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ABSTRACT

Technological innovation affects the structure and content of jobs. Research indicates that there is a need for a theory of technological innovation and strategic human resource management considering several factors, such as an employee's beliefs about the effect of technological innovations on the quality of work life and work content. Furthermore, application skills held by the individual should allow, the employee to use technology innovatively. Employees' beliefs about technological innovation need to be positive to assure a high quality of work life as well as the effective use of new technology. Relationships are proposed among several variables: quality of work life, acceptance of technology, job and task characteristics, anticipated technology-induced change, job content of skills, organized labor, and the public's acceptance of technological innovation. Relationships are also posed for these variables: range and depth of application skills, mechanical and application skills, variety and complexity of application, innovative application, discrete tasks, and developing job-related applications. Research testing of these relationships is suggested. (Author/ABL)

TECHNOLOGICAL INNOVATION AND STRATEGIC HUMAN RESOURCE MANAGEMENT: DEVELOPING A THEORY

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TECHNOLOGICAL INNOVATION AND STRATEGIC HUMAN RESOURCE MANAGEMENT: DEVELOPING A THEORY

Abstract

Technological innovation affects the structure and content of jobs. Research indicates that there is a need for a theory of technological innovation and strategic human resource management considering several factors, such as an employee's beliefs about technological innovations' effect on quality of work life and work content. Furthermore, application skills held by the individual should allow the employee to use his/her technology innovatively. Employees' beliefs about technological innovation need to be positive to assure high quality of work life as well as effective use of new technology. Some of the pieces of a tentative theory are suggested here.

TECHNOLOGICAL INNOVATION AND STRATEGIC HUMAN RESOURCE MANAGEMENT:

DEVELOPING A THEORY

The question of how individuals respond to work has been at the centre of some of the most active controversies in organizational research. The debate of job enrichment versus social information processing has contributed to two recent shifts in theories about how people react to work environments. The first change has been an increased emphasis on subjective and cognitive factors, with wider acceptance of the notion that an individual's interpretation of his/her work situation is at least as important as objective reality (Glick, Jenkins & Gupta, 1986; Staw, Bell & Clausen, 1986).

The second major shift in job attitude theory has been greater attention given to environmental determinism. Not only have need-based theories come under severe criticism (Salancik & Pfeffer, 1977), but recent attempts to find a coherent set of individual differences that moderate the effects of job enrichment have not been particularly successful (White, 1978). The approach to job attitudes has moved from models indicating some interaction of the person and environment toward greater situational determinism.

Determinism is grounded in social information processing theory which argues that individual's attitudes are not a function of deep-seated needs but a product of how people socially construct the world around them (Staw, Bell & Clausen, 1986). Because tasks and changes in the workplace caused by computerization are ambiguous, individuals may interpret them in ways that are dictated by the context and meaning of their own actions. Thus, how one interprets the effect of computerization on jobs, whether observed by others or manifest in one's own behaviour in its social context, could be as strong an influence on attitudes toward computerization as the objective work situation.

This paper presents an inter-disciplinary approach to technological innovation and strategicl human resource management. Literature from sociology, management, and psychology will be used to develop a theory assessing employee beliefs about technological innovation. The discussion centers primarily on technological innovation and its perceived effect on the level of technological skills maintained by the individual. What distinguishes this paper from earlier work is that it concentrates on beliefs held and attributions made by the workforce to technological innovation. The framework specifically emphasizes the relationship of technology and the human resource domain.

Employees' Beliefs about Technological Innovation

In recent years, almost all research on work attitudes and technology2 has been situationally-based. For instance, situational variables including task characteristics, supervision, and ergonomics have been commonly isolated as determinants of job attitudes (Locke, 1976). Rarely, however, do work attitudes emanate from an endogenous source of variance that is reflective of the ongoing state of the person and his/her beliefs as opposed to being a product of the situation.

