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ABSTRACT

A model of technological training has two dimensions: level of cultural stability and employee's level of cognitive ability. Each dimension has two variables. The variables of cultural stability are (1) technological adoption and organizational adaptation and (2) structure of work and work processes. For cognitive ability, the variables are training and skills. This model suggests that successful technology adoption and organizational adaptation require a fit between culture and cognitive ability by the employees. Such a fit will enable the organization to offer the necessary training where it is needed most, thereby allowing employees to acquire the necessary skills to perform well with the new technology. The legal environment will affect the interrelationship between technology adoption and organizational adaptation profoundly. Culture may be an important factor since labor laws may differ across provinces and most certainly between countries. Thus, action strategies employed by a company must differ due to local labor laws. In less-developed countries, firms may introduce technology and automatically lay off redundant workers in large numbers. In Canada, if technology adoption results in more than 50 layoffs within any 4-week period, the group termination falls under the Canada Labour Code and a joint committee consisting of displaced workers and management must be established to determine severance pay, retraining support, and any other compensation. The practical implication for managers is the need for an integrated training strategy considering cultural factors. A firm must provide three types of training: job-specific training; training in company cultural habits and action strategies; and training for understanding and using the organizational culture to everyone's advantage. Sixty-two references are included and nine tables are appended. (CML)

TECHNOLOGICAL ADOPTION AND ORGANIZATIONAL ADAPTATION: DEVELOPING A MODEL FOR HUMAN RESOURCE MANAGEMENT IN AN INTERNATIONAL BUSINESS ENVIRONMENT

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Short title: Organizational Adaptation

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TECHNOLOGICAL ADOPTION AND ORGANIZATIONAL ADAPTATION: DEVELOPING A MODEL FOR HUMAN RESOURCE MANAGEMENT IN AN INTERNATIONAL BUSINESS ENVIRONMENT

Why should one specifically use an international perspective when discussing innovation technological adoption and organizational adaptation[1]? Four factors may explain why. The first factor is the internationalization of trade and business. For instance, several countries have entered or are currently preparing to enter into free-trade agreements (e.g., Australi. - New Zealand, USA - Canada, USA - Mexico, USA - Israel) and in 1992 the Common Market will eliminate any trade restrictions between its member countries. Trading blocks thus formed might impose barriers limiting market access for firms not located in participating countries for commodities such as agricultural products, steel and computer chips. To illustrate, a Swiss firm may need to open a subsidiary in a Common Market member country, duefully incorporated under that country's laws. Such a move will allow the firm to take full advantage of the liberalization of the Common Market (e.g., trade and participate in government sponsored programs) while otherwise its market access may be limited.

The second factor evolves out of the first: internationalization of trade means managing cultural diversity as effectively as possible. For instance, the Swiss firm's subsidiary in West Germany may recruit and employ any engineer or scientist who is a citizen of one of the European Community member countries without any employment restriction (no immigration or work permit necessary), since these individuals are free to move wherever their workplace may be located within the European Community. Thus, the firm's workforce is probably somewhat multi-cultural. In such a work environment of cultural diversity, effective innovation hinges on the people having the necessary habits, skills, and styles from which they can construct the appropriate "strategies of action" to manage adaptation (cf. Swidler, 1986). Another example leading to cultural diversity

in an organization's workforce is a joint venture between, for instance, a Japanese and USA firm. The joint venture has both Japanese and USA employees who must have the tolerance to understand and accept each other's different cultural values and habits in order to work successfully within these parameters.

The third factor stems from the previous two in that a firm's workforce will have acquired different knowledge and skills through formal and informal education. Considering the international workforce or even the cultural variety within a country (e.g., ethnic groups and minorities) the firm must assure that its employees either already possess or learn a similar set of skills, knowledge and strategies of action through training.[2] The training will assure successful technological adoption and organizational adaptation by enabling employees to work together and understand each others actions, styles and habits. Moreover, it will give employees the new skills needed to make effective use of innovative technology (e.g., Gattiker, in press b).

The last factor is that labour laws, codes and other government imposed rules and regulations will affect a firm's decision-making process about possible technology adoption and organizational adaptation. For instance, the labour law in one country may require that the firm and workers form a committee which discusses and determines how redundancy effects should be dealt with before new technology will be introduced.

Technological adoption necessitates subsequent organizational adaptation to make effective use of new technology. This paper will concentrate on developing a theory[3] offering research strategies to further investigate the interrelationship between culture, training and effective technological innovation as well as organizational adaptation. The theory draws on several disciplines: psychology, sociology and management. It is hoped that this theory will increase our knowledge about how to train individuals to manage innovation and technological adoption as effectively as possible.

DISTINGUISHING THE DIMENSIONS AND ELEMENTS OF THE TECHNOLOGY ADOPTION AND ORGANIZATIONAL ADAPTATION THEORY

If a comprehensive theory is needed, what should the dimensions be? It seems that two dimensions must be added or given particular attention by employees and firms alike: the employee's level of cognitive ability[4] and the macro and micro aspects of cultural stability[5].

What kind of theory can be developed within the above two dimensions? Further conceptualization of what is included in the two dimensions is necessary before this question can be answered thoroughly. One way to facilitate this is to search for general variables which are primarily culture-free and timeless continua (Hage, 1972, p.10). Such general variables are universal and easy to work with; most importantly, they help us 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-- in this case, level of cognitive ability and cultural stability-- and determine the general variables.

Insert Table 1 about here

Each general variable listed in Table 1 has several elements to it which need to be researched further. Element is a primitive term used to define classes of a phenomenon (Hage, 1972, pp. 28 & 120). Each general variable and its respective elements will be discussed in more detail below. Why would one choose both cultural stability and cognitive ability to develop a technology adoption and organizational adaptation theory? To begin with, research in high technology firms has shown that cultural stability or instability is an important component for a firm's success in fostering innovation. For instance, Perry and Sandholtz (1988) reported that cultural instability in a high technology firm tends to encourage innovation and organizational adaptation while cultural orthodoxy reduces the tolerance for new ideas and, therefore, hinders innovation. For

example, in an orthodox and very stable culture, such as Russia before Pestroika, cultural diversity was surpressed and adoption of new technologies, innovation and also the necessary organizational adaptation was not especially appreciated, supported, nor rewarded.

Conversely, if individuals are used to and accept cultural instability they may also be more tolerant toward the learning of new skills, as well as innovation and its adaptation by the firm. This tolerance towards learning will greatly facilitate the formal or informal training needed for individuals to acquire the tools, habits and new skills needed to succeed. If the training is in a formal setting, however, effectiveness of such efforts depends upon students' ability to learn. High cognitive ability in the workforce may not by itself assure successful adaptation to new technology, but together with a willingness to be open to change and to accept that action strategies may have to alter to make better use of new opportunities, it is vitally important.

What distinguishes this model from others? Most conceptual approaches for explaining culture's impact upon organizations have been put into a national vacuum. Thus, how leadership, human resource selection and reward systems affect organizational culture and vice versa is described within one culture or nation (e.g., U.S.) without considering the fact that internationalization of business renders such an approach limiting. Moreover, training and management development is usually described within one culture, again ignoring the challenges and opportunities for such an approach in an international context.

Another important distinguishing factor for the model outlined in Figure 2 is the fact that both cultural stability and cognitive ability are dimensions whose variables and elements interrelate and affect each other. Thus, as within an organic system, changing the level of one variable will eventually affect the other parts of the system. In most models, technological adoption and subsequent organizational adaptation is not seen as being part of an open and organic system (Scott, 1981) but instead as a static and often closed system.

