts of the HRM system to adjust to changing transaction costs before an entire overhaul is undertaken. For example, career management control and the basis of performance appraisal were found to be affected by changes in transaction costs, while other HRM practices were not. Interviews with R&D managers and personnel managers suggest that in fact HRM systems are changed slowly, beginning with relatively 'peripheral' areas such as career management control that are considered more flexible than such HRM practices as the salary and promotion system. It was suggested that such changes are made as a response to the pressure for change while more long-term and far-reaching adjustments are slowly implemented. Data concerning which HRM practices are changed first, if indeed a piecemeal approach is followed, will be gathered at the same time as the data on the causes of the 'stickiness' of the HRM practices is obtained.

Another way to investigate which HRM practices change first is to examine the Japanese financial industry, which as mentioned previously has been undergoing severe changes in the competitive environment with great effects on the HRM systems. Examination of archival data over that last ten years would provide researchers a portrait of the initial changes made in HRM policies to cope with the pressures. In addition, comparison with research into the HRM systems of Japanese subsidiaries in other countries would provide researchers insights into the aspects of the HRM system that are most resistant to change. For example, a recent study of American managers in Japanese subsidiaries in the U.S. found that there was little use of incentive rewards, a cause of

considerable dissatisfaction (Pucik, Hanada, and Fifield, 1989). This research direction could provide valuable information on the influence of national origin of a firm on changes in HRM systems.

The data gathered for the present study as well as the additional data obtained to answer the questions just outlined can then be compared with samples drawn from similar populations in other developed countries. This comparison will lead to a model of the factors that shape the transaction costs of an employment relationship that has universal applicability, and help determine the degree to which the transaction costs framework is a culture-free model. A particularly appropriate locale would be those member countries of the EEC such as France and Germany that are facing changes in the technological environment similar to those occurring in Japan.

Finally, an area of potentially fruitful research is suggested by the results of the Scheffes' tests conducted to establish the differences in perceptions between the R&D managers and the researchers. One question raised by the results is why there are so many differences between the R&D managers and researchers' perceptions concerning the area of performance appraisal and the criteria upon which promotion and salary decisions are made. The R&D managers see the performance appraisal as less subjective, the basis of performance appraisal as emphasizing individual results, and the criteria for promotion and salary decisions as individual performance and results. I will conduct further research into the two groups, which will require that the constructs be measure more completely than was possible in this study. This additional data will help establish whether these differences exist in other samples drawn from the same population, and will investigate the reasons for the differences in perceptions. For instance, it may be that there is unintentionally poor communication between managers and researchers, or alternatively that there is a desire on the part of managers to keep researchers uninformed of the true

nature of performance appraisal and compensation systems. Several interviews with R&D managers suggested that a desire to keep researchers uninformed may be a key motivation. The reason given for providing little performance feedback was that this leads to clear differentiation between researchers and could be demoralizing for those performing below average. Obviously such an attitude implies that the purpose and use of performance appraisals in Japan are far different from in the West, and valuable insights could be gained from further investigation into this question. The answers to such questions have important consequences for theorists studying performance and compensation issues, as well as for the Japanese managers of the firms in which these researchers work, particularly if the differences are due to unintentionally poor communication.

8.7 Summary

The research undertaken to answer the questions embodied in the hypotheses was carried out with sufficient success to suggest that the theoretical model that forms the basis of this study is well enough specified to permit testing. As discussed in the limitations and future research sections, however, the present research is only the first step in the testing of the model and, while offering valuable insights and conclusions, has raised at least as many questions as it answered.

ENDNOTES

Endnote 1

Other scholars who work emphasizes the way in which historical forces and economic efficiency goals influenced the shape of Japanese employment practices include Fruin (1983) and Garon (1987). Fruin's work provides evidence of the evolution of the Japanese employment relationship toward the present industrial ILM subsystem from a very externalized relationship. Garon's account documents the clear role the state played in molding Japanese labor relations, particularly the influence of its overriding goals of ensuring the creation of a sound, stable labor force to aid in achieving the economic growth of the nation.

Endnote 2

As Teece (1988) has recently pointed out, whether an innovating firm actually reaps the economic benefits depends to a large extent on the appropriability regime that surrounds it, the nature of the dominant design paradigm, and the existence of complementary assets to bring the innovation to market. For a more complete description of these constraints, see Teece (1988).

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APPENDIX A

QUESTIONNAIRE - JAPANESE VERSION

アンケートに御協力をいただきありがとうございます。ここでこのアンケートを含めた私の研究の目的を簡単に説明させていただきます。

日本が国際的な競争でトップの座を維持するためには、日本企業が今後の激しい変化にいかにうまく適応することができるかという一点にかかっています。現在日本企業が直面する最大の課題は、新しい技術革新にどう対応していくかということだといえましょう。このことは日本の企業における研究技術者や科学者の位置づけがますます重要になることを示唆しています。つまり研究開発部門の人材が、いまやこれからの競争戦略における最も重要な要素の一つになったといえるのです。すなわち研究開発部門の人材をいかに企業が使いこなすことができるかが、成功を握る一つの鍵になると思います。

この研究プロジェクトは以上のような問題関心のもとで、次の事柄を中心課題としています。

まず、(1) 日本企業は現在、技術のあり方に対する方向転換期に直面しており、ある企業は従来の技術改良型からまったく新しい技術革新型へと向っています。(2) その結果、研究開発（R&D）の役割が技術革新や発明／発見に重点がおかれるようになり、従来のR&D人材に対する考え方に基本的な変更をせまられることになります。従来の人事管理制度は主に新卒採用、年功序列型の昇進、昇給等にみられるように"内部労働市場"とよばれるものでした。(3) したがってこの人事システムも企業の技術のあり方の変化にともなって、新しい方向へと移りつつあるだろう。以上の3つの仮説が立つことになります。そしてこの研究で明らかにしようとしていることは、その人事システムの変化とはどのようなものなのかということです。

さらに本研究では次の二点についても明らかにしようとしています。ひとつは、低成長の産業と急成長しつつある産業では、R&D部門の雇用方法にどのような違いがあるのか、もうひとつはそれぞれの産業における研究者の研究タイプ（基礎研究、応用等）によってどのような雇用形態の違いを生んでいるのか、という二点です。

このアンケートへの御回答を得ることは、企業、日本政府の政策担当者、また日本へＲ＆Ｄ設備投資をしている外国の企業にとっても重要な意味を持つと考えます。

結論として本研究プロジェクトは、日本が他の先進国と並んで、技術と経営管理の変換期に立った時、どのようなＲ＆Ｄ人事を行えばよいのか、そのポイントとなる情報を提供するものと考えています。

以上で、この調査の主旨がおわかりいただけたかと思います。つきましてはこのアンケート用紙にぜひとも回答していただき、この研究の成功のために御協力をお願いする次第です。あなたのお答えの秘密は厳守いたします。あなたの回答は、会社の他のＲ＆Ｄスタッフのものと一緒に回収されます。どうぞこのアンケートに御回答下さい。およそ２５分位かかると思いますがよろしくお願いいたします。書き終りましたら、その用紙を下記の方に提出して下さい：

Sully Taylor
Ph.D. Candidate, University of Washington,
Graduate School of Business
Fulbright Research Fellow,
Hitotsubashi University