Williamson (1985, chap. 1-3) argues that most technological change3 is started because of environmental factors. Thus the firm tries to rearrange its resources in such a way as to stay effective and sustain growth (Salancik & Pfeffer, 1978, chap. 1). To remain competitive in a changing environment, the firm will often adopt technological innovations4 resulting in continuous change to the workplace. Consequently, this change affects human resources (Gattiker, in press). The organization needs to cope with changes affecting its employees and other resources by providing the necessary long-term plan, as well as assisting and measuring the effects of change employees perceive over time (Gattiker, 1984). Employees' beliefs about change caused by technological innovation must be assessed to determine if the change was effective and resulted in desired outcomes (Cammann, 1981). Such an assessment will help a firm to assure the effective management of technological innovation and thereby justify the financial commitments made.

Is there a need for a theory of technological innovation and strategic human resource management? Some authors have reviewed portions of the literature and suggested that additional work is needed in this area (Dierkes & Von Thienen, 1984). My thinking is that need must be established by three factors: a theory must apply to a significant population, it must be useful in both research and practice, and there must be some reason for believing that the prior thinking cannot be conveniently stretched to encompass the particular population.

The significance of the number of individuals facing continuous innovation in their work is now beyond dispute. Approximately twenty to thirty percent of all office employees in North America and Europe work with computers and this percentage is rising (cf. Betcherman & McMullen, 1986). Computer-aided design and manufacturing have led to similar changes on the shop-floor. Biotechnology is changing farming while lasers are affecting production processes. Technological innovation is penetrating every economic sector of the industrialized countries. Thus work content and structure of jobs are affected across industries and cultures.

Another important issue is whether we currently have a theory for technological innovation and human resource management which is useful in research or practice. Even the briefest examination of the literature (e.g., Bikson & Gutek, 1983; Dierkes & Von Thienen, 1984; Gattiker, in press) shows that we do not--at least not one that is widely accepted. Most researchers cite different studies in making their points about what may facilitate strategic human resource management in the face of technological innovation. Furthermore, in most cases, the beliefs about technological innovation held by the employees and their importance to the process of technology's successful introduction into the work process are not even mentioned.

There is a need to provide a synthesis between these results and related work by other researchers. Ideally, that synthesis will create a framework within which each study dealing with technological innovation and its acceptance by employees can be seen in perspective. Similarly, the synthesis would offer a guide to where information is currently lacking. It could be hoped that the work that has already been done, when it has been unified by such a theory, would offer practical help for understanding the current situation of employees' beliefs about technological innovation.

Dimensions and Elements of the Theory of Technological Innovation and Strategic Human Resource Management

If a comprehensive theory is needed, what should the dimensions be? There are two dimensions to be added which require particular attention from employees and firms alike: the individual's beliefs about technological innovation and the skills he/she must possess to use it effectively.

One way to conceptualize the structure of the theory needed is to search for general variables which are 'culture-free' and 'timeless' continua according to Hage (1972, p. 10). Such general variables are universal, simpler to work with, and most importantly, they help us to recognize that many variables are needed to explain social phenomena. The approach used in developing general variables in this paper has been to identify the dimensions--beliefs about technological innovation as well as skills--and the general variables.

An attitude is generally viewed as a disposition to respond in a favorable or unfavorable manner to an object or occurrence (Oskamp, 1977, pp. 2-12). Fishbein (1967) suggested that one useful way to conceptualize the notion of work attitude is to subdivide it into three related parts: (1) a person's beliefs about job and work, (2) the attitude itself (e.g., dissatisfaction) and (3) behavioral intentions. Beliefs represent the cognitive side of one's attitudes toward technology and innovation. This paper concentrates on beliefs which are conceived by the individual after interpreting an event within its context, such as change in his/her workplace. An attitude or emotion follows from this process. According to Schachter and Singer (1962), there are two critical processes that comprise any emotion--arousal and attribution. A person's arousal and attribution (interpretation) will mold his/her beliefs about work and innovation (Landy, 1985, chap. 11). Environmental determinism would propose, therefore, that the individual explains events according to how he/she socially constructs and interprets the event within its context (Hewstone, 1983; chap. 1). An increasing appreciation of the role of cognitive activity in work-related behaviour is needed in order to better manage technological innovation in an organization (Gattiker, in press).