The last distinguishing factor for the approach outlined here is the fact that most recent models have concentrated on explaining the necessary processes for creating an environment fostering innovation with very limited focus upon human resource management's interrelationship with potential success in this area. Thus the model outlined in Figure 1 represents an open-system approach to technological adoption and organizational adaptation taking the internationalization of business (cultural stability) and also human resources (cognitive ability) into consideration, thereby distinguishing itself from other more limited attempts.

Insert Figure 1 about here

Figure 1 outlines the theory and depicts it as a an-open system with two dimensions, namely cultural stability and cognitive ability. Moreover, the figure illustrates the various elements for each dimension of the model and their subsequent variables. In the sections below both dimensions of the theory, namely the level of cultural stability and the level of cognitive ability, and also their general variables and elements as well as interrelationships will be discussed in more detail.

Cultural Stability: General Variables and their Elements

Both a country and an organization's culture encompass symbolic vehicles such as meanings, beliefs, ritual practices, work forms and ceremonies. These also include informal cultural practices such as "the grapevine", gossip, stories, and the organizational rituals of daily work life. According to Swidler (1986), these symbolic forms are the means through which action strategies are shaped. Culturally-shaped skills, habits, and styles explain what is distinctive about the behavior of organizations, groups, and societies. Cultural stability is defined as an environment which sustains existing strategies of action, while instability is inherent in change which causes new patterns of action to evolve.

How does cultural stability relate to managing the firm? As mentioned earlier, based on their study of a high technology firm, Perry and Sandholtz (1988) concluded that, interestingly enough, a "liberating" organizational form encourages innovation in a firm. The culture is, therefore, not stable but instead in constant flux and tolerant of internal diversity (strategies, habits and values), thereby encouraging innovation. The firm believes in innovation and, most important, social pressure rewards innovation while lack thereof may result in dismissal. Diversity may manifest itself by such simple means as having people come to work in various types of clothing (suit, shorts, baseball cap and sneakers) based on their preference (cf. Goldstone, 1987). Table 2 lists the two general variables and their respective elements which are contained in the cultural dimension of the theory presented earlier (cf. Table 1).

Insert Table 2 about here

Technological Adoption and Organizational Adaptation

Organizational adoption as used in this paper refers to the firm's decision to adopt a new technology or innovation. Adoption may occur via a continuous or discontinuous process. The latter usually represents a radical change while continous adoption is a gradual process. An example for discontinuous adoption might be a situation wherein an office employee, who has never worked with a computer, arrives at work one day to find a personal computer connected to a local area network at his or her desk. Hence, tasks done manually yesterday should be done with the computer today. A continuous adoption is illustrated by a case where an employee changes from a mainframe terminal to a networked personal computer.

Hence, technological adoption requires organizational adaptation to make effective use of the technology. Organizational adaptation could be as simple as preparing a workplace (ergonomic work table for using computer) to re-arranging organizational structure.

The term organizational adaptation is used in a number of ways in current literature, ranging from referring to reactive or pro-active change (Miles & Snow, 1978) to more specifically denoting reacting to environmental changes (Astley & Van de Ven, 1983). Moreover, organizational adaptation is also used to describe the alignment of organizational capabilities with internal contingencies such as the employees' attitudes toward technology. In this context, the term refers to both pro-active and reactive behavior on the part of the firm with the intention to align its organizational capabilities with internal and external contingencies.

The distinction between adoption and adaptation lies in the fact that adoption usually represents the installation of new technology (e.g., in the office or factory). In contrast, adaptation is the organizational system's attempt to adjust to the technology. This adjustment may result in changes in work structure and processes. Job descriptions may be altered and new positions may be formed. The flow of information and the decision-making process may change due to adoption of new technology. Thus adoption is the first step in an often timely process by the organization to adapt the technology and its own structures and processes in such a way that they fit and, therefore, allow the effective use of new technology.

Organizational adaptation is often caused by product or process innovation which was triggered internally (e.g., R&D unit), externally or a combination of both. In either case, innovation usually requires adaptation by the firm to respond or make effective use of it. The general variable, technological adoption and organizational adaptation, is obviously important to manage change for the future survival of the firm.

Cultural tools and strategies. As discussed in the above section, individuals must acquire certain tools and action strategies in order to accomplish desired outcomes. Based on these varying skills, technological adoption and organizational adaptation is managed differently. One of the areas which has fascinated North American researchers in the last decade is Japanese management techniques and philosophy (Tanaka, 1988). Unfortunately,

some research indicates that these may not be applicable in other countries because the necessary action strategies could not develop out of a North American or European worker's "tool kit" (cf. Hofstede, 1984; Swidler, 1986; Tanaka, 1988).

To manage cultural diversity in one's workforce and promote change in cultural values, strategies and habits effectively, potential sources of diversity need to be identified and understood. It seems that four sources for cultural diversity can be identified. First, **cross-national** differences (political climate, religion and other factors) between, for instance, Japan and the USA must be recognized and dealt with before establishing a joint venture (Osborn, Strickstein, Olson, 1988). Second, **geographical/regional culture** (e.g., language, cuisine, life style and others) may affect the firm's success. For example, in Geneva, not only the language (French) is different than in Zurich (Swiss German), but lifestyles and cultural values also differ significantly (cf. Hofstede, 1984). Third, **intra-cultural** differences between ethnic groups (Chinese vs. Polish immigrants in the USA) and between the majority and minorities, such as Maoris in New Zealand and Kurdes in Iraq, will further increase the cultural diversity in a firm. Fourth, the firm must deal with the **professional or trade culture**. A joint venture between a French (USA) and West German (Japanese) company may have to confront the fact that the French (USA) managers are trained in public administration (finance and accounting, Fligstein, 1987), while the German (Japanese) ones have an engineering (engineering, production) background. Last but not least, the two firm's **organizational culture** (e.g., when attempting to make a takeover or start a joint venture) may be totally different. For example, when Asea (Sweden) and BBC (Brown-Boveri Company) (Switzerland) merged in 1987, two different cultures let to a great diversity in action strategies, values and habits. Thus the CEO of the new Asea/BBC conglomerate had to hold numerous talks with union, employees and other groups to explain to them what the new organization would all be about (e.g., future strategy, areas of growth, job security, risk taking and management style).

To manage the above four sources of cultural diversity effectively, Nissan decided to bring all its first-line supervisors in its first North American plant to Japan for several weeks. This approach enabled the Americans to learn about Japanese management, quality circles and many other things which supposedly were important habits, skills and action strategies accounting for part of Nissan's success. Moreover, the Americans learned about diversity caused by their own regional (South vs. Midwest) and/or intra-cultural (ethnic groups) differences and Nissan's organizational culture. This approach does not eliminate cultural diversity but it increases tolerance for it by offering the individual the opportunity to observe, experience, understand and learn to work with different cultural habits and strategies.

Managing technological and technological adoption and organizational adaptation.

In a prescient early observation, Leavitt (1964) suggested that important changes can be brought about in an organization through alteration of its technology. Nonetheless, change risks disturbing the psychological contract or status quo for employees who have learned an earlier set of rules (Larwood, 1984, p. 213). Since people generally wish to protect the systems they have found to be successful and want to avoid potentially risky restructuring (cf. Klein, 1966), most people cannot be expected to welcome major change.

Technological adoption often requires firms to continuously reorganize and adopt their organizational processes. For instance, new hardware and software developments lead to changes in the use of computer-based information technology in organizational settings (Gattiker, 1984). Technological developments have led to the transformation of the manufacturing sectors in many countries. Flexible manufacturing systems (FMS) have changed the production process as well as work structure. Such innovation inevitably affects a firm's workforce. Employee acceptance of such changes must be secured in order to facilitate effective use of the technology (Gattiker, 1987c).