〔 1 〕 あなたの会社の人事管理について

1. 私は、大学在学中にいまの会社にリクルートされました。

はい　　いいえ

2. 私はいまの会社に入る前に他の企業で働いていました。

はい　　いいえ

3. 上の質問(2) で「はい」と答えられた方、研究開発部門に限っていえば何社位で働いた経験がありますか。

＿＿＿＿＿＿ 社

4. 出身大学はどちらですか。

＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿

5. もし「修士」もしくは「博士」の学位をお持ちの場合、どちらの大学から取得されましたか。

＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿

6. あなたの最終学歴について（学位を書いて下さい。）

＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿

7. 大学では何を専攻されましたか。（学科あるいは学系を記入して下さい。）

＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿

	まったくその通り	かなりそうだといえる	どちらかといえばその通り	どちらかといえば違う	かなり違うといえる	まったく違う
8．就職先を決める際、自分の大学の教授達から受けた影響が大きく左右しました。	1	2	3	4	5	6
9．私は自分の望み通りの会社を自由に選ぶことができました。	1	2	3	4	5	6

10．あなたがいまの会社に入られた当時の年令は？

＿＿＿＿＿＿ オ

11．現在の年令は？ ＿＿＿＿＿＿ オ

12．私の入社当時の初任給は、他の研究開発技術者や科学者のそれと比べてほんのわずか高かったように思います。	1	2	3	4	5	6

13．あなたの入社当時、最初の研修期間はどのくらいでしたか。

＿＿＿＿＿＿ 週間

14．私の受けた最初の研修は、事務系の新入社員のそれと同様でした。	1	2	3	4	5	6
15．私が初めて受けた研修は、主に研究に関連した専門知識に関するものでした。	1	2	3	4	5	6
16．入社以来受けてきた研修は、ほとんど自分の意志によって受けたものです。	1	2	3	4	5	6
17．入社以来受けてきた研修は、主として研究に関連した技術的なものです。	1	2	3	4	5	6
18．入社以来受けてきた研修は、自分の会社外のプログラムで、他社の参加者と共に受けたものがほとんどです。	1	2	3	4	5	6
19．私はしばしば、自分の専門知識に関する会議に出席します。	1	2	3	4	5	6
20．私は自分がどの技術会議に出席するか、ほぼ自分の意のままに選択することができます。	1	2	3	4	5	6
21．私はわが社のどの研究プロジェクトに参加するか、ほぼ自分の意のままに選択することができます。	1	2	3	4	5	6

	まったくその通り	かなりそうだといえる	どちらかといえばその通り	どちらかといえば違う	かなり違うといえる	まったく違う
22. 私がどの研究開発プロジェクトに参加するかを決めるのは、すべて私の上司です。	1	2	3	4	5	6
23. どの研究プロジェクトに参加するかを決める際、通常は、自分の希望を考慮に入れてもらえます。	1	2	3	4	5	6
24. 私は、自分の現在の給料は、研究開発部門で自分と同等の職階にある他の人々のそれよりは幾分多いように思います。	1	2	3	4	5	6
25. 自分の昇給は、自分自身の仕事ぶりによって大きく左右されます。	1	2	3	4	5	6
26. 私は、自分の現在の給料は、研究開発部門で自分と同等の職階にある他の人々のそれよりは幾分少ないように思います。	1	2	3	4	5	6
27. 自分の昇給は、勤続年数のみで決められているように思います。	1	2	3	4	5	6
28. 私は、会社が私の昇進あるいは昇級を決定する際、私の年令を非常に重要な要素としているように感じます。	1	2	3	4	5	6
29. あなたが最近昇進あるいは昇級したのは、何年前のことですか。 _____ 年前						
30. 私は、会社が私の昇進あるいは昇級について検討する際、私の研究開発の成果を非常に重要な要素として考慮に入れていると思います。	1	2	3	4	5	6
31. 私の場合、昇進あるいは昇級しなければ大幅な昇給につながりません。	1	2	3	4	5	6
32. あなたは研究開発部門で何年働いていますか。 _____ 年						
33. 私の会社では、ライン長にならない管理職研究者がいます。	1	2	3	4	5	6
34. 私の会社では、ライン長になる研究者とライン長にならない研究者の待遇は平等です。	1	2	3	4	5	6

［ 2 ］ あなたの専門知識および研究技能について

	まったくその通り	かなりそうだといえる	どちらかといえばその通り	どちらかといえば違う	かなり違うといえる	まったく違う
1．私の現在の研究技能は、いまの会社で常に役に立つと思います。	1	2	3	4	5	6
2．私の現在の専門知識は、向こう５年間はわが社の研究開発に非常に役に立つと思います。	1	2	3	4	5	6
3．もしわが社の技術の方向が変ったとしても、この企業で研究開発を続けるために必要な新しい科学技術を学ぶことができると思います。	1	2	3	4	5	6
4．私の現在の専門知識は、向こう１０年間はわが社の研究開発に非常に役に立つと思います。	1	2	3	4	5	6
5．私は自分の持つ研究技能および専門知識から、わが社が必要としている様々な技術革新を生みだすことができると確信しています。	1	2	3	4	5	6
6．私が、もしわが社にとって重要な革新につながるような重大な技術の発見を一度したなら、それから後もさらに発見を重ねることができるとかなり確信しています。	1	2	3	4	5	6
7．私が良い仕事をしているかどうかを、私の上司は簡単に判断できます。	1	2	3	4	5	6
8．私の上司は私の業績評価をする際に、私がどれほど会社のために新技術知識を生みだしているかということを基本とした判断をすると思います。	1	2	3	4	5	6
9．私の仕事は単なる技術研究以上のもの（たとえば、事務管理および外部のグループとのコミュニケーション等）を含んでおり、したがって私の上司が私の仕事ぶりすべてについて判断するのはむずかしいと思います。	1	2	3	4	5	6
10．私の仕事は単なる技術研究だけではありません。	1	2	3	4	5	6
11．私がすべての仕事をうまくこなしているかどうか、上司に正しく伝えるのはむずかしいです。	1	2	3	4	5	6

	まったくその通り	かなりそうだといえる	どちらかといえばその通り	どちらかといえば違う	かなり違うといえる	まったく違う
12．私が良い仕事をしているかどうか判断する能力について，私の上司達は少し自信がないように思います。	1	2	3	4	5	6
13．自分の会社の技術の方向が変わった場合，私は，いまの企業でそのまま研究開発に従事し続けるために，自分の専門分野と異る新しい技術を学ぶことを厭いません。（たとえば，半導体材料から磁気材料まで）。	1	2	3	4	5	6
14．あなたの会社が全く異る技術への方向転換を決定し，そのためにあなたの持っている専門知識が今ほど有効でなくなった場合を考えてみてください。このような状況で，次のことばにどの程度同意しますか？：私は研究開発部門から，社の他の部門，たとえば生産あるいはマーケティング部門にスムーズに移ることができます。	1	2	3	4	5	6
15．将来私は，研究開発部門から社内の他の管理部門に変わりたいと思います。	1	2	3	4	5	6
16．私は，研究開発部門以外の部門の管理職に異動することを厭いません。	1	2	3	4	5	6
17．将来私は，いまの研究開発部門から，社内の生産部門に変わることになると思います。	1	2	3	4	5	6
18．私はいまの研究開発部門から，社内の生産部門に変わってもかまいません。	1	2	3	4	5	6
19．私はこの会社の成功のために，通常与えられた範囲以外の仕事にも努力を惜しまないつもりです。	1	2	3	4	5	6
20．私はこの会社で長く働きたいので，ほとんどどのようなタイプの仕事も与えられれば，厭わずするつもりです。	1	2	3	4	5	6
21．仕事のタイプが同じである限り，他の会社でも同じように働いてもよいと思います。	1	2	3	4	5	6
22．私の現在の状況では，この会社をやめても大した違いはないと思います。	1	2	3	4	5	6
23．この会社にいつまでかかわっていても，それほど得るものはありません。	1	2	3	4	5	6
24．私はこの会社の将来をとても気づかっています。	1	2	3	4	5	6