Insert Table 1 about here

Each general variable listed in Table 1 has several elements to it which must be researched further. 'Element' is a primitive term defining classes of a phenomenon (Hage, 1972, pp. 28, 120). We will discuss below each general variable and its respective elements in more detail.

Beliefs About Technology and Innovation

The individual's cognitive evaluation of technology in the workplace could help explain the effective management of innovation. A positive belief about working with technology and innovation would be desirable since researchers have argued that the effective use of technology requires employees to feel comfortable with it. One recent study showed, for instance, that personal computers were perceived as most helpful in improving work effectiveness and the quality of job life (Gattiker, Gutek & Berger, 1985). Table 2 shows how the general variables of quality of work life and anticipated change as well as the respective elements make up the technology and innovation dimension of the theory.

Insert Table 2 about here

Quality of Work Life

Lately, quality of work life has gained attention in the literature, but it has not yet come to centre stage in the organizational research domain. The areas of concern and activity encompassed by the term 'quality of job life' are broad and diverse, and many different terms are in use, including industrial democracy, increased worker participation as well as health aspects. One of the recent North American definitions is Suttle's (1977). He defined quality of work life as "the degree to which members of a work organization are able to satisfy important personal needs through their experiences in the organization." New efforts to study and improve the quality of work life have been varied (Podgorecki, 1981; Rice, McFarlin, Hunt & Near, 1985; Suttle 1977). Need-based theories have come under severe criticism though, and results have been mixed (Salancik & Pfeffer, 1977).

Determinism theory argues that how an individual feels about his/her quality of work life is not a function of needs but a product of how the employee socially constructs the work environment (e.g., Staw, Bell & Clausen, 1986). Consequently, the following definition could be put forward: quality of work life is the product of how an individual interprets his/her work environment (e.g., type of job, work conditions, and peer relationships) and how this interpretation is influenced by the context and meaning of one's own actions.

In the context of technological innovation, the quality of work life might encompass, but is not limited to, two elements: (1) an individual's acceptance of the technology and (2) job and task characteristics. The following sections will discuss these elements in more detail.

Acceptance of technology. The term 'acceptance' could be defined as a person's receptive psychological state based on perceived impact on such things as one's job, skills, and career progress (Gattiker, 1984). Acceptance has been identified as crucial to the effective use of computer-based information systems (Bikson & Gutek, 1983) although relevant research has been limited (Gattiker, 1984). Until recently, researchers had failed to relate acceptance to effective use of technology (Dierkes & Von Thienen, 1984).

Gattiker and Larwood (1986) took a step toward measuring the construct of computer acceptance. Their data indicated that acceptance correlated highly with use of computers and knowledge about them. A subsequent study by Gattiker (1987) showed similar results for computer-based information systems in organizations. The data also showed that a 'rational' employee or manager will accept an information system to a greater degree if his/her superiors use this system extensively in their own work (cf. Larwood, Gutek & Gattiker, 1984).

Gattiker and Larwood (1986) also found that individuals who anticipated a major influence on their future employment prospects from computers and information systems felt compelled to acquire computer literacy. The data demonstrated that people who perceived computers to have an impact on their work were more likely to accept them. The above results may be explained by the fact that the single most important factor for 'accepting' technology may be a person's concern about his/her future employment.

Job and task characteristics. A job consists of a set of tasks which have degrees of responsibility, decision-making, autonomy, and variety associated with them. The individual's interpretation of job and task characteristics is an important factor in assessing quality of work life. Most research has concentrated on individual perceptions of job characteristics but has ignored task characteristics (e.g., Hackman & Oldham, 1980). Rohmert and Landau (1983) proposed that a person's perception of task characteristics alone may be difficult to interpret when comparing one individual's scores to another's. An analysis of the different job tasks as seen by incumbents could facilitate comparisons.

The importance of job and task characteristics to an individual's quality of work life does not mean, however, that job enrichment is the answer. Instead, what is proposed here is that job enrichment must help change job and task characteristics important to, though currently not liked by, employees (White, 1978). Therefore, it is necessary to ensure that worker beliefs about job and task characteristics are positive.