Organizational adoption may be facilitated by the participation of the workforce in the decision-making process. For instance, West German laws outline exactly how workers

and their union representatives must be informed about technology and organizational changes due to adoption. (e.g., Osterloh, 1986). Despite this, an extensive case study by Wilpert (1986) which looked at five West German companies concluded that, unfortunately, the legal stipulations were inadequate to set a comprehensive framework for the decision process. Wilpert also suggests that agreements between unions and firms to consult and bargain throughout the process of introducing new technology would ensure that employees are informed and involved in the process. This could lead to greater acceptance of technological adoption and smoother organizational adaptation.

Participation can be accomplished in two ways: legal requirements or informal, voluntary participation. For instance, while West German and French firms are required by law to let their workforce participate in the decision process when it comes to technology and the necessary organizational adaptation, American and Japanese firms use the voluntary model. Still, strategy differences within each group of countries, such as those between the voluntary models followed by the United States and Japan, are common. Worker participation in the decision-making process about technologicy adoption at Ford may, therefore, largely be based on union contracts, while at Toyota technology adoption is being discussed thoroughly within quality circles and only initiated after some kind of consensus has been achieved. Furthermore, how participation may be implemented and used is most likely going to differ between two firms in one country (Ford vs. Chrysler). Each approach toward participation (legal or voluntary), however, does achieves involvement of the workforce in the decision-making process, and thus is valuable.

In an organizational culture which tolerates diversity, it is possible that even where legal participation and co-determination is stipulated, informal channels may be used first. Such an approach helps management to encourage the use of various solutions to problems thereby increasing the creativity of the workforce. Before a solution becomes the norm, however, it has been developed based on informal participation to fit the employees' and the firm's needs, thereby making the participation steps required by law

a rubber stamp process (Gattiker, 1998b).

Structure of Work and Work Processes

In recent years, much attention has been paid to the phenomenon of the de-skilling of craft workers (Braverman, 1974; Hall, 1986). De-skilling is seen as an act of capitalism which attempts to transfer control of work to management by depriving the employee of his or her skill. Integrated, self-controlled craft work is replaced by centralized design, standardized procedures and products, and the fragmentation of skills into detail work in unskilled, specialized roles. Nonetheless, as will be shown below, Braverman's thesis that the workforce is becoming increasingly unskilled and homogenized is not necessarily conceptually and empirically founded (cf. Francis, 1986, chap. 5).

Element of specialization. The elimination of certain crafts has led to the creation of different occupations. Technological developments account for some of these changes. Nevertheless, these developments may have led to such undesirable effects as the extreme specialization of certain occupations. Some occupations have a narrowly defined set of responsibilities and any job-holder must have certain skills in order to work with the new technology. For instance, a study by Shaiken, Herzenberg, and Kuhn (1986) found that even in small-batch production, there was little sign of the new "craft worker" described by Piore and Sabel. Moreover, a premium placed on quality and fast delivery would require that technology and shop-floor skills be used in a complementary fashion, which these authors did not find. Instead, programming changes were not made on the shop-floor but by a separate programming department. A similar fragmentation was discovered by Kraft and Dubnoff (1986), who looked at computer software workers at the leading edge of the computer revolution. These results are not universal. In a contrasting study, Attewell (1987a) used quantitative industrywide data on insurance occupations and found no aggregate de-skilling. Instead, he even reported in one study that skilling levels increased due to office automation for clerical type positions in insurance offices (Attewell, 1987b). Similarly, in West Germany and Sweden up-skilling has resulted from technology-induced

adaptation in firms and industry (e.g., Brumlop & Juergens, 1986; Van Houton, 1987), thus suggesting that technology may not necessarily lead to de-skilling as suggested by Braverman (1974). These data suggest that technology's effects upon skills might depend on the type of work industry and firm or country involved to mention a few variables.

Athough the above suggests that cross-national differences may account for the various outcomes reported in studies, three interrelated factors may better explain why in some cases up-skilling and in other de-skilling may occur due to technological change. First, **labour market structure differences** may be apparent. For instance, internal labour markets (see section below) in Sweden and West Germany often guarantee employees that quality of work life should improve with new technology (Betriebsrat, Max Planck-Institut fuer Bildungsforschung, 1988). Thus de-skilling is not a viable option (cf. Brumlop & Juergens, 1986; Van Houton, 1987). Second, up-skilling of jobs with the help of technology could be one strategy for fighting high labor costs (UBS, July 1988), thereby increasing productivity of capital. In contrast, low labour costs, as for certain positions in the USA (e.g., hired under contract at minimum wage without any fringe benefits and no opportunity to acquire seniority rights), may encourage further de-skilling to reduce wages and facilitate the hiring of cheap labour (e.g., illegal immigrants). Third, formal education received by employee and the skills needed may determine how much up-skilling could be a viable option. If people with certain skills are not available and workforce tenure is relatively short, it may be more economical for a firm not to invest in training but, instead, keep the skills requirement for performing a job as low as possible. Furthermore, illiteracy and lack of understanding of basic mathematics may prevent an organization from up-skilling certain jobs unless its employees acquire the skills in a remedial program.

The above shows that further de-skilling or up-skilling with the help of technology depends upon the three factors described above and suggests that Braverman's thesis is neither right or wrong but too general to explain the process adequately.

The organization and its internal labor market (ILM). For the purposes of this discussion, the central idea of the internal labor market approach is that both managers and workers in the large and medium-sized firms, as they try to maximize opportunities for profits and wages, attempt to reduce uncertainties arising from the market environment. For managers, a major concern is the uncertainty over whether employees will stay with the firm. For instance, virtually all computer programmers in North America used to learn their trade either in school or in private training institutions, while Europeans learned through apprenticeships with a mixture of organizational training and outside schooling. At that time, programmers' loyalty was to their profession but not necessarily to their firm. Turnover was relatively high since these individuals had no difficulty finding other jobs and transferring their skills. As well, their wage demands had the potential to interrupt internal wage scales. Therefore, some companies started offering a more truncated training program to qualified applicants within the firm. This, in turn, stabilized the internal pool of programmers since they could no longer transfer their skills as easily as they had before (cf. Osterman, 1986). This trend is continuing and increasing in other positions, not only as a result of technological innovation, but primarily because of companies' attempts to stabilize their internal labor markets.

For employees, the major point of uncertainty is that unfavorable labor market conditions, such as high unemployment, will lower the costs of their dismissal and replacement by new workers. Thus workers also have an interest in institutionalizing the administrative rules that govern internal job ladders and wage and salary increments linked with promotion. Employees do attempt (especially through trade unions) to enforce principles such as seniority as the primary criterion for determining the order of promotions and temporary lay-offs (Pfeffer & Cohen, 1984). To the extent that employees are successful in enforcing such rules, uncertainty of employment is differentially distributed across the workforce and the actual or potential beneficiaries become more likely to cooperate in the production process (Stark, 1986). The efforts made to reduce

uncertainties by both firms and employees therefore take the form of bureaucratic rules which are ILMs' distinctive trait (Osterman, 1984, pp. 2-6).

This means that ILM structure can affect technological innovation and adaptation efforts. For example: work roles may prevent employees from doing certain jobs, and implicit employment guarantees may prevent lay-offs. This relates to culture because organizations use different approaches to manage ILM based on their culture and nationality. Piore (1986) concluded that although American firms have greater employment flexibility under the law, cultural parameters such as union contracts and implicit employment guarantees may force them to lay-off workers according to seniority as a last resort. In Western Europe, laws outline procedures which limit a firm's choices. Nevertheless, the final outcome for labor market flexibility is similar, despite the different cultural strategies used.