25．下記の項目は、あなたの会社で研究開発に携わる科学者や技術者が受けている評価について述べたものです。それぞれの項目についてどの程度同意できるか、適当なものに○をつけて下さい。

	まったくその通り	かなりそうだといえる	どちらかといえばその通り	どちらかといえば違う	かなり違うといえる	まったく違う
a．わが社の研究技術者および科学者の仕事の評価は、その研究プロセスやその努力のいかんよりも、結果で決まります。	1	2	3	4	5	6
b．わが社の研究技術者および科学者の評価は、彼らの上司個人の主観的評価が重要視されています。	1	2	3	4	5	6
c．わが社の、最も重要な研究技術者および科学者の評価は、定期的な公式の一対一による評価インタビューです。	1	2	3	4	5	6
d．わが社の研究技術者および科学者の仕事への評価は５～１０年を単位に行われるので、彼らの可能性や本当の能力がわかります。	1	2	3	4	5	6
e．わが社の研究技術者および科学者の給与の額は、それぞれの仕事ぶりのよしあしによって決まります。	1	2	3	4	5	6

［ 3 ］ あなたの研究動機について

	まったくその通り	かなりそうだといえる	どちらかといえばその通り	どちらかといえば違う	かなり違うといえる	まったく違う
1．私の受けた社内研修は、社内でのみ役に立つものです。	1	2	3	4	5	6
2．もし私が他の会社に移るとしても、自分のいまの仕事の技能はそのまま生かすことができると思います。	1	2	3	4	5	6
3．私のいま持っている研究に関する研究技能（すなわち、研究技法や研究装置の知識）は、いまの会社と同業界なら他の企業に移ったとしても有効だと思います。	1	2	3	4	5	6
4．私の専門知識はいまの会社と同業界なら、他の企業でも有効だと思います。	1	2	3	4	5	6
5．私の仕事をうまくやっていくためには、私の研究室外の人々と知り合うことが大変重要です。	1	2	3	4	5	6
6．良い仕事をするためには、自分の企業の政策や手続きを十分に把握していることが大切です。	1	2	3	4	5	6
7．もしいまの会社と同業界で、他の会社の研究開発室に移ったとしても、短期間で自分の仕事の効果を１００パーセントあげることができると思います。	1	2	3	4	5	6
8．自分の仕事の中で、どちらかといえば私は、自分の専門分野での評価を高められそうな研究開発プロジェクトに携わりたいと思います。	1	2	3	4	5	6
9．自分の仕事の中で、どちらかといえば私は、組織での昇進につながるような研究開発プロジェクトに携わりたいと思います。	1	2	3	4	5	6
10．私が参加する研究プロジェクトの選択をするとしたら、会社での地位向上を遅らせるようなことがあっても、社内外の同僚や専門家から認められるような研究を選びたいと思います。	1	2	3	4	5	6

11. 下記のリストは、仕事から得られるさまざまなメリットを述べたものです。あなたが仕事を探すとすれば、下記のそれぞれをどの程度重要視しますか。（あなたの現在の仕事とは関係なく答えて下さい。）

	絶対に重要	大変に重要	ある意味で重要	少し重要	特に重要ではない	全く重要でない
a. 新しい知識と技能を学び発展させることができる。	1	2	3	4	5	6
b. 自分がいま持っている知識と技能をフルに活用することができる。	1	2	3	4	5	6
c. 良い収入が得られる。	1	2	3	4	5	6
d. 管理部門者としての地位と権威を向上させることができる。	1	2	3	4	5	6
e. 社内の重役と交流できる。	1	2	3	4	5	6
f. 自分の専門分野の評価を得られる。	1	2	3	4	5	6
g. むずかしい、挑戦的な問題に取り組むことができる。	1	2	3	4	5	6
h. 自分のアイディアを自由に活用できる。	1	2	3	4	5	6
i. 自分の分野の幅広い専門知識に貢献できる。	1	2	3	4	5	6

12．あなたの仕事に関連して、あなたにとって何が重要か、次の事柄を大切な順に１から７までにランクづけして下さい。

___ 私の専門分野の名声を築き上げる機会

___ 私の独自のアイディアを実現する自由を得るための自治権

___ 高い給与を得るための社内の昇進の機会

___ 新知識を学び、技能を向上させる機会

___ 私の知識や技能をフルに活用する機会

___ むずかしい問題や新しい課題に取り組む機会

___ 仕事の安定／保証

13．あなたの職業についてどのように考えていますか？　「自分のやりたいことをやっていく」を１、「組織内での地位向上を目指す」を６として、あなたの考えを最も表している程度（１－６）を○で囲んでください。

やりたいことをやる					地位向上を目指す
1	2	3	4	5	6

[4] あなたの仕事について

企業の研究者や技術者の仕事は、産業の基礎になっている技術の性質に応じて異なります。技術進歩には、製品や生産工程の技術革新が徐々に積み上げられるようにして進む「漸進的な進化の段階」と桁違いに改良が進んだり根本的な原理の発見が行われるといったような非連続的な変化を特徴とする段階とがあります。漸進的な進化の段階に現れる積み上げ的な技術革新の例としては、ＶＴＲ（ビデオ・テープ・レコーダ）の録画時間の長時間化や鉄鋼の亜鉛メッキ工程の改良などが挙げられます。これらの技術革新は、インクリメンタル・イノベーションと呼ばれています。非連続的な技術革新の例としては、ＩＢＭの３６０シリーズや集積回路（ＩＣ）やＬＤ転炉（純上吹酸素製鋼炉）が挙げられます。これらの技術革新は、ラディカル・イノベーションと呼ばれています。

以上のようなインクリメンタル・イノベーションとラディカル・イノベーションの区別を念頭において下記の質問事項を読み、現在のあなたの仕事を最も適切に表している答えを○で囲んで下さい。

	まったくその通り	かなりそうだといえる	どちらかといえばその通り	どちらかといえば違う	かなり違うといえる	まったく違う
1．私の主な仕事の責任は重要な技術革新を考え出すことです。	1	2	3	4	5	6
2．私と同じ研究所の他のメンバーが、私の研究している技術を理解していることはめったにありません。	1	2	3	4	5	6
3．私の主な仕事は、わが社の新製品や市場開拓につながるような技術革新を生みだすことです。	1	2	3	4	5	6
4．私は、比較的容易なテクニカルな問題の解決に焦点を置いて研究を行っています。	1	2	3	4	5	6
5．新製品や市場開拓を実現するために、私の会社は研究開発部門で新しい発明を成し遂げる必要があります。	1	2	3	4	5	6
6．私の上司（研究室長）は、私の研究からどのような成果が出ることを望んでいるのかを明確にすることがほとんどできません。	1	2	3	4	5	6