Anticipated Technology-Induced Change

Mankin, Bikson, and Gutek (1984) concluded that technological innovation affects jobs and task structures in organizations. However, it seems that managerial positions are less affected than lower-level positions. This is not surprising since only a thorough knowledge of tasks allows mechanization and automation (Doswell, 1983, chap. 3). Little is known of the tasks involved in managerial work, making automation impossible at this time and mechanization very difficult to realize (Panko, 1984). Thus it seems feasible to assume that managers interpret technology-induced change and its effects more positively than support personnel, since the job effects are far less severe for managers than for others.

Another important factor in the acceptance of technological innovation is the person's anticipated change occasioned by it and his/her interpretation of that change. Gattiker and Larwood (1986) found that people who anticipated substantial change in their work environment due to technological innovation were highly motivated to acquire the new skills necessary to use the technology. This may have been due to a self-defense mechanism which suggests to the 'rational' employee that acquiring the skill is preferable to losing one's job.

Job content of skills. Spenner (1983) argued that a consensus of what the concept of skills contains and how it should be measured is lacking in the literature. Based on his review of previous research, he concluded that skills have two dimensions: substantive complexity and either autonomy or outside control of skills. The latter deals with the closeness of supervision and repetitiveness of work. Substantive complexity could be conceptualized as (1) the number of discrete tasks one does, (2) the difficulty of each task (i.e. the time required to become proficient), and (3) the current level of proficiency. These concepts can be applied to assess a person's level of skills when working with a technology.

An employee's beliefs about the contents of his/her job and the skills required, however, may be substantially different than an objective outsider's assessment (Rohmert & Landau, 1983). Thus to manage technological innovation effectively, it is also necessary to assess the individual's perception of impact on skills and job content (cf. Marr, 1986).

Organized labour and the public's acceptance of technological innovation. Unions can influence their members' assessments and beliefs about technological innovation. Fenwick and Olson's (1986) study suggests that unions are primarily concerned with the effects of technological innovation on job security and income. Several union pamphlets are designed to instill fear of technological innovations in the worker. For instance, a brochure published by the West German union IG Metall suggests to employees that technological innovation can endanger their employability as well as quality of work life (IGM, 1984). How unions affect technological innovation in an organizational setting is uncertain. While union members are essentially concerned with extrinsic job factors, non-unionized employees focus more on intrinsic factors (Fenwick & Olson, 1986). Thus unions inspire workers to focus their attention on assessing technological innovation's effect on extrinsic aspects of their jobs.

Public opinion is another important factor relating to the general acceptance of technological innovation. Media, government, and other organizations shape, or at least influence, employee assessments of technological innovation. Indeed, the media have been preoccupied with the possible increase in unemployment because of innovation.

Nevertheless, the final word has not been spoken since job losses due to technological innovation are often offset by the creation of work opportunities in different areas (cf. Gattiker, in press). The power of public opinion and unions over employees may differ since some individuals may be less likely to be influenced than others. Further research in this area is highly necessary.

Summary and Conclusion

There are specific relationships between the general variables identified above, as schematized in Table 3. Hage (1972, chap. 4) has argued that linkages between elements of a theory must be specified with theoretical statements as follows: theoretical linkages are phrases which indicate why, while operational linkages explain how. Hage further stated that operational linkages make a theory measurable and explain if the linkage is a linear one, a curve, or a power, thereby simplifying data-processing and analyses.

Insert Table 3 about here

Table 3 displays the different theoretical linkages between the elements of the two dimensions. The operational statements specify the coefficients indicating the relationship between the two variables. For instance, V1 and V3 have a positive linear correlation with different coefficients and a lower/upper limit. How can this be interpreted? Every individual anticipates a certain level of technological innovation when looking at his/her job content. The lower limit indicates that a certain level of acceptance will always be apparent. The upper limit means that, at some level, job content changes are as significant as they can be and acceptance of such technology-induced change has gone as far as it possibly can. The different positive coefficients illustrate that the ratio between V1 and V3 may range from .01 to a perfect 1.00 relationship.

