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THE DEVELOPMENT AND VALIDATION OF A THEORY OF WORK ANALYSIS

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TABLE OF CONTENTS

LIST OF FIGURES

ABSTRACT

The analysis of work is used to design and classify jobs, as the basis for selecting, training, and evaluating personnel, and for other purposes. A variety of work analysis methods exist to meet the wide range of purposes for which work analysis is used. Yet, despite the variety of methods for analyzing work, there is no single, unifying theory of work analysis. To address the need for a sound theoretical base to support work analysis, a theory of work analysis was developed using concepts derived from the literature and Robert Dubin's methodology for theory building.

The concepts for a theory of work analysis were derived from literature in eight areas: (a) technology and work, (b) work roles and role theory, (c) work design and employee effects, (d) work design and work reengineering, (e) process analysis and process improvement, (f) work performance and training needs, (g) job and work analysis, and (h) theory and theory building. The theory's concepts and their interrelationships were structured according to Dubin's methodology for theory building.

Three methods were used to validate the theory of work analysis: (a) critique of the theory was elicited from three scholarly experts on work analysis, (b) the theory was critiqued using C. H. Patterson's criteria for evaluating theory, and (c) three practitioner experts provided a written critique of the theory. Synthesis of the critique from these sources was integrated using a two-axis matrix, and modifications to the theory were made based on this critique.

The resulting theory of work analysis is based of the interaction of factors in the "work environment," the "work task," and the "worker." The theory proposes that the content of work analysis is derived from all three of these concepts, and that change in any one of these concepts brings about change in both of the other concepts. Furthermore, work analysis applied to one of these concepts must account for change in the other two concepts. An illustration is also presented of how work analysis methods would change if this theory was adopted.

CHAPTER 1

INTRODUCTION AND PURPOSE

Work analysis has been used as a way of systematically studying and defining human work activities since the turn of the century. Work analysis focuses on the nature of human work and examines the substance of work activity.

There has been broad interest in the discovery and description of work activity from a variety of groups and professional disciplines: business organizations, government agencies, labor unions, vocational counselors, occupational educators, industrial engineers, experts in labor law, industrial psychologists, and others interested in what people specifically do in the course of their work. This interest in work analysis arises in part from the variety of important uses for work analysis information. Managers in organizations use work analysis for recruiting, selecting, training, and evaluating personnel. Unions use work analysis for contract negotiations and handling grievances. Work analysis is an important basis for designing jobs and establishing occupational standards, training workers for job licensing requirements, and setting job certification levels. In addition, work analysis is used to establish working conditions, job safety standards, and a range of personnel and behavioral science research activities. In short, work analysis is used by a variety of users for a number of reasons.

Interest in analyzing work has prompted the development of work analysis methods which are as diverse as the applications for which the analysis is used. For example, early government research in work analysis was characterized by a functional approach to the analysis of a variety of existing jobs as a means for determining manpower and employment policy. This government-sponsored research provided the groundwork for a growing occupational database and led to the development of scales that specifically describe work tasks using hierarchies (Fine and Wiley, 1971; U.S. Department of Labor, 1972; U.S. Department of Labor, 1977).

Attention to work analysis by industrial psychologists stems from their interest in human work motivation. The motivational perspective is based on assumptions about the needs and values of job incumbents. These assumptions have guided the ways in which industrial psychologists use work analysis and have led to prescriptions for optimum work design (Hackman and Oldham, 1976; Ilgen and Hollenbeck, 1991; Salancik and Pfeffer, 1977).

Work analysis has been an important cornerstone of industrial engineering since the work of Frederick Taylor, Henry Ford and the Gilbreths (Finch, 1960; Taylor, 1912). Industrial engineering takes a normative approach to the way work should be designed based on principles of engineering design and systems reliability (Konz, 1979). Work analysis encompasses the physical characteristics of the workplace and the performance capabilities of the worker, and provides the basis for integrating mechanical, ergonomic, and human factors into the design of work systems that maximize efficiency and reliability. Human and nonhuman components of work are viewed as belonging to a common pool of work design elements and are evaluated equally in their potential contributions to task output.