	まったくその通り	かなりそうだといえる	どちらかといえばその通り	どちらかといえば違う	かなり違うといえる	まったく違う
7．私は、技術の流れを大きく変えること（ブレークスルー）に研究の焦点を置いています。	1	2	3	4	5	6
8．私の研究成果は、わが社に非常に強いインパクトを与えることができるはずです。	1	2	3	4	5	6
9．私は自分の望むような研究成果を得るために、どのような手順でことを運ぶべきかについてはっきりと分かっています。	1	2	3	4	5	6
10．私の研究を特徴づけるならば、インクリメンタル・イノベーションを生みだすことです。	1	2	3	4	5	6
11．私の研究の大部分は最先端の研究といえるでしょう。	1	2	3	4	5	6
12．わが社の生産部門のスタッフが私の研究の方向づけに示唆を与えることがあります。	1	2	3	4	5	6
13．私の研究を特徴づけるならば、ラディカル・イノベーションを生みだそうとしていることです。	1	2	3	4	5	6
14．私は個人的に自分の現在の仕事は、自分の専門分野の知識に重要な貢献をすることになりそうだと感じています。	1	2	3	4	5	6
15．わが社のマーケティング部門のスタッフが私の研究の方向づけに示唆を与えることがあります。	1	2	3	4	5	6
16．私の研究が成功するか否かは、研究開発室の他のメンバーとの密接なチームワークに大きく左右されます。	1	2	3	4	5	6
17．私の研究を進める上で必要なアイディアは、ほとんど自分自身で思いついたものです。	1	2	3	4	5	6
18．社内の研究開発部門外のスタッフとの会話は、私の研究に非常に有益です。	1	2	3	4	5	6

	まったくその通り	かなりそうだといえる	どちらかといえばその通り	どちらかといえば違う	かなり違うといえる	まったく違う
19. 私の研究を進める上で必要なアイディアは、しばしば同僚との会話の中から手に入ります。	1	2	3	4	5	6
20. 私の研究にとって、直感にたよるよりも、細心の注意をはらった研究手順にしたがうほうが大切です。	1	2	3	4	5	6
21. 私の行っているタイプの研究では、多くの創造的アイディアを持つというよりは、時間をかけて培われてきた、確固たる研究技能を持つことのほうがより大切です。	1	2	3	4	5	6
22. 私の研究では、時には、理にかなった研究ステップを飛び越えて危険をおかすことも必要です。	1	2	3	4	5	6
23. 私の研究室では新しいプロジェクトが、他者がまだ手がけていない新しいアイディアであれば、そのプロジェクトはほとんど認められます。	1	2	3	4	5	6

24. 私が働いている研究開発室は、

殆ど基礎研究をしている	殆どが基礎研究で多少の開発を行なっている	基礎研究と開発が半々である	殆どが開発で多少の基礎研究をやっている	殆ど開発である
1	2	3	4	5

25. あなたの全勤務時間の中で、下記の事柄について通常どのくらいの割合で時間を費やしますか。（時間が一定でない場合、平均で答えてください。）５％きざみでお願いします。

	時間の割合	
A. 教育と研修	_____	%
B. 教育以外の専門的仕事（研究、他のメンバーの専門的仕事の管理、同僚との共同研究、コンサルタントおよびテクニカル・サービスなど）	_____	%
C. 事務管理およびその他の非専門的仕事（内部の事務管理、上司とのコミュニケーション、外部のグループおよび顧客とのコミュニケーションなど）	_____	%
合　計（100 %になるように）	_____	%

26. 上の設問の B（教育以外の専門的仕事）にもさまざまな活動があります。現在、下記に挙げた目的の各々について、（教育を除いた）時間の何パーセントがあてられていますか。５％きざみでお願いします。

	仕事の割合	
I. 研究と発明（新知識の発見、知識を実用的なかたちにすること）		
A. 広範囲の問題に関連する一般的知識	_____	%
B. 新製品あるいは工程の発明	_____	%
C. 特定の問題を解決をするための特定の知識	_____	%
II. 開発		
D. 特定の製品あるいは工程の設計	_____	%
E. 既存の製品あるいは工程の改良	_____	%
III. 他の人々あるいはグループを手助けするためのテクニカル・サービス（試験、標準技法による分析、コンサルタント、問題解決）	_____	%
IV. その他の目的（具体的に）	_____	%

_____

[5] あなたの研究分野について

下記の項目は、あなたが携わっている研究分野が属している産業を取りまく技術的環境を想定して答えて下さい。あなたの考え、印象に基づき、それぞれの項目についてどの程度同意できるか、適当なものに○をつけてください。

	まったくその通り	かなりそうだといえる	どちらかといえばその通り	どちらかといえば違う	かなり違うといえる	まったく違う
1．私の研究分野では、次世代製品の開発に必要な技術はすでに入手可能です。	1	2	3	4	5	6
2．私の研究分野が属している産業の上位３社の売上高のうち、過去３年間に開発された新製品の売上げが占める割合は１％～５％の間です。	1	2	3	4	5	6
3．私の業界の関連技術は、外部から容易に購入できます。	1	2	3	4	5	6
4．私の業界では新しい技術を必要とするとき、その獲得を困難にする多くの障害があります。	1	2	3	4	5	6
5．私の業界では、技術の流れを変えるような重要な革新（ブレークスルー）は頻繁に現れます。	1	2	3	4	5	6
6．私は自分の業界では、向こう１０年の間に重大な技術のブレークスルーが数多く現れるとみています。	1	2	3	4	5	6
7．私の研究分野が属している産業の上位３社の売上高のうち、過去３年間に開発された新製品の売上げが占める割合は１％以下です。	1	2	3	4	5	6
8．私の研究分野が属している産業の上位３社の売上高のうち、過去３年間に開発された新製品の売上げが占める割合は５％以上です。	1	2	3	4	5	6

下記の質問事項は、あなたの研究分野が属する産業について答えて下さい。実態に最も近い程度の数字を○で囲んでください。

9.

わが社／産業に属する他社はマーケティングのやり方を殆ど変えなくとも市場の変化に遅れたり競争に負けたりしない					わが社／産業に属する他社はマーケティングのやり方を非常にしばしば、ほぼ半年毎に変えなければならない
1	2	3	4	5	6

10.

製品／サービスが陳腐化する速度が非常に遅い（例、銅のような非鉄金属）					製品／サービスが陳腐化する速度が非常に速い（例、ある種のファッション用品）
1	2	3	4	5	6

11.

競争企業の行動を容易に予測できる（例、ある種の一次産業）					競争企業の行動を予測できない
1	2	3	4	5	6

12.

消費者の要求や好みの予測はまったく容易である（例、牛乳）					消費者の要求や好みを殆ど予測できない（例、ハイファッション用品）
1	2	3	4	5	6

13.

生産技術は確立されており、変化することはあまりない（例、鉱業）					生産様式の変化は頻繁に生じ、しかも大きく変わる（例、先端エレクトロニクス）
1	2	3	4	5	6

APPENDIX B

QUESTIONNAIRE - ENGLISH VERSION

Thank you for your cooperation in this questionnaire. Here, I will briefly explain the objectives of my research, as well as this questionnaire.

For Japan to maintain its leading position in international competition will depend solely on whether Japanese companies can respond skillfully to dramatic changes in the future. At present, the biggest task facing Japanese companies appears to be how to deal with new technological innovations. This suggests that the position of research technicians and scientists in Japanese companies will become increasingly important. In short, making R & D personnel one of the most important aspects of their competitive strategies for the future. In other words, I believe that one of the keys to success will be how companies use their R & D personnel.

Based on an interest in the above subject area, this research project concentrates on the following major topics:

Firstly, (1) Japanese companies are presently facing a time of directional change with regard to the state of technology, and some companies are heading towards a completely new type of technological innovation from the conventional type of technological improvement.

(2) As a result, the role of R & D has come to place priority on technological innovation & invention/discovery and urging a fundamental change in the thinking thus-far towards R & D personnel. The conventional personal management system was that known as the "internal labor market", as indicated primarily by the employment of new graduates and seniority-based advancement and rises in salary.