A firm's internal labor market also limits its choices of how to manage technological adoption and organizational adaptation. This means that bureaucratic rules can put an organization into a straightjacket (cf. Betriebsrat, Max-Planck-Institut fuer Bildungsforschung, 1988). With new technology, this could mean that individuals cannot be shifted easily from one job to another within a firm, nor can job duties and skill requirements be changed without major adjustments to job descriptions and union bargaining contracts.

Summary and Conclusion

We have suggested that there are specific relationships between the general variables identified above. Table 3 represents a way of schematizing these relationships. Hage (1972, chap. 4) has argued that linkages between elements of a theory must be specified with theoretical statements. These are phrases which indicate why, whereas operational linkages explain how. Hage has stated that operational linkages make a theory measurable and should explain if the linkage is a linear one, a curve, or a power[6], thereby simplifying data-processing and analysis.

Insert Table 3 about here

Table 3 illustrates the different theoretical linkages between the elements of the two dimensions. The operational statements specify the coefficients which represent 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 country and its culture experience some degree of stability which is represented by the lower limit. Additionally, stability tends to lead to work forms or jobs which become more specialized (e.g., extensive technological change limits job specialization and skills stagnation) as the culture becomes more stable and immune to change. The different coefficients mean that the relationships can be made up of different ratios between V1 and V3, ranging from .01 to a perfect 1.00 relationship.

Power is a coefficient which is constantly changing (e.g., power curve). Adoption and adaptation (V2) and specialization (V3) have a relationship which can change and is not linear (Hage, 1972, pp. 100-106). The lower limit suggests that some innovation and specialization is inevitable for all organizations. Furthermore, technological adoption and organizational adaptation can be continuous, but their frequency and the level of specialization that can be reached is limited. Exactly where the upper and lower limits are, as well as what power coefficients therefore apply, still needs to be tested.

The relationship between V2 and V4 is positive and linear but different coefficients are possible. Hence, the more technology adoption and organizational adaptation a firm experiences, the more likely its workforce will push for some sort of participation in the decision-making process. Increased participation does, however, increase bureaucratic rules since numerous factors must be considered before the firm may introduce a new technology. There may exist a maximum as well as a minimum but most firms will be somewhere in the middle. The correlation may also differ based on such factors like co-

operation and trust between management and employees. Distrust may increase the tendency for rules and regulations.

Table 3 lists the basic operational linkages only. As a result, it provides only a framework for future research. The table also indicates that bureaucratic rules for ILM increase with increased levels of cultural stability (V1 and V4). Cultural stability tends to increase the number of laws affecting organizations as well as employees. 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 by future research.

Level of Cognitive Ability: General Variables and their Elements

There is very little research available that deals with the effects of cognitive ability on technology training. Educational psychologists have argued that a person's ability will influence how he/she will learn and what performance outcomes should be expected (Lepper, 1985; Snow, 1986). For example, Gattiker (1987a) found that students with less cognitive ability (e.g., lower grade-point average) did better in a course teaching micro-computer skills if they had previously taken a course in computer science. Another study found that individuals with less cognitive ability benefit most from additional time spent on learning exercises using new technology (Gattiker, 1987b). One reason could be that additional hands-on experience, acquired when practicing one's skills on the computer (or having previously attended another computer course), speeds up one's automated processes (e.g., using a software package without having to use the manual) and thereby positively affects one's overall performance. Nonetheless, limited cognitive abilities may prevent total elimination of the performance gap between ability groups.

Organizations will have to train individuals who have various levels of ability. Some employees may be functionally illiterate, whereas others, such as R&D personnel, may have graduate education in engineering or other areas. In either case, it is obvious that training methods must differ. An additional concern must be the individual's past job

experience. For instance, Kohn et al. (1983) reported in their longitudinal study that an employee's intellectual flexibility is influenced by his or her experienced job complexity. High job complexity will increase intellectual flexibility while low complexity will decrease intellectual flexibility. The degree of complexity is synonymous with the variety of skills the job holder should possess in order to complete the duties and responsibilities involved. The research by Kohn and colleagues suggests that past job experiences as well as formal education will influence a person's current level of ability. This will affect one's training ability as well as skill level (depth, range, and application). Table 4 lists the two general variables and their respective elements which are contained in the ability dimension of the theory presented earlier. (cf. Table 1).

Insert Table 4 about here

Training

Training content. Knowledge theorists argue that an important prerequisite for problem solving is the ability to access knowledge when needed. Acquiring knowledge relevant to one's job situation, therefore, is no guarantee that individuals will activate that knowledge in a relevant situation (Dooling & Lachman, 1971). Educational research indicates that activation is easier for people if their previous experiences provide a basis for producing relevant schemata (e.g., Gick & Holyoak, 1983), and if learning activities help individuals to experience problems and recognize the usefulness of their own knowledge for solving them (Adams, Perfetto, Yearwood, Kasserman, Bransford & Franks, 1985).

Training must be designed in such a way that individuals can access newly acquired knowledge in relevant job situations. An individual should be capable of using the technology innovatively in his or her job. This suggests that employees should be able to access cultural skills and strategies applicable to situations such as international

contract negotiations. Also, R&D engineers must be able to work together with production workers whose cultural skills are very different. In this context, the learning of another language in a classroom should be complemented with an opportunity for the individual to live in that country, thereby learning the cultural nuances of words as well as their various meanings.

Training method. Training should focus on allowing the individual to master challenges during the period of learning. The overall goal is to increase the employee's competence in a particular area, while a learning goal focuses on activating his or her own ability to overcome obstacles, thereby increasing learning ability (Dweck, 1986).

New technology has opened new avenues for training. For instance, computer-aided learning (CAL) has become popular. CAL has three distinct dimensions: 1) drill-and-practice applications, in which the instructor presents material to students by conventional means and the students practice the new skills using the computer during class or on their own time; 2) tool mode, in which the student uses the computer to perform certain tasks utilizing software and statistical packages with and without time constraints; and 3) tutee, in which students give the computer directions in a programming language it understands, such as Pascal.

Of course, in addition to CAL, there are more traditional approaches to learning, such as studying a manual or using a laboratory setting for learning exercises. Furthermore, video disks are also used to train workers. The issue here is not to determine which of the methods is better, but what different methods of training should be used to increase learning for employees with different levels of cognitive ability. Research by Gattiker and his colleagues found that university students with low cognitive ability gained most from CAL when trying to acquire computer application skills (e.g., Gattiker & Paulson, 1987; Gattiker, 1987a). Depending upon an individual's learning style, however, teaching styles must differ considerably. No matter what kind of training method is used, the ultimate objective is to increase the individual's competency.

A teaching method which presents information the way the individual prefers to process it is an important factor to successful training. Gregorc (1982) developed a taxonomy of learning which consists of four cognitive styles: 1) logical sequential, 2) abstract sequential, 3) abstract random, and 4) concrete random. Each label represents a style of ordering and processing information which dominates an individual's approach to learning new skills. Effective learning requires not only a match between the individual's learning style and the teaching style but also, most interestingly, a match between the technology and the styles. For example, logical sequential learning is most successful when CAL follows a sequence of logical steps to guide the individual to a higher level of mastery. For the concrete random individual, however, such techniques might fail because the individual likes to study the problem from different angles, not necessarily following a logical sequence of steps. The above exemplifies that a person's learning style and preference in processing information must be considered when trying to design a training program for a firm's workforce.