Power is a coefficient that is constantly changing (e.g., power curve). Organized labour and the public's acceptance of technology-induced change (V2) as well as the employee's acceptance of it (V3) represent a relationship which can change and is not linear (Hage, 1972, pp. 100-106). The lower limit suggests that some level of acceptance or rejection by unions and/or the public is most likely. Furthermore, such acceptance can be very positive, but it has limits. Tests must be conducted to ascertain where exactly the upper and lower limits are, as well as what power coefficients apply.

Table 3 lists only the basic operational linkages and therefore provides just a framework for future research. If technology-induced changes are perceived to affect one's job content and skills negatively, the employee probably thinks that his/her job and task characteristics have been lowered (V1 and V4). Table 3 also suggests that if the union's attitude toward technological innovation is negative, employees will assume that job and task characteristics will suffer (V2 and V4). In both cases, the operational linkage suggests a positive linear relationship. Again, the different coefficients as well as the upper and lower limits need to be identified.

Beliefs about Effects of Innovation on Technological Skills

Technological skills are viewed as a component of work structure and organization. Like other skills, they have two basic dimensions: substantive complexity and skills subjected to autonomy or outside control. The latter designates the discretionary bounds and the amount of room for action within a work role as provided by the structure of the job and technology arrangements. Substantive complexity for technology-related skills is the level, scope, and integration of mental, interpersonal, as well as manipulative tasks necessary for working with the particular technology. Table 4 lists the general variables and their elements representing the dimensions of beliefs held by the employee about the effects of innovation on his/her technological skills.

Insert Table 4 about here

The explanations given below illustrate that an individual's perception of the effects of change on technological skills is greatly influenced by the structure of work and the organization. Thus to assure effective use of technology by the employee, it is necessary to secure the individual's positive assessment of the technological skills he/she holds. Obviously, if an employee feels that his/her skills are inadequate to the fullest capabilities of the technology, cost and benefit ratios may not be as good as they should be. Investments made in a new technology for the workplace may thus become questionable.

Range and Depth of Application Skills

Job functions may require an individual to perform problem-solving, planning, and decision-making tasks with a variety of application skills related to his/her technology. Technological innovation has led to increased specialization in all types of work (professional, skilled, and semi-skilled) while reducing the range of skills required to perform the tasks and functions in one's work (Gattiker & Larwood, in press; Shaiken, Herzenberg & Kuhn, 1986). Therefore, the individual may need only a few technological skills to perform his/her job.

Although employees may have a smaller range of skills to work with the technology, they may have more depth than ever before. For instance, a car mechanic specialized in repairing fuel-injected engines with the necessary technology probably knows little about diesel engines. The increase in technology utilized in garages led to such specialization, requiring the individual's 'in depth' mastery of the skills necessary to use certain equipment effectively (Kraft & Dubnoff, 1986). Often, a shop-floor employee no longer knows how to handle many pieces of equipment skillfully. Instead, he/she specializes in using one or two machines with great skill (cf. Shaiken, Herzenberg & Kuhn, 1986).

Mechanical and application skills. For computers, mechanical skills include the person's basic knowledge of how to log on and off a main-frame; how to format, copy and use diskettes on a micro-computer; and basic knowledge about terms such as bytes and random access memory (RAM). It is further assumed that the individual is capable of using a Disk Operating System (DOS) manual to answer basic questions relating to computer tasks (Gattiker & Paulson, 1987).

In addition to a person's mechanical computer skills, he/she will then have to acquire application skills as well, such as the ability to use certain software packages. For instance, both a secretary and an accountant might use a word-processing package and a spreadsheet to prepare reports, tables, and do calculations. Such application skills represent his/her proficiency in using a variety of software, allowing the individual to solve certain problems either with a manual or by other means.

The above illustrates that the type of mechanical skills held by an employee is pre-determined by the job structure. Task complexity determines the type of technology needed to perform the job. Mechanization of certain tasks, therefore, dictates the type of technology used and the mechanical skills needed to operate them safely and efficiently. An employee develops beliefs about his/her level of mechanical and application skills for working with the technology. Employees sometimes believe that not having adequate mechanical and application skills reduces their use of technology in their workplace and lowers their productivity (e.g., Gattiker & Larwood, 1986). Therefore, human resource managers should assure that individuals feel comfortable about their level of mechanical and application skills, thereby encouraging them to make the best use of the technology in their work.