(3) Consequently, this personnel system appears to be moving in a new direction together with changes in the state of technology in enterprise.

The above three hypotheses are taken to stand in my research project. Further, what this research is trying to clarify is what exactly the changes in the personnel system are.

In addition, this research is also trying to clarify the following two points. One is what the differences are in the employment method of the R & D division in low-growth industries and those of rapidly growing industries. The other is what differences arise in the type of employment according to the research categories of researchers (e.g. basic research, application, etc.) in various industries.

I believe that obtaining your responses to this questionnaire will be of important significance to enterprise, Japanese government policy-makers and also for foreign enterprises undertaking capital investment in R & D in Japan.

In conclusion, I believe this research project will provide essential information on what kind of R & D personnel management it is best to undertake at a time when Japan--along with the other leading industrialized nations --is standing on the threshold of an era of change in technology and business management.

I hope you have understood the major points of this research as outlined above. Now, I would ask for your kind cooperation in ensuring the success of this research by filling out the questionnaire. Your answers will be kept in the strictest of confidence and will be collected together with those of other R & D staff in your company. The time required to fill out the questionnaire will take approximately 25 minutes. When you have completed the questionnaire, please send it the address below. Thank you for your cooperation.

(1) REGARDING YOUR COMPANY'S PERSONNEL MANAGEMENT SYSTEM

1. I was recruited by my present company while still at university.

YES NO

2. I worked for another company before entering my present company.

YES NO

3. If you answered YES in question 2) above, how many companies have you worked in (limited to work of an R & D nature)?

_____ companies

4. What university did you graduate from?

_____

5. If you possess a masters or Ph.D. degree, from which university did you obtain it?

_____

6. What was your last academic qualification? (Please write your academic degree)

_____

7. What did you major in at University?

_____

8. When deciding on your employer were you greatly influenced by the lecturers (professors) at your university?	1	2	3	4	5	6
9. I was able to freely choose the company I desired.	1	2	3	4	5	6

10. At what age did you enter your present company?

Age _____

11. What is your present age?

Age _____

12. My initial starting salary when I joined the company was only slightly higher than of other R & D technicians and scientists.	1	2	3	4	5	6

13. How long was your initial in-service training period, when you first joined the company?

_____ weeks

14.	The initial in-service training I received was the same as other new employees from the business management field.	1	2	3	4	5	6
15.	The initial in-service training I received was mainly concerning research-related expert knowhow.	1	2	3	4	5	6
16.	The training I have received since joining the company has mostly been taken at my own volition.	1	2	3	4	5	6
17.	The training I have received since joining the company has mainly been of a research-related, technological nature.	1	2	3	4	5	6
18.	The training I have received since joining the company has mostly been programs outside my own company and taken together with participants from other companies.	1	2	3	4	5	6
19.	I frequently attend conferences relating to my own specialist field of knowledge.	1	2	3	4	5	6
20.	I can almost always choose which technology conferences I will attend according to my own wishes.	1	2	3	4	5	6
21.	I can almost always choose which of my company's research projects I will participate in according to my own wishes.	1	2	3	4	5	6
22.	All the R & D projects I participate in, are decided by my superiors.	1	2	3	4	5	6
23.	When decisions are made regarding which project I will participate, my wishes normally get taken into consideration.	1	2	3	4	5	6
24.	My present salary is slightly more than other people of the same job-ranking in the R & D field.	1	2	3	4	5	6
25.	My salary rises are largely affected by my own performance on the job.	1	2	3	4	5	6
26.	My present salary is slightly less than other people of the same job-ranking in the R & D field.	1	2	3	4	5	6
27.	My salary rises are determined only according to continuous years of service.	1	2	3	4	5	6
28.	I feel that my age is an extremely important consideration, when the company decides on my promotion.	1	2	3	4	5	6

29. How many years ago was your most recent promotion?

_____ Years ago

30. When the company looks into my promotion, I feel that my R & D results are taken as an extremely important consideration.	1	2	3	4	5	6
31. In my case, unless I am promoted, my job won't lead to any substantial salary increase.	1	2	3	4	5	6

32. How long have you been working in the R & D division?

_____ Years

33. In my company, the career path for management positions and technicial positions are sharply separated.	1	2	3	4	5	6
34. In my company, the remuneration for technical and management positions is equal.	1	2	3	4	5	6

(2) REGARDING YOUR FIELD OF EXPERTISE AND RESEARCH KNOW-HOW

1.	I think my present research knowhow is of constant use to my company.	1	2	3	4	5	6
2.	I think my present expertise will be extremely useful to my company's R & D in the next five years.	1	2	3	4	5	6
3.	Even if the technological direction of my company changes, I believe I can learn the new scientific technology required to continue in this company's R & D.	1	2	3	4	5	6
4.	I believe my present expert knowledge will be extremely useful to my company's R & D in the next 10 years.	1	2	3	4	5	6
5.	I am confident that I can create the various technological innovations that my company needs from my own research knowhow and expertise.	1	2	3	4	5	6
6.	I am quite confident that should I make a great technological discovery that will lead to important technological innovations for my company, that I will be able to repeat on this success in the future.	1	2	3	4	5	6
7.	My superior can easily judge whether I am doing a good job.	1	2	3	4	5	6
8.	When my superior evaluates my performance I think he judges on the basis of to what extent I am creating new technological knowhow for my company.	1	2	3	4	5	6
9.	My job includes more than just technological research (eg. administrative work and communication with outside groups), so it is difficult for my superior to evaluate my total work performance.	1	2	3	4	5	6
10.	My job is not just technological research.	1	2	3	4	5	6
11.	It is difficult to convery accurately to my superior whether I am doing all my work well.	1	2	3	4	5	6
12.	I think my superiors somewhat lack confidence in their ability to evaluate whether I am doing a good job or not.	1	2	3	4	5	6
13.	In the event that the technological direction of my company should changes, I do not mind having to learn new technology different to my own field of expertise in order to continue pursuing R & D in my present company (eg. switching from semi-conductor materials to magnetic materials).	1	2	3	4	5	6

14.	Please consider a case where your company decides to move in a completely different technological direction, and as a result the expert knowlegde you possess becomes redundant. In this situation, to what extent do you agree with the statement: I can move smoothly from the R & D division into other divisions in the company, eg. sales or marketing divisions.	1	2	3	4	5	6
15.	In the future, I would like to change from the R & D division to other management divisions within the company.	1	2	3	4	5	6
16.	I do not mind moving to a management position in a division other than R & D.	1	2	3	4	5	6
17.	In the future, I think I will be transferred from my present R & D division to the company's production division.	1	2	3	4	5	6
18.	I do not mind if I am transferred from my present R & D position to the company's production division.	1	2	3	4	5	6
19.	For the sake of the company's success, I will not begrudge my efforts in work outside my normally assigned area of duty.	1	2	3	4	5	6
20.	Because I want to work at the company for a long time, I will do almost any kind of work assigned to me without complaint.	1	2	3	4	5	6
21.	As long as the working hours remain the same, I believe it is okay to work the same way at a different company.	1	2	3	4	5	6
22.	In my present situation, there would be no major difference if I quit this company.	1	2	3	4	5	6
23.	There's not that much to be gained, even if I stay with this company for a long time.	1	2	3	4	5	6
24.	I'm very anxious about this company's future.	1	2	3	4	5	6
25.	The items, below, are in reference to evaluation received by the scientists and technicians involved in R & D in your company. Please circle appropriately, according to how much you agree with each item. a. The evaluation of work done by my company's research technicians and scientists is determined on results rather than taking into account the actual research process and effort involved.	1	2	3	4	5	6

b. In the evaluation of my company's research technicians heavy emphasis is placed on the subjective evaluation carried out by their individual superiors.	1	2	3	4	5	6
c. My company's most important evaluation of its research technicians and scientists takes place at regular, official one-to-one evaluation interviews.	1	2	3	4	5	6
d. Because the evaluation of the work of my company's research technicians and scientists is carried out in periods of 5-10 years, the company can understand their potential and true ability.	1	2	3	4	5	6
e. The salaries of my company's research technicians and scientists are determined according to the quality of their individual work performance.	1	2	3	4	5	6