Job Skills Facilitating Effective Use of New Technology

The discussion of skills also involves the range and depth issue. Specialization leads to a smaller range but greater depth of skills. For instance, a nurse specializing in gynaecology will have a great depth of skills in this area but may have a limited range of skills in emergency care. This suggests that there is a linkage between skill requirements for certain positions and specialization of employees. Positions which require highly specialized skills of limited range and great depth may be difficult to transfer into unless training is provided. Similarly, a transfer out of such a position may also require additional training to smooth the transition.

Job skills. Sociologists have claimed that jobs have inherent skill requirements. Thus the primary mechanism through which skilled people select their work appears to be long-term occupational shaping rather than immediate or substantial changes in the structure of their work (e.g., Kohn et al., 1983; Spenner, 1983). Professional and craft

workers offer different skills and choose different jobs which make use of those skills (Kohn et al., 1983). Furthermore, the comparison between professional and craft jobs indicates that there are major differences in the content and length of training. The former emphasizes and uses theory while crafts stress and use hands-on experience (Hall, 1986, p. 68).

In the past, we have usually distinguished between industrial (blue-collar), salaried (white-collar), craft and secondary employment sub-systems (Osterman, 1986). At this time, however, what interests us most is whether the future will offer employment sub-systems including the following work types: (1) knowledge worker, (2) skilled, (3) semi-skilled, and (4) low-skilled employee. The knowledge-worker category would include managers, R&D scientists and engineers--professionals who acquire, process and interpret information from a variety of sources to solve problems. Professionals who diagnose problems, such as doctors and lawyers, are also included in this category. The usual distinction between blue and white-collar workers has been dropped. Instead, this system distinguishes between skilled workers-- including potters, nurses, and teachers--and semi-skilled workers--computer operators, bank tellers, and so forth. Skilled workers acquire skills that are not firm-specific. These employees thus have more market power than their semi-skilled counterparts who have firm-specific skills. Low-skilled employees include mailroom staff, messengers, fast-food clerks, and gas station attendants. This fourfold classification system is far from earlier efforts to understand sub-categories of work; it differs in that it tries to capture some of the technological adoption and organizational adaptation developments which have led to different positions and jobs.

The benefits of this classification system can be shown by contrasting it with a traditional system of classification. Computer software specialists design, write, and modify the instructions which make computers work. Using a traditional classification system, one would say that this is both a white-collar (Osterman, 1986) and professional job (Hall, 1986, p. 68). This categorization, however, is inadequate to distinguish

between different types of software positions. Job content and the degree of control exercised determine which of the first three categories (knowledge, skilled, or semi-skilled work) the job will be put into. Kraft and Dubnoff (1986) found that, for instance, software specialists doing maintenance/application work and system programming were semi-skilled because their skills were firm-specific, job content was narrow, and control limited. Skilled software positions, however, require designing applications based on specific customer needs and demand frequent interaction with customers and peers. Software employees in the knowledge category had to plan, manage, and make decisions about software and hardware purchases and sales which affect the lower level software positions. This example illustrates the usefulness of the four-category system presented in this paper.

How will these four job categories apply when introduction of new technology into the work world? Rapid changes and its inherent instability forces people to adjust. For instance, technolological changes requires the learning of new skills and change requires intellectual flexibility and a person's capability to face complexity (cf. Kohn et al., 1983). Training and re-training to acquire new skills may become the single most important factor in adaptation by helping people to move into new positions.

Technology application skills. These skills vary according to the technology used by the individual, which may range from computers to lasers. For office workers, application skills for workstations usually include a person's ability to use word processors, spreadsheets, database managers, some statistical packages, programming and business-related software such as graphics (Jones & Lavelli, 1986). Gattiker (1987c) has argued that a person with the above skills has a first level of literacy in a technology. A systems programmer developing an expert system for oil exploration or a fighter pilot, however, require skills at the professional level.

Technological innovation has created different types of technology application skills. For instance, research about computer-numerical control (CNC) machines and flexible

manufacturing systems (FMS) indicates that planning responsibility and autonomy are often absent from the shop-floor (Shaiken, Herzenberg, & Kuhn, 1986). Managers and skilled workers in the office who have some shop-floor experience contribute the knowledge needed to design and plan new products and implement their production. This results in de-skilling of the formerly skilled craftsworker on the shop-floor. He or she is left to operate a machine which is semi-skilled if not unskilled work. Shaiken, Herzenberg and Kuhn (1986) stated that a more broadly skilled workforce emerging from FMS and CNC production holds more promise in theory than in practice (Piore & Sabel, 1984). The machine operator can often override the computer program during the manufacturing process; however, actual program changes are done by someone else. This would indicate that technology application skills for semi-skilled or low-skilled employees are narrow in focus and scope and further encourage specialization.

Bikson and Gutek (1983) found that office workers' application skills for workstations were not adequate for them to make full use of the computer-based technology in their jobs. Instead, their training was so job specific that it prevented them from developing applications on their own using standard software. Similar results were reported by Verdin (1988). She found that some managers were not satisfied with personnel information systems because they did not feel adequately trained to use them effectively. It appears that employees often do not have adequate technology application skills for them to make effective use of technology. Furthermore, their skills may be limited in scope and decision-making may not be required, so these skillful employees become de-skilled operators. Nonetheless, even though the above developments (e.g., de-skilling) may occur, cross-national differences as outlined earlier in this paper (see Element of Specialization) may in part account for the sometimes negative skills outcomes attributed to technological adoption.

Summary and Conclusion

The sections discussed above indicate that there are specific relationships between the elements of the general variables. Table 5 presents a way of schematizing these relationships. Again, theoretical linkages as well as operational ones are identified.

Insert Table 5 about here

The relationship between the learning goal (V6) and a person's job skills (V7) is curvilinear. This means that up to a certain point, one's competency level increases along with the number of skills. After the maximum point has been reached, the number of skills may still increase but one's competency in using them may deteriorate. One reason for this could be a person's limited cognitive apability to store all of this different information. The different coefficients simply mean that the curve and its peak can change for each employee or work group. The theoretical linkage between variables 5 and 7 suggests that easier access to knowledge increases the level and depth of skills. Accessing the knowledge easily and regularly in one's job is the most effective way to retain skill and proficiency (e.g., Kohn et al., 1983). Training with the objective of improving an individual's competency in using the technology will enable the individual to increase the range and depth of his or her skills (V6 and V8) and use the technology more effectively on the job. Again, the relationship is curvilinear because the individual can increase his or her competency for a range of skills only to a certain level, and beyond it, competency will decrease. Increasing one's range of skills may reduce the in depth knowledge about applying various skills to one's job.

THEORETICAL AND OPERATIONAL LINKAGES BETWEEN CULTURAL STABILITY AND COGNITIVE ABILITY

The theoretical perspective just described should be recognized as merely a skeletal framework. The theoretical linkages as well as the operational definitions needed to test the theory have been identified. The research necessary to describe the pieces themselves

still needs to be done, and the dynamics of how the pieces of the theory interrelate to one another awaits testing. I hope that the dynamics will be examined by later researchers.

Table 6 outlines how training content and training method relate to the degree of stability in cultural tools and strategies as well as managing adaption and organizational adaptation. For instance, increased competency (V6) improves the ease with which technological adoption and organizational adaptation (V2) triggered tansition can be managed. Thus if individuals know how to make effective use of new technology due to their training they will be more likely to adjust to the change and feel less threatened by the outcome.

Table 7 proposes the interrelationships between skills and technological adoption and organizational adaptation. It is suggested that limited participation in the technology adoption and organizational adaptation process (V2) will reduce the skill levels attained by the firm's employees. One reason for this could be that participation helps employees at an early stage to learn more about new technology and start to understand how it will be used in their work area. Moreover, certain skills are acquired during these early stages (Gattiker, 1988a) and it should motivate individuals to acquire further skills early on either through formal (e.g., training) and or informal means.