Variety and complexity of applications. The problem-solving strategies handled by the employee make up the variety and complexity of application skills. Task skills and mechanical abilities do not give him/her the problem-solving skills necessary to apply the technology at the workplace. Instead, they provide basic understanding of the technology with some 'hands-on' experience. Consequently, the individual with task and mechanical skills has not yet acquired the problem-solving skills needed to use the machine when performing various tasks.

Once again, the structure of work as well as the complexity and autonomy experienced should correlate highly to the variety and difficulty of applications in using one's technology. For example, a keypunch operator's job structure inherently limits his/her possible applications of a variety of skills at different levels of complexity. Variety of applications in using a technology in one's work is closely related to the range of job skills held by the individual (Hall, 1986, chapter 2).

Complexity of skills required to use the technology effectively determines the time necessary to become proficient. Therefore, an operator of a machine can become accomplished with little time in training, while a pilot needs substantial training to become proficient in handling a jet fighter. Piore and Sabel (1984) suggested that programmable technology would increase the importance of shop-floor skills in production. One reason put forward by these authors was that small-batch production requires workers' skills to debug programs and cope with complex innovation in the production process on a continuous basis. Research in factories, however, does not support this theoretical notion but, instead, provides evidence to the contrary (Shaiken, Herzenberg, & Kuhn, 1986).

The variety of technological skills held by an individual also depends on job content and structure. Even though a technology may offer a wide range of possibilities, individuals often need only a few skills to do their work. Office workers questioned by Mankin, Bikson, and Gutek (1984) felt they employed computers in their work in a limited manner. For instance, some reported that they used the computer solely for word processing even though electronic mail and other programs were available. Here, the job structure may not have allowed employees to apply their technology to a variety of tasks with different levels of complexity. Such beliefs held by employees may be detrimental to the effective use of technology and may suggest a lack of fit between employee capabilities and job requirements (Kohn, Schooler, Miller, Miller, Schoenbach & Schoenberg, 1983).

Innovative Application

Innovative application of new technology requires the worker to grasp and understand the machine to a great extent. The range and depth of application skills held by the individual will, in turn, greatly influence whether or not he/she uses the technology innovatively (e.g., Gattiker & Larwood, in press). Acquiring computer skills and applying them to a variety of discrete tasks in one's job enables an individual to solve other problems as well. A high level of mastery is necessary, however, before he/she will feel confident enough to think about expanding the use of the technology to other spheres of his/her job.

Discrete tasks. Another way to measure skills is to look at the number of discrete tasks the individual performs with the technology. Having mechanical and application skills to use a computer proficiently does not guarantee the effective use of an information system, which requires a certain amount of technological creativity (Cameron & Whetten, 1983, chap. 1). Discrete tasks make use of a variety of skills the individual may have, such as putting ledgers on the accounting information system, posting an entry on a journal, and drawing up financial statements (e.g., income statements and cash flow). Thus the work, in its very substance, requires initiative and judgment. For instance, writing reports, doing calculations on a spreadsheet, and communicating with other employees by using an electronic mail system require occupational self-direction. A variety of approaches can be used to do one's work; however, the individual will only be capable of doing these tasks if he/she has the application skills necessary to work with the technology (Kohn et al., 1983, p. 22).

Naturally, individuals cannot always perform a variety of discrete tasks using technology-related skills because close supervision or the structure of work might not permit it (Kohn et al., 1983, chap. 1-3). An example would be a reservation agent for an airline. The use of the computerized reservation system and the structure of his/her job demand few discrete tasks to perform the work effectively. Thus, the discrete tasks necessary to perform one's job determine the different discrete tasks one will do with the technology. If an employee is dissatisfied with the discrete tasks he/she must do with the technology, job enrichment or transfer may prove beneficial for the firm as well as the individual (cf. White, 1978).