Each of these three approaches to the analysis of work reflects its own interest and purpose in analyzing work activity. Each approach, in turn, relies on its own distinctive set of methods for collecting and analyzing job-related information. These range from informal discussion with a single job incumbent to expert analysis of critical work behaviors and technologies.

Thus, there is a wide variety of interests in, approaches to, and methods for analyzing work. Yet, despite this proliferation of work analysis *techniques,* there is no unifying *theory* of work analysis. That is, despite the existence of multiple methods for analyzing work which have evolved from a variety of interests and disciplines, none of the approaches to work analysis is based on a conceptually sound *theory* of work analysis. Most of the work analysis methods reviewed for this study begin by defining concepts necessary for conducting work analysis. A few approaches to work analysis offer a simple visual model of basic work analysis concepts and how they are connected (Griffin, 1982;

McCormick, 1979). However, there is no evidence of a single, unifying theory of work analysis upon which any of these diverse methods are based.

Interventions aimed at improving work performance, including human resource development, are anchored in an accurate assessment of what the work itself entails, that is, what specifically needs to be done to achieve work goals. Analysis of the work itself is an important prerequisite for human resource development and other work-oriented disciplines. As a necessary foundation of human resource development, work analysis should operate from a sound theoretical base. The purpose of this study is to develop a theory of work analysis.

CHAPTER 2

SIGNIFICANCE OF THE RESEARCH

The research derives its significance from the importance of work analysis and the need to provide a conceptually sound theory upon which to base the analysis. The need for such a theory is especially significant given that the context within which work analysis is performed is changing in two important ways: contemporary work organizations are undergoing change and so is the nature of work itself.

Transformation of Contemporary Work Organizations

Organizations, large and small, public or private, in a range of industrial sectors, are the primary medium through which work is accomplished. The structure of contemporary work organizations is changing. Organizations are becoming flatter and less hierarchical in efforts to reduce bureaucracy and manage costs. Organizations are also becoming smaller and leaner as managers eliminate work inefficiencies and duplication of effort. A consequence of these emerging flatter, "downsized" organizations is the need for major shifts in the distribution of work tasks and roles among workers. In a workplace once modeled on narrow job definitions and a wide range of functional specialists, today's workplace is often characterized by increasingly sophisticated work methods and the presence of relatively fewer workers. Narrow job definitions are giving way to broader responsibilities and a greater interdependence among workers. Jobs are being eliminated, combined and reconfigured as organizations fundamentally rethink the ways in which work should be done. Once a basic element in the design of work, jobs can no longer be considered the inviolable building blocks of work activity they once were.

Yet *jobs* are the conceptual starting point for existing methods of work analysis. Traditional work analysis techniques are bounded by considerations of the tasks to be

analyzed (the work) and those who will perform the tasks (the worker). These elements come together to constitute the notion of *a job*-- a discrete set of work activities performed by the individual. Yet, the notion of job in today's organizations is simply too fluid to be a meaningful starting point for the systematic analysis of work. Work analysis cannot be constrained by the job or job boundaries. A theory of work analysis needs to address the changing nature of contemporary work structures and provide a broader basis for conceptualizing work and work analysis than the traditional notion of a job.

The Evolving Nature of Work

The nature of contemporary work is changing. A theory of work analysis must accommodate the evolving nature of work if it is to provide a conceptually sound anchor for work analysis practices. Efforts underway in organizations to reduce costs and add labor-saving technology not only eliminate jobs throughout the organization, they increase the sophistication of work for those who remain. Today's workers increasingly need to understand work operations as a whole, rather than what used to be their specific tasks within it. Monitoring and maintaining the work *system* is becoming in today's workplace what operating a single *machine* had been for mass production work. Today's workers have to make sense of what is happening in the workplace based on abstract rather than physical cues. According to Zuboff (1988), this transformation of work involves the development of "intellective" rather than "action-centered" skills. As employees acquire responsibility for monitoring and maintaining a broader range of work processes, their involvement is increasingly characterized by intervals of inactivity punctuated by periods of non-repetitive problem-solving. Gone are the days when problem-solving meant making a telephone call to management or the maintenance department.