Insert Tables 6-9 about here

One of the major points remaining is the linkage between the structure of work and work processes and the skills. Table 8 suggests that a highly structured ILM does increase the structure of training content. Hence, due possibly to skill level changes, training content must be approved to avoid potential job classfication changes. Due to the nature of the strict approval process (e.g., union and management), a highly structured ILM will

likely increase logical and sequential training (step-by-step) following a pre-approved outline. Thus, on-the job training is less likely. Table 9 outlines the relationship between skills and the structure of work and work processes.

In Table 9 the relationship between V3 and V7 suggests that increased specialization improves the depth of a person's job skills in a certain area but limits his or her skill range. The same applies for technology application skills (V3 and V8). A highly structured ILM tends to result in narrow job descriptions which, in turn, cause the individual to become highly skilled in a narrow area applicable to his or her job. Once again, the same is true in a highly structured ILM for technology application skills.

The above proposes interrelationships between the variables outlined in Tables 2 and 4 and suggests the operational linkages. Most important is the fact that level of cultural stability and cognitive ability are assumed to be interrelated. Thus a training or adaptation strategy within a firm must take this interrelationship into careful consideration.

CONCLUSION

The model proposed suggests that successful technology adoption and organizational adaptation require a fit between culture (organizational and national) and cognitive ability by the employees. Such a fit will enable the organization to offer the necessary training where it is needed most, thereby allowing employees to aquire the necessary skills to perform well with the new technology. Due to space limitations, the legal environment was not extensively discussed, although it will affect the interrelationship between technology adoption and organizational adaptation profoundly. Culture may be an important factor since labour laws may differ across provinces/states and most certainly between countries. Thus action strategies employed by a company's subsidiaries must differ due to local labour laws. For instance, in less-developed countries firms may introduce technology and automatically lay off redundant workers in large numbers. In Canada, if technology adoption results in more than 50 lay-offs within any four week period, the group

termination falls under The Canada Labour Code, section 59.7 - 60.31, and a joint committee consisting of redundant workers and management must be established. The committee will determine severance pay, re-training support and any other compensation to be paid to the redundant workers. If the committee cannot agree a federally appointed arbitrator will draft an agreement which will be binding for both parties.

Implications for Managers

The most obvious practical implication deriving from this model is the firm's need for an integrated training strategy considering cultural factors. However, popular management literature is of little help here. For instance, recent suggestions in the popular literature point out demographic trends in the USA workforce (e.g., in the Nineties the majority of new employees available will be women or black, Hispanic or Asian men) and state that firms must be successful in attracting these employees (Kupfer, September 26, 1988). Unfortunately, such information does not mention nor discuss the potential effect of these shifts upon cultural stability in organizations. Moreover, how a firm may manage this increase in cultural diversity successfully in combination with training is anybody's guess.

Globalization of business does not only require having subsidiaries in various countries and a global strategy linking them with headquarters. More important is the fact that training strategies need to be developed which differ for various groups of employees (e.g., knowledge workers vs. unskilled labourer) when it comes to technical skills training. It remains to be discovered how the firm can assure that knowledge workers can form an effective team with unskilled labourers. The two groups may not have the same mind-set; that is to say, values, norms and action strategies may be so different that communication becomes difficult, even if they speak the same language.

This paper would then suggest that a firm must offer or support three types of training: (1) job specific training, (2) training to acquire plant/subsidiary cultural habits and action strategies and (3) training for understanding and using the

organizational culture to everybody's advantage.

Depending upon the formal education acquired by the new employee skill training may differ across countries. For instance, vocational training in Europe may be at a more advanced level then in North America. Moreover, skills and knowledge acquired during formal education may assure a European employee's literacy, thus making such upgrading programs more of a North American phenomenon than anything else. Additionally, skills acquired during vocational training may determine in part what additional on-the job or off-the job training may be required to perform well.

The second type of training must be management's attempt to create a corporate culture which penetrates all branches and subsid ies around the globe. The training may differ across subsidiaries depending upon the cultural differences between headquarters and the subsidiary's geographical location. For example, if the latter is located in China, it may be quite difficult to create an environment which favors risk taking and encourages the development of innovation and rapid adaptation due to differing political and economic environments. Thus, a modified culture fitting the national culture may be a more realistic goal to accomplish.

Thirdly, within the subsidiary or branch, management must assure that all employees understand the cultural habits, beliefs, and strategies of action. Only if all groups acquire the corporate culture will it be possible to have project teams from various parts of the organization work effectively with each other. Hence, engineers, designers, production workers and accountants must know and understand each other's behaviours, non-verbal cues and habits. All the above shows that training may very much depend upon the culture the organization is part of. Moreover, certain training methods (e.g., lecture, hands-on, on-the job vs. off-the job) and content (theoretical, practicing of skills, problem solving techniques and access of relevant knowledge) may be more successful in one cultural environment than another. Successful technology and organizational development makes the co-ordination of training and culture into one strategy a necessity.

Theoretical Implications

It seems assured that future research on technology adoption and organizational adaptation cannot ignore the model developed here, despite its complexity. We still have far to go to develop the issues presented here before we can address the question: how do cultural stability and training affect a firm's technological adoption and organizational adaptation efforts? Can increased tolerance for cultural diversity of a firm's workforce and its effective training (job skills and culture) help improve the firm's R&D and innovation efforts? Since these questions are central to understanding technology adaption and organizational adapation and also technology's effective use in organizations, these issues should be a major agenda item for future research.

Studying training within a vacum is of little help when trying to advance our knowldge about organizations and their processes. Perrow (1986, chap. 2) has argued succinctly that most organizational theories and proposed systems models ignore the complexity of the processes to be accounted for with such conceptual pieces. This paper responds by suggesting that a multi-disciplinary approach is needed to study the complex organizational processes involved in deciding to adopt a technology and subsequently going through organizational adaptation.

The theory outlined in this paper also suggests that an exchange of ideas about technological innovation and training needs to be encouraged by providing publication outlets with a multi-disciplinary perspective. Up to this point, technological adaptation and human resource management has become a fragmented discipline rooted mostly in one traditional discipline (e.g., sociology or management) instead of spanning several disciplines. One reason may be that the publication of such multidisciplinary work is quite difficult. This in turn prevents most researchers from performing work with a multidisplinary framework, since most people do not want to put their careers at risk.

At this point, very little is known on how culture and training may together affect the outcome of technological adoption and organizational adaptation. Instead, research

has concentrated on little fragments of the overall puzzle, with some notable exceptions (e.g., Hofstede, 1984). Furthermore, very rarely has research about technology concentrated on human resources and training (e.g., Gattiker, 1988c; Gattiker & Larwood, in press). A more serious omission may, however, be the fact that up to now no attempt has been made to integrate the culture-training-technology angle as done in this paper. It is hoped that the theory outlined herein will spark some new excitement and ideas into this research domain.

Issues in the 1990's

Numerous issues arise from this paper which must be addressed by employers, employees, union representatives and public policy makers to assure the successful management of adaptation by organizations in various countries. For example, as discussed earlier, research indicates that individuals do not necessarily invite change and adaptation in their work environment caused by technology adoption. Nonetheless, such desire for stability may in part be determined by environmental factors. Resistance toward technological change may have been reinforced by undesirable occurences negatively affecting public opinion.

For instance, political and social consequences of nuclear power plants have gained substential media (and thus public) attention since the Three Mile Island and 1987's Chernobyl accidents occured. Additionally, Nigeria has rejected hazardous waste from Italy and other European countries for storage in 1988. This in turn created anxiety and public awareness of possible dangerous side-effects caused by technological advancement. Hence, the public may swing away from inviting and accepting change and instead welcome stability when they see that change and innovation have led to some outcomes which are not very desirable.