(3) REGARDING THE MOTIVATION BEHIND YOUR RESEARCH

1.	The in-house training I have received has only been useful for in-house purposes.	1	2	3	4	5	6
2.	Even if I were to move to another company, I believe that I can utilize my knowhow as is, from my present job.	1	2	3	4	5	6
3.	I believe that even were to move to another company, as long as it was in the same industry as my present company, I could effectively use the research-related technical knowhow (eg. research techniques and knowledge of research equipment) which I now possess.	1	2	3	4	5	6
4.	I think my expert knowledge would be valid in another company, as long as its in the same industry as my present company.	1	2	3	4	5	6
5.	In order to continue performing a good job, it is extremely important to get to know people outside the research lab.	1	2	3	4	5	6
6.	In order to do a good job, its important to have a sufficient grasp of the policies and procedures of one's company.	1	2	3	4	5	6
7.	Even if I were to move to a research lab in another company in the same industry as my present company, I believe I could raise my job efficiency to 100% in a short period of time.	1	2	3	4	5	6
8.	With reference to my own work, I would prefer to be involved in R & D projects which are likely to enhance my evaluation (reputation) in my own field of expertise.	1	2	3	4	5	6
9.	With reference to my own work, I would prefer to be involved in R & D projects which lead to advancement in the organization.	1	2	3	4	5	6
10.	If I were to choose a research project to participate in, I would prefer to choose research which is acknowledged by my colleagues and experts both inside and outside the company, even if it were to delay the improvement of my position in the company.	1	2	3	4	5	6
11.	The items, below, are a list of various benefits obtained from employment. If you were to look for a job, how much importance would you place on each of the following. (Please answer, without any consideration to your present job.)						

(over page)

a. Being able to learn and develop new expertise and knowhow.	1	2	3	4	5	6
b. Being able to fully utilize the expertise and knowhow you currently possess.	1	2	3	4	5	6
c. Being able to obtain a good income.	1	2	3	4	5	5
d. Being able to improve your position and authority as a member of the management staff.	1	2	3	4	5	6
e. Being able to mix with the company's directors.	1	2	3	4	5	6
f. Being able to obtain acclaim in your field of expertise.	1	2	3	4	5	6
g. Being able to tackle difficult and challenging problems.	1	2	3	4	5	6
h. Being able to fully utilize your own ideas.	1	2	3	4	5	6
i. Being able to contribute to your own wide-range of expert knowledge.	1	2	3	4	5	6

12. Please rank the following in the order of their importance to you in your job, giving each a ranking from 1 to 7.

____ Opportunity to build a reputation in my field of expertise.

____ Autonomy to obtain the freedom to realize my my own unique ideas.

____ Opportunity for advancement in the company in order to obtain a high salary.

____ Opportunity to gain new knowledge and improve my technical knowhow.

____ Opportunity to fully utilize my knowledge and technical knowhow.

____ Opportunity to tackle difficult problems and new topics.

____ Job stability/guarantee

13. Your philosophy regarding your job

Please circle the number which best expresses your thinking between the two poles of:

1 = To continue to do what I want to do
6 = Aiming to improve my position within the organization

1 2 3 4 5 6

(4) REGARDING YOUR JOB

The work of researchers and technicians in corporations differs according to the nature of the technology which has become the basis of industry. In technological advance, there has been two stages. One is the "progressive evolution stage", where technology advances with the gradual accumulation of technological innovations in products and production processes. The other is a stage characterized by unconnected changes, where technology advances by a vast improvements being made and the discovery of fundamental theories.

An example of accumulative innovations in technology, as seen in the progressive evolution stage, is the improvement in the plating process of magnetic tapes and extending the recording time of video tape recorders. These technological innovations are called incremental innovations. Examples of unconnected innovations include IBM's 360 series; integrated circuits; and LD revolving furnaces. These technological innovations are called radical innovations.

Keeping the above differences in incremental and radical innovations in mind, please read the following questions and circle the answer which most appropriately expresses your present job.

1.	My main job responsibility is to think up important technological innovations.	1	2	3	4	5	6
2.	Other members of my research lab seldom understand the technology I am researching.	1	2	3	4	5	6
3.	My main job is creating technological innovations which lead to new products for the company and open up new markets.	1	2	3	4	5	6
4.	I carry out research focusing on relatively easy solutions to technical problems.	1	2	3	4	5	6
5.	In order to realize new products and open new markets, my company needs to achieve new inventions in the R & D field.	1	2	3	4	5	6
6.	It is virtually impossible for my superior (research lab chief) to state explicitly what results are desired from my research.	1	2	3	4	5	6
7.	I place the focus of my research on break-throughs (which dramatically change the flow of technology).	1	2	3	4	5	6
8.	I expect the results of my research to have a very strong impact on my company.	1	2	3	4	5	6
9.	I know exactly what order I need to proceed in to achieve the research results I desire.	1	2	3	4	5	6

10.	If I were to characterize my research, it would be that of creating incremental innovations.	1	2	3	4	5	6
11.	The majority of my research can be said to be high technology research.	1	2	3	4	5	6
12.	On occasion, my company's production staff give suggestions on the direction of my research.	1	2	3	4	5	6
13.	If I were to characterize my research, it would be that of trying to create radical innovations.	1	2	3	4	5	6
14.	I personally feel that my present work will make an important contribution to my own field of expertise.	1	2	3	4	5	6
15.	On occasion, my company's marketing staff makes suggestions on the direction of my research.	1	2	3	4	5	6
16.	Whether or not my research succeeds is influenced greatly by close teamwork with other members of the R & D lab.	1	2	3	4	5	6
17.	Ideas necessary for moving ahead with my research are virtually all thought up by me myself.	1	2	3	4	5	6
18.	Talking with staff outside my own company's R & D division is extremely useful to my research.	1	2	3	4	5	6
19.	Ideas necessary for moving ahead in my research are frequenly obtained from discussions with my work colleagues.	1	2	3	4	5	6
20.	For my research, following research procedure with greatest possible care is more important than relying on intuition.	1	2	3	4	5	6
21.	In the type of research I am undertaking, having solid research techniques which have been nurtured over time, are more important than having a lot of creative ideas.	1	2	3	4	5	6
22.	Sometimes in my research, it is necessary to take risks which go beyond the bounds of reasonable research steps.	1	2	3	4	5	6
23.	In my research lab, new projects--if they are a new idea which nobody else is working on yet--then that project is almost always approved.	1	2	3	4	5	6

24. The situation in the research lab I work in:

1	2	3	4	5
Doing mostly basic reseach	Undertaking mostly basic research, plus some development	50-50 in basic research and development	Doing mostly development and some basic reseach	Mostly development

25. Of your total working hours, how much time do you normally spend (in percentage terms) with regard to the items listed below. Please answer in averages where time is not fixed. (Please write in percentages divisible by 5%)

A. Education & Training _____ %

B Specialist work other than education (eg. research, management of other members' specialist work, joint-research with colleagues, consulting & technical services, etc.) _____ %

C. Administration & other non-specialist work (eg. internal administration, communication with superiors, communication with outside groups and clients, etc.) _____ %

TOTAL (So that it adds to 100%) _____ %

26. For the above question B. (specialist work apart from education) there are a diverse range of activities. At present, what percentage of your time (excluding education) are you giving to each of the below-mentioned purposes. Please write in percentages divisible by 5%.