Developing job-related applications. The numerous discrete tasks an individual performs require application of the possible uses of the technology to many situations. This enables the employee to develop other applications in his/her work based on current level of proficiency, such as problem-solving strategies. It is assumed here that the person feels comfortable with the technology and enjoys using it in a variety of tasks at different levels of complexity.

Developing job-related applications dictates that the individual has acquired a substantial level of computer literacy beyond the novice level. Research in end-user computing infers that well written, comprehensible manuals and efficient help functions within the system are essential (Gattiker, 1987). Technical jargon, therefore, may be detrimental to the innovative use of the technology. Nutt (1986) found that an end-user's limited tolerance of ambiguity might limit the innovative use of a technology unless manuals, technical advice of information systems specialists, and other help sources are easily accessible and understandable. Unfortunately, training for computer end-users is too often limited to focusing on immediate job applications (Mankin, Bikson & Gutek, 1984). Employees were not given the knowledge needed to attempt innovativeness in applying their technology and thus become more effective. It appears that effective technology training may be one of the most important factors affecting the development of job-related applications and individuals' beliefs that those activities are worthwhile. Again, the confidence factor looms, which affects the development of innovativeness in searching for new ways to make effective use of the technology in one's job.

Summary and Conclusion

These arguments infer that there are specific relationships between the elements of the general variables. Table 5 presents a way of schematizing these relationships. Again, theoretical as well as operational linkages are identified.

Insert Table 5 about here

The relationship between the mechanical and application skills (V5) and a person's discrete job tasks (V7) is a positive linear correlation with a limit. This means that, up to a certain point, the number of mechanical and application skills, as well as the number of discrete tasks performed with the technology, increases. Nevertheless, there is a maximum and a minimum point. The different coefficients simply mean that the curve and its peak can change for each employee or work group. The theoretical linkage between variables 6 and 7 suggests that if more discrete tasks are performed with a technology, the variety and complexity of application skills increases. Applying technology skills regularly in one's job is the most effective way of sustaining skill and proficiency (e.g., Kohn et al., 1983). The greater an employee's variety and complexity of applications, the more likely it is that he/she will develop new innovative applications for his/her work, (V6 and V8) and mechanize some of the mundane tasks (Doswell, 1983, chap. 3). Again, the relationship is positive and linear.

Conclusion

It should be understood that the theoretical perspective just described is merely a skeletal framework. Its linkages and the operational definitions needed to test the theory have been identified. The research necessary to delineate the pieces themselves still needs to be done and the dynamics of how the pieces of the theory interrelate to one another awaits testing. Ideally, these dynamics are examined in later research.

The discussion in this paper assumes that technological innovations lead to changes in work content and job structure (Spenner, 1983). A strategic endeavour for management would be to ensure that human resources can use any new technology effectively. This paper suggests that such an outcome is influenced by individual beliefs about a technology's effect on:

1) quality of work life and positive perception of technology-induced changes in the workplace, and

2) application skills which allow the individual to use the technology innovatively and not just for a few mundane functions in a robot-like fashion.

Assessing the beliefs employees hold about technological innovation in the workplace is an important step for strategic human resource management (Gattiker, in press). It allows firms to respond to technological change by introducing technology in a manner that enables employees to accept such developments. Beliefs are not only related to attitudes but, more importantly, they are related to human resource costs and benefits. For instance, negative beliefs about technology-mediated work will certainly have an effect on absenteeism rates and voluntary turnover in an organization. Some preliminary data also indicates that how a technology is utilized by employees is greatly influenced by the beliefs they hold about it. Monetary benefits for the firm (profits) and for the employee (wages, job security) can only be attained if the effective use of the technology is assured for each job (cf. Gattiker, 1987).

The most important step which follows from the work presented in this paper is the test of the model and its relationship to human resource costs and benefits. A humanitarian approach to technological changes which considers the beliefs and concerns of the human resources involved will not only benefit the employee but also the organization and will thereby facilitate future prosperity and, above all, job security.

Footnotes

1) In this context, the word strategic is used as in strategic management, meaning the decision process that brings together the capabilities of the organization with the opportunities and threats it faces in its environment (Rowe, Mason, & Dickel, 1982).