Research should address the potential linkage between public opinion about innovation and technology and its impact upon resistance by employees toward organizational adaptation. Another issue requiring attention is how cultural tolerance and understanding

may be improved. For instance, recently some major USA business schools have started to consider requiring proficiency in at least one foreign language from their graduates. The issue requiring attention here is the fact that knowing a foreign language may not automatically increase one's knowledge and understanding of another culture as is often implied.

Our research agenda should include further work which is to test if learning and aquiring a foreign language early in one's formal education and later spending of a year abroad attending school/university may be a better alternative than acquiring a foreign language during graduate education without experiencing total imersion into the culture. Managers and employees with foreign language skills may not be more tolerant to cultural diversity than their colleagues. Additionally, an increase in the understanding and tolerance of multiculturalism within one's own country may be another important step on the road to success. Unfortunately, in most countries such understanding and tolerance is hard to find.

The above suggests that managers, researchers and public policy makers must grapple with these issues to increase our understanding of the processes involved with successful technologicy adoption and organizational adaptation dealing with cultural stability and training of various degrees and shades. As this direction is pursued further, new theory and practical insights will be gained which may suggest not only revisions to managerial practice, but also to our general approach to work, training and technology adoption.

Footnotes

1) 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. More specifically: "Technological innovation should be understood to be a technology-based process or the product of such a process that is the result of the efforts or activities of an individual, group and/or organizational system, and which represents a departure from the previous state and which may facilitate more effective resource allocation" (Gattiker, in press a).

(2) Training in an organizational context may be defined as any organizationally-initiated procedures which are intended to foster learning among organizational members. Learning, similarly, may be thought of as a process by which an individual's pattern of behaviour is altered in a direction which contributes to organizational effectiveness (Hinrichs, 1976).

(3) What the term theory means is unclear when looking at the social sciences literature (e.g., Hage, 1972; Homans, 1980). In this context a theory is meant to have a set of propositions and theoretical statements, each stating a relationship between its concepts. The term theory as used in this paper does, however, not only contain concepts and statements, but also outlines the theoretical and operational linkages between different elements and dimensions of the theory.

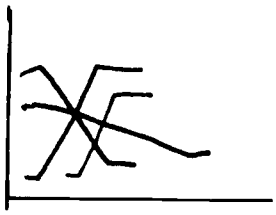
(4) Cognitive ability as used in this context is synonymous with the individual's abilities for performing controlled processes. A person's efficiency in learning new skills, unfortunately, is often dependent upon the information processes that are needed to perform a given task. Automatic information processes are characterized as fast, effortless (from a standpoint of allocation of cognitive resources), and

unitized (or proceduralized) in such a way that they may not be easily altered by a subject's conscious control; they may often allow for parallel operation with other information processing components within and between tasks. Automatic processes are operations which are developed only through extensive practice under consistent conditions, and include skilled behaviours as diverse as typing and skiing. As these processes become automatic, the cognitive or attentional resources devoted to the task are reduced. In contrast, controlled processes are necessary when task requirements are novel, and when the subject may not be able to internalize the consistent aspects of the task. Controlled processing is typically slow and difficult because performance is limited by the amount of cognitive resources available to the individual. An example of an activity requiring controlled processing might be making a decision to stop production in a plant due to severe quality problems, a resource intensive task which does not allow for much automatic processing (Ackerman, 1987). However, often a task may be a mixture of controlled and automated processes. For instance, bringing a new high technology product to market using the appropriate marketing techniques requires some automated processes (e.g., advertising strategy and distribution channels to be used) while assessing the market potential and consumers' receptiveness is a controlled process (drawing the right conclusions from the test market results).

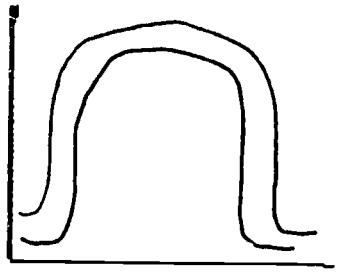
(5) Cultural stability as used in this paper means the repetition and elaboration of old cultural "themes" and a single or major interpretation of the core culture. Stability can result in repetition and elaboration of old models, thereby increasing hostility to change and innovation. In contrast, limitied stability results in cultural diversity and ferment seems likely to favor innovation, technological adaptation and tolerance of pluralism, thereby enhancing risk taking. Thus, national culture may not in itself be decisive in determining the degree of innovation, but instead, the attitudes held by rulers and elites toward cultural diversity may have more influence.

If tolerance toward cultural diversity is great (e.g., minorities, ethnic groups, underground culture, pop art/music and religions), supporting or at least tolerating innovation and change instead of suppressing it, innovation and adaptation is more likely to occur (Goldstone, 1987).

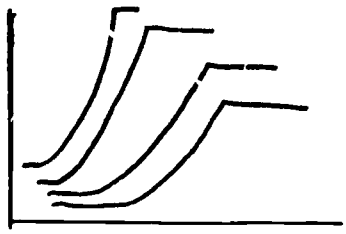
(6) Hage (1972, pp. 99-101) divides the operational linkage into four parts. First, there is the basic form such as linear, curvilinear and power (power is a coefficient that is changing). Second, the direction of the operational linkage which is either positive or negative. Third, the coefficients and fourth the upper and lower limits. Thus, a correlation which is positive, ranging from 0.0 - 1.0 may have a lower and upper limit. To illustrate, technological adoption and subsequent organizational adaptation may affect grievance rates from a certain take-off point. Moreover, there may be an upper limit beyond which technological adaptation may no longer affect grievance rates.



Linear correlation with different coefficients and lower/upper limits.



Curvilinear correleation with different coefficients and upper/lower limits.



Power correlation with different coefficients and upper/lower limits.

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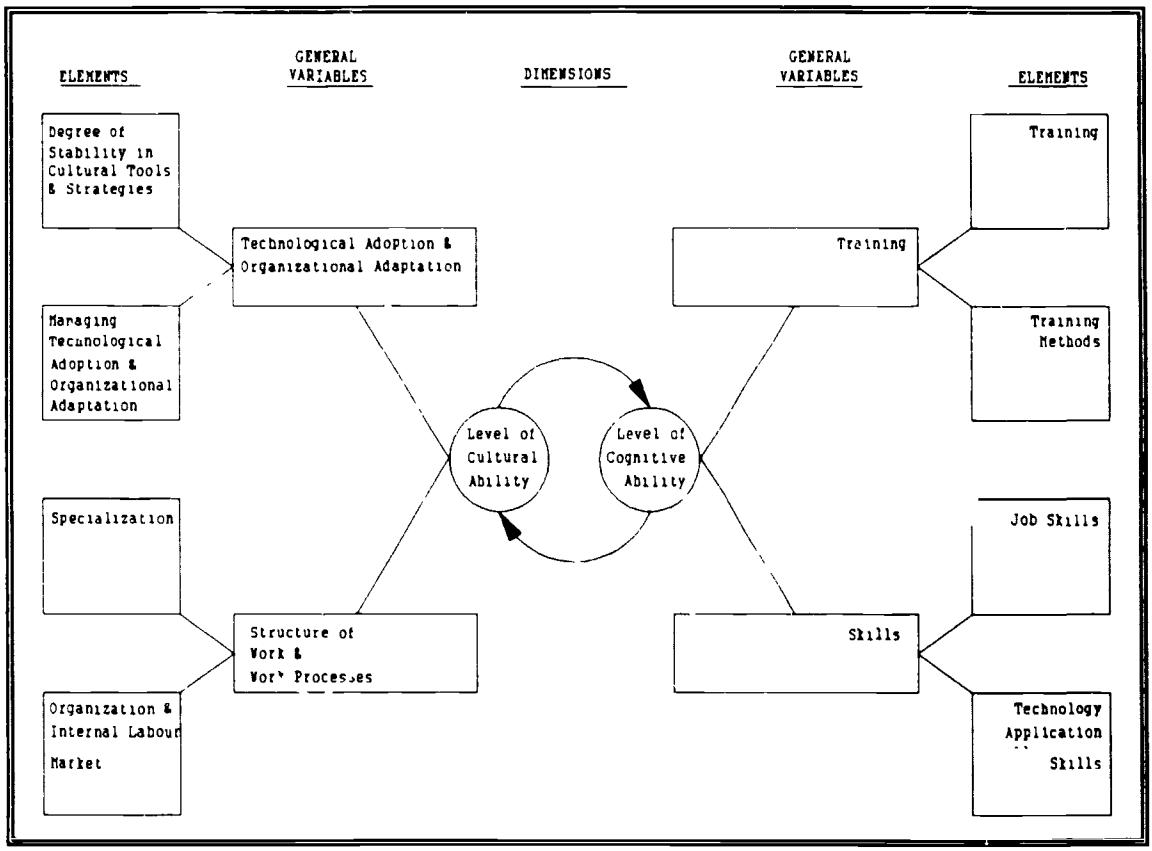