	Percentage of work
I. Research and Invention (Discovery of new knowledge and putting knowledge into a practical form)	
A. General knowledge relating to a wide range of problems	_____ %
B. Invention of new products	_____ %
C. Specific knowledge for solving specific problems	_____ %
II. Development	
D. Design of specific products or processes	_____ %
E. Improvement of existing products or processes	_____ %

III. Technical services for assisting other people or groups (eg. tests, analysis according to standard techniques, consultation and problem-solving, etc.) _____ %

IV. Other purposes (in detail) _____ %

(5) REGARDING YOUR COMPANY' INDUSTRY

The items below are with regard to the technological environment which the industry you are involved in, is up against.

Based on your thoughts and impressions, please circle the appropriate response according to the extent that you agree with each item.

1.	In the industry I am in, it is already possible to obtain the necessary technology for developing next-generation products.	1	2	3	4	5	6
2.	Of the sales of the top three companies in my industry, sales of new products developed in the past three years account for between 1 - 5 %.	1	2	3	4	5	6
3.	It is easy to purchase the technology related to my industry from outside the company.	1	2	3	4	5	6
4.	In my industry there are a lot of obstacles making it difficult to acquire new technology when it is needed.	1	2	3	4	5	6
5.	In my industry, major innovations (breakthroughs) that change the flow of technology, occur frequently.	1	2	3	4	5	6
6.	In my own industry, I believe there will be a large number of major breakthroughs in the next ten years.	1	2	3	4	5	6
7.	Of the sales of the top three companies in my industry, sales of products developed in the last three years account for less than 1 percent.	1	2	3	4	5	6
8.	Of the sales of the top three companies in my industry, sales of products developed in the last three years comprise more than 5 percent.	1	2	3	4	5	6

The below items are with reference to the industry which accounts for the biggest percentage of your company's sales. (In other works, the main industry you are involved in.) Please circle the number which is closest to the actual state of affairs.

9.	My company does not lose out to competition or lag behind in market changes, even though it doesn't make changes in its marketing approach.	1	2	3	4	5	6

My company has to change its marketing approach very frequently--about every six months.

10.	The speed at which products and services become obsolete is extremely slow (eg. nonferrous metals like copper).					The speed at which products & services become obsolete is very fast (eg. certain types of fashion goods).
	1	2	3	4	5	6
11.	Can easily predict the behavior of competitors (eg. certain kinds of primary industry).					Cannot predit behaviour of competitors
	1	2	3	4	5	6
12.	Extremely easy to predict consumer demands and tastes.					Almost impossible to predict consumer demand and tastes (eg. high-fashion goods).
	1	2	3	4	5	6
13.	Production technology is firmly established and not that many changes are made (eg. mining).					Changes in production format occur frequently, and also usually change substantially (eg. advanced electronics).
	1	2	3	4	5	6

ANSWERS TO QUESTIONNAIRE

I. FOR ALL PARTS EXCLUDING SECTION 3.11

1=EXACTLY SO
2 = CONSIDERABLY SO
3 = MORE YES THAN NO
4 = MORE NO THAN YES
5 = CONSIDERABLY DIFFERENT (I DISAGREE SOMEWHAT)
6 = CONSIDERABLY DIFFERENT (I DISAGREE COMPLETLY)

II. FOR SECTION 3.11

1 = DEFINITELY IMPORTANT
2 = VERY IMPORTANT
3 = IMPORTANT TO SOME EXTENT
4 = SLIGHTLY IMPORTANT
5 = NOT PARTICULARLY IMPORTANT
6 = COMPLETELY UNIMPORTANT

APPENDIX C

INTERVIEW QUESTIONS

1. How long have you worked for this company?

2. Did you join this company after working at another firm in R&D?

3. What is your present area of research?

4. What is the highest degree you hold?

5. Why did you join this company?

6. Did you want to be a researcher before joining this company?

7. How long do you want to be a researcher?

8. How connected is your present research to your university major?

9. Is there any possibility you'll quit this company in the future?

10. If you did quit this company, what would be the reason?

11. How basic is the research you do now?

12. Does your company have clear, separate career ladders for management and research people?

13. Is there pressure on you to eventually become a manager?

14. If you stay in research, will you have the same opportunities for advancement as a management track person?

15. How is your job performance evaluated?

16. Are the results of your performance appraisal communicated to you directly?

17. Can your boss clearly specify the research results he wants you to attain?

18. Is there a set number of patents you have to produce each year?

19. Do you think the number of mid-career hires will increase in this company in the future?

20. If someone joined your research lab from another company, and had experience in that research, how long do you think it would take for him to become 100% effective?

21. Do you think that communication with people outside your lab but inside your company is crucial to performing your job successfully?

22. What kind of training did you receive upon entering this company?

23. What kind of training do you receive now?

24. Who decides what kind of training you get now?

25. How do you receive information about training opportunities?

26. When you attend meetings (symposium, conferences) outside your company, do you talk to fellow attendees about your research in general terms?

27. When you attend such meeting, do you talk to fellow attendess about the working conditions within your firm?

28. Do you feel the management system is different for researchers as compared to the company in general?

29. If there are differences, what are they?

APPENDIX D
ITEMS DELETED AFTER FACTOR ANALYSIS

(4.2) Other members of my research lab seldom understand the technology I am researching.

(4.4) I carry out research focusing on relatively easy solutions to technical problems.

(4.9) I know exactly the order I need to proceed in to achieve the research results I desire.

(2.6) I am quite confident that should I make a great technological discovery that will lead to important technological innovations for my company, that I will be able to repeat on this success in the future.

(2.19) For the sake of the company's success, I will not begrduge my effots in work outside my normally assigned area of duty.

(1.19) I frequently attend conferences relating to my own specialist field of knowledge.

(1.31) In my case, unless I am promoted, my job won't lead to any substantial salary increase.