2) Working with technology is often defined as the physical activities, combined with the intellectual and knowledge processes, by which materials in some form are transformed into output, using the technology as a tool to perform this task (Roznowski & Hulin, 1985). Rousseau (1979) has noted that these processes are highly interdependent. For example, working with computers in an office may involve converting input such as financial data into outputs such as balance sheets. Performing tasks with advanced technology is a complex process which is likely to be influenced by the person's beliefs toward such technology (Staw, Bell & Clausen, 1986). Technology-mediated work entails physical activities combined with intellectual and knowledge processes to transform input into output. Technology, as employed in this study, includes various types ranging from flexible manufacturing systems and lasers to personal computers.

3) Technological change is used in a number of ways in the current literature ranging from both reactive and proactive change (Miles & Snow, 1978) to a more specific denotation of reacting to environmental changes (Astley & Van de Ven, 1983). The usage in this paper is mostly the former, allowing for both reactive and proactive change (Hrebiniak & Joyce, 1985). Additionally, technological change is also used to describe the alignment of organizational capabilities with internal contingencies such as

human resources and their beliefs about technology and its effect upon their work.

4) Technological innovation implies change in work structure and content. Innovation, as used in this paper, includes both process and product innovation leading to a reorientation of production facilities and production process improvements applying and integrating new technology into the work process.

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Table 1

Beliefs About Technological Innovation and Strategic Human Resource Management: Dimensions and Their General Variables

BELIEFS ABOUT TECHNOLOGICAL INNOVATION	EFFECTS OF TECHNOLOGY ON TECHNOLOGICAL SKILLS
Quality of Work Life	Range and Depth of Application Skills
Anticipated Technology-Induced Change	Innovative Application

Table 2

Dimension of Technological Innovation: General Variables and Their Elements

GENERAL VARIABLE	ELEMENTS
Quality of Work Life	-acceptance of technological innovation -job and task characteristics
Anticipated Technology-Induced Change	-job content/skills -organized labour and the public's acceptance

Table 3

Theoretical and Operational Linkages Between Elements of Technology Beliefs

ANTICIPATED TECHNOLOGY-INDUCED CHANGE	QUALITY OF WORK LIFE			
	Acceptance of Technological Innovation (V3)		Job and Task Characteristics (V4)	
	Theoretical Linkage	Operational Linkage	Theoretical Linkage	Operational Linkage
Job Content/Skills (V1)	If job content/skills are perceived to be lowered, acceptance of technological change will decrease	Positive linear correlation with limit and different coefficients	If job content/skills are perceived to be lowered, the individual will deduce negative effects on job/task characteristics	Positive linear correlation with limit and different coefficients
Organized Labour and the Public's Acceptance (V2)	Positive attitude toward technological change by union/public opinion will increase acceptance by the employee	Power curve with limits	Negative attitude toward technological change by union/public opinion encourages the employee to assume negative effects on his/her job/task characteristics	Positive linear correlation with limit and different coefficients

Table 4

Beliefs About Effects of Innovation on Technology Skills: General Variables and Their Elements

GENERAL VARIABLE	ELEMENTS
Range and Depth of Application Skills	-mechanical and application skills
	-variety and complexity of applications
Application	-discrete tasks
	-developing job related applications

Table 5

Theoretical and Operational Linkages Between Elements of the Technology Skills Dimension

RANGE AND DEPTH OF APPLICATION SKILLS	INNOVATIVE APPLICATION			
	Discrete Tasks (V7)		Developing Job-Related Applications (V8)	
	Theoretical Linkage	Operational Linkage	Theoretical Linkage	Operational Linkage
Mechanical and Application Skills (V5)	Performing various discrete tasks with the technology increases skills	Positive linear correlation with limit and different coefficients	Higher level of skills increases the development of job-related applications	Positive linear correlation with limit and different coefficients
Variety and Complexity of Applications (V6)	The number of discrete tasks performed with the technology influences the variety and complexity of the applications	Positive linear correlation with limit and different coefficients	Greater variety and complexity of technology applications increases development of job-related applications	Positive linear correlation with limit and different coefficients

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