FIGURE 1 - The components of a basic technological adoption and organizational adaptation system.

Table 1

Technology Training: Dimensions and Their General Variables

LEVEL OF CULTURAL STABILITY	LEVEL OF COGNITIVE ABILITY
Technological Adoption and Organizational Adaptation	Training
Structure of Work and Work Processes	Skills

Table 2

Cultural Stability: General Variables and Their Elements

GENERAL VARIABLE	ELEMENTS
Technological Adoption and Organizational Adaptation	-degree of stability in cultural tools and strategies (V1) -managing technological adoption and organizational adaptation (V2)
Structure of Work and Work Processes	-specialization (V3) -organization and internal labor market (V4)

Table 4

Level of Cognitive Ability: General Variables and Their Elements

GENERAL VARIABLE	ELEMENTS
Training	-training content (V6) -training method (V7)
Skills	-job skills (V8) -technology application skills (V9)

Table 3

Theoretical and Operational Linkages Between Elements of Culture

TECHNOLOGICAL ADOPTION AND ORGANIZATIONAL ADAPTATION	Specialization (V3) Theoretical Linkage	Operational Linkage	STRUCTURE OF WORK AND WORK PROCESSES ILM (V4) Theoretical Linkage	Operational Linkage
Degree of Stability in Cultural Tools and Strategies (V1)	A higher degree of cultural stability increases the level of specialization of the workforce	Positive linear correlation with limit and different coefficients	A higher degree of cultural stability increases the level of bureaucratic rules for a firm's ILM	Positive linear correlation with limit and different coefficients
Managing Adoption and Organizational Adaptation (V2) increases the level	Participation based on legal constraints of specialization of the workforce	Power curve with limits type of voluntary	Participation based on labour laws or some with limit and agreement increases the level of bureaucratic rules for a firm's ILM	Positive linear correlation different coefficients

Table 5

Theoretical and Operational Linkages Between Elements of Cognitive Ability

TRAINING	SKILLS Job Skills (V7) Theoretical Linkage	Operational Linkage	WORK PROCESS Technology Application Skills (V8) Theoretical Linkage	Operational Linkage
Training Content (V5)	Easier access of knowledge increases the range and depth of job skills	Positive linear correlation with limit and different coefficients	Easier access of knowledge increases the range and depth of technology application skills	Positive linear correlation with limit and different coefficients
Training Method (V6)	Increased competency improves range and depth of job skills of the workforce	Curvilinear linkage with different coefficients	Increased competency improves the range and depth of technology application skills of the workforce	Curvilinear linkage with different coefficients

Table 6

Theoretical and Operational Linkages Between Elements of Cognitive Ability (Training) and Cultural Stability (Technological Adaptation and Innovation)

TECHNOLOGICAL ADAPTION AND ORGANIZATIONAL ADAPTATION	TRAINING			
	Training Content (V5)		Training Method (V6)	
	Theoretical Linkage	Operational Linkage	Theoretical Linkage	Operational Linkage
Degree of Stability in Cultural Tools and Strategies (V1)	Less stability in the culture increases the desire for abstractness of training information	Positive linear correlation with limit and different coefficients	The more stability in cultural strategies & tools, the more training must focus on practicing the new skills (hands-on)	Positive linear correlation with limit and different coefficients
Technological Adoption & Organizational Adaptation (V2)	Increased adoption requires more job relevant training to improve access of relevant job skills	Positive linear correlation with limit and different coefficients	Increased competency improves the ease with which technological adoption and innovation triggered transition can be managed	Positive linear correlation with limit and different coefficients

Table 7

Theoretical and Operational Linkages Between Cultural Stability (Technological Adaptation and Innovation) and Cognitive Ability (Structure of Work and Work Processes)

TECHNOLOGICAL ADOPTION AND ORGANIZATIONAL ADAPTATION	SKILLS			
	Job Skills (V7)		Technology Application Skills (V8)	
	Theoretical Linkage	Operational Linkage	Theoretical Linkage	Operational Linkage
Degree of Stability in Cultural Tools and Strategies (V1)	A higher degree of cultural stability decreases the level of cultural tools and skills held by the workforce	Negative linear correlation with limit and different coefficients	A higher degree of cultural stability increases the level of bureaucratic rules for a firm's ILM	Positive linear correlation with limit and different coefficients
Managing Innovation and Adoption (V2)	Limited participation by employees during the adoption process decreases skill levels	Power curve with limits	Participation based on labour laws or some type of voluntary agreement increases the level of bureaucratic rule for a firm's ILM	Positive linear correlation with limit and different coefficient

Table 8

Theoretical and Operational Linkages Between Elements of Cognitive Ability

STRUCTURE OF WORK AND WORK PROCESSES	TRAINING			
	Training Content (V5) Theoretical Linkage	Operational Linkage	Training Method (V6) Theoretical Linkage	Operational Linkage
Specialization (V3)	Easier access of knowledge increases the range and depth of job skills	Positive linear correlation with limit and different coefficients	The more advanced the ILM, the more structured will training content be	Positive linear correlation with limit and different coefficients
ILM (V4)	Increased competency improves range and depth of job skills of the workforce	Curvilinear linkage with different coefficients	The more advanced the firm's ILM, the more logical sequential the training method will become	Positive linear correlation with limit and different coefficients

Table 9

Theoretical and Operational Linkages Between Elements of the Cognitive Ability Dimension (Skills) and Cultural Stability Structure of Work & Work Processes)

STRUCTURE OF WORK AND WORK PROCESSES	SKILLS			
	Job Skills (V7) Theoretical Linkage	Operational Linkage	Technology Application Skills (V8) Theoretical Linkage	Operational Linkage
Specialization (V3)	Higher specialization increases the depth of job skills but decreases the range of skills	Positive linear correlation with limit and different coefficients	Higher specialization increases the depth of technology application skills but decreases the range of skills	Positive linear correlation with limit and different coefficients
ILM (V4)	A highly structured ILM increases the depth of job skills but decreases the range of skills	Positive linear correlation with limit and different coefficients	A highly structured ILM increases the depth of technology application skills but decreases the range of skills	Power curve with limits