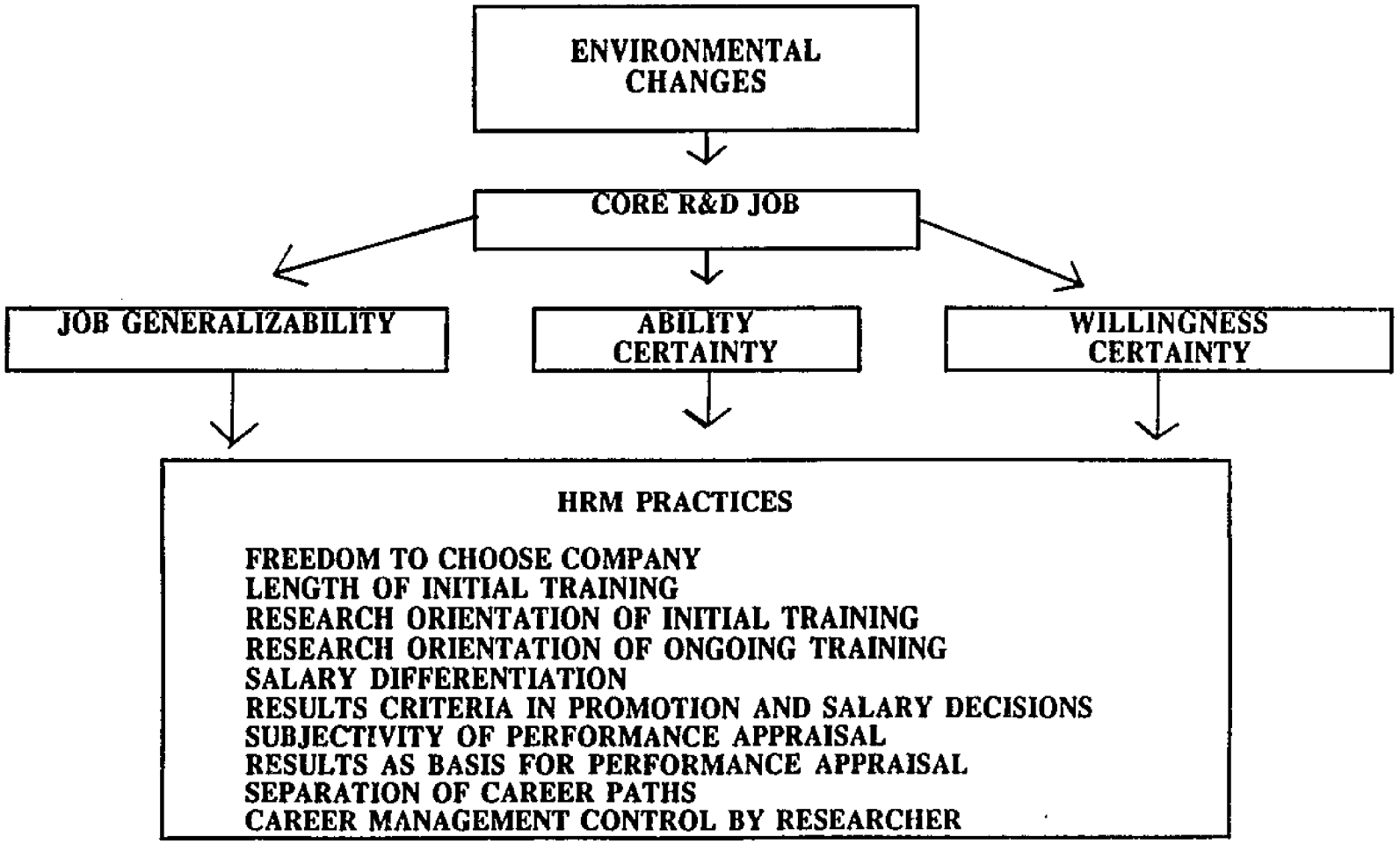
APPENDIX E
R&D MANAGER AND RESEARCHER GROUP MEANS ON ALL VARIABLES: NON-SIGNIFICANT RESULTS

VARIABLE MEAN	F	R&D MANAGER MEAN	RESEARCHER
General Environmental Chances	.0369	3.91	3.88
Technological Changes	2.16	4.10	3.85
Product Changes	.808	4.12	4.32
Basic Research	.231	3.86	3.79
Job General.	2.13	4.76	4.56
Ability Certainty	2.13	4.76	4.56
Willingness Certainty	.051	3.08	3.04
Type of Ongoing Training	1.21	2.51	2.33
Career Mgtmt. Control	1.08	3.29	3.14

APPENDIX F

MODEL OF INFLUENCE OF TRANSACTION COSTS ON HRM PRACTICES

MODEL OF INFLUENCE OF TRANSACTION COSTS ON HRM PRACTICES



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M.A.	Pennsylvania State University Department of Spanish State College, PA, 1979 Major: Spanish Literature
M.A.T.	School for International Training Brattleboro, VT, 1974 Major: English and Spanish as Second Languages
B.A.	Southern Methodist University Dallas, TX, 1971 Major: Latin-American History and English Literature

PROFESSIONAL EXPERIENCE

1988-1989	Part-time Lecturer, Japan Studies Program University of Washington The Jackson School of International Studies
1984-1985	Teaching Assistant, Human Resource Management University of Washington Graduate School of Business Administration

1981-1984	Teacher/Program Developer Sumitomo Metal Industries Kashima and Osaka (Japan)
1981	Lecturer, Spanish Department of Foreign Languages West Virginia University
1980	Director, West African Intensive English Program Department of Foreign Languages West Virginia University
1977-1979	Teaching Assistant, Spanish Department of Spanish The Pennsylvania State University
1974-1977 1972-1973	Teacher, English and Spanish as Second Languages The Language Institute of Japan
1972-1973	Bookkeeper Waterbed Systems International, Dallas, Texas

COURSES TAUGHT

Business in Japan (IB 440, Fall, 1989)
Human Resource Management (HRM 301)
The Political Economy of Japan (co-taught) (SISEA 442)
Japan: Technological Leader of the 21st Century (SISEA 490)

PUBLICATIONS AND PRESENTATIONS

"Expatriate Subsidiary Managers: Matching Managerial Style to Internal Environment", (forthcoming), with Stanley Slater, Proceedings of the 1989 Annual Meeting of the Decision Sciences Institute, New Orleans, LA, Nov., 1989.

"A Cross-Cultural Test of Compliance Gaining Strategies", with Jeremiah Sullivan, presentation to be given at the Academy of Management Annual Meeting, Washington, D.C., August, 1989.

"Japan's Technological Capabilities and Its Future" with Kozo Yamamura, in Gunter Heiduk and Kozo Yamamura, eds., Technological Competition and Interdependence: Japan, Germany, and the United States in Search of Policy for the Twenty-First Century. Seattle: University of Washington Press, forthcoming.

"Japanese Management of Engineers", presentation given to the Matrix Engineering Association, Seattle, WA, May, 1989.

"Japan's Technological Capabilities and Its Future" with Kozo Yamamura, paper presented at the Symposium on Technological Leadership in the 21st Century, Duisburg, West Germany, August, 1987.

"A Research Framework for Cross-Cultural Adaptation", paper given at the Academy of International Business, London, 1986.

"Japanese Management", presentation given at the Trident Naval Base Human Relations Program, WA, 1986.

RESEARCH IN PROGRESS

"Japan's Employment Practices in Transition: A Transaction Cost Analysis" (Ph.D. Dissertation) Advisor: Dr. Thomas Roehl

"Process, Organizational, Relational, and Personal Determinants of Managerial Compliance-Gaining Strategies" (with Jeremiah J. Sullivan and Terrance L. Albrecht)

"International Human Resource Management as Competitive Advantage" (With Stanley Slater and Nancy Napier)

HONORS AND FELLOWSHIPS

Edna Benson Fellowship, 1988-1989
Fulbright Graduate Fellow (Japan), 1987-1988
University of Washington Graduate School of Business Nominee for the ACCSB Doctoral Student Fellowship, 1987
Boeing Endowment for Excellence Fellowship, 1987
National Resource Foundation Fellow, 1985-86, 1986-87
FLAS Fellow, Summer, 1985
Phi Sigma Iota, 1979
Phi Beta Kappa, 1971
Academic Achievement Scholarship, 1968-1971
Alpha Lambda Delta, 1967

PROFESSIONAL SOCIETIES

Academy of Management
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Japanese Personnel Management - Changes and Trends
The Transfer of Japanese Personnel Systems Abroad
International Human Resource Management
The Management of Technical Specialists

LANGUAGES

Spanish - fluent
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