In addition, flatter organizational structures require employees at the shop floor level to exercise more authority over a wider variety of tasks. They can no longer rely on management for planning and scheduling as these duties are being integrated into production jobs themselves. Today's work requires an increasingly holistic perspective of

the organization and attention to the demands of both internal and external customers. Once the mainstay of traditional forms of work, procedural thinking has become subordinate to systems thinking for all workers, not just managers.

Another important factor underlying the changing nature of contemporary work is a perceptible shortening of the half-life of knowledge. New knowledge drives the evolution of new work systems and technologies. The half-life of knowledge in technology-intensive fields such as engineering and health care is now less than four years. This means that the relevant expertise of an engineer completing training today will erode by fifty percent in just four years. The half-life of knowledge is not much longer in most of the other business, professional, and technical fields upon which organizations rely for their expertise. The profound influence this constant turnover in knowledge has on the nature of work and the way work is accomplished is all too obvious to those who must continually update their work knowledge and skills.

Advanced technology, leaner organizational structures, and an environment of fewer resources are powerful factors that are reshaping organizations and fundamentally changing the nature of work. Given the evolving nature of contemporary work, systematic efforts to analyze this work must be theoretically grounded. Traditional, atheoretical models of work analysis were designed for static work environments where organizational structures and the nature of work itself were stable by comparison to today's work environment. The dynamic, continuously evolving workplace of today requires work analysis based on theory that is constant and can support specific work analysis methods as they are updated and transformed. As work changes, work analysis methods must change. A theory of work analysis is needed to guide and support this change.

CHAPTER 3

REVIEW OF THE LITERATURE

The literature necessary for developing a theory of work analysis is both extensive and diverse. The literature on theory addresses theory building, the role of theory, and the use of systems theory in the behavioral sciences. Work analysis has its conceptual base in areas which include industrial engineering, work design, technology and work, industrial psychology, and human performance technology. Indeed, the domains embraced by theory building and work analysis are both conceptually rich and quite diverse.

Consequently, a large volume of literature has been reviewed for this research. For the convenience of the reader, the literature reviewed in this chapter is grouped and presented by topic under the following categories:

- Technology and Work
- Work Roles and Role Theory
- Work Design and Employee Effects
- Work Design and Work Reengineering
- Process Analysis and Process Improvement
- Work Performance and Training Needs
- Job and Work Analysis
- Theory and Theory Building

Technology and Work

The literature reviewed in this section offers several perspectives on technology and work. They range in scope from global perspectives on technology and international competition to narrower views on how technology influences the policies and practices of the individual firm. Davis and Taylor (1976) examine two important aspects of technology

that are often not addressed in research on the topic: *assumptions* about the use of technology and problems with *conceptualization and measurement* in research on the effects of technology. Davis and Taylor point out that the use of technology in the workplace is inevitably based on important values and assumptions, whether or not they are made explicit. Adler (1992) broadly examines the themes and ideological positions of research on technology and work by developing an outline that distinguishes research since World War II into four distinct generations. He also summarizes two important themes in current research on technology and work.

The two works reviewed next take a more global perspective of technology and how it has influenced the skills of the American workforce and industrial competitiveness on an international scale. The report of the MIT Commission on Industrial Productivity (1989) provides a macro-economic view of the strengths and weaknesses of our country's manufacturing sector, and highlights the improvements needed in the use of human resources and technology to improve our country's competitive position. The Commission on the Skills of the American Workforce (1990) also takes a national perspective in their study of how increasingly sophisticated work has changed the skills needed by our workforce, and what our country *is doing* and *should be doing* about developing work skills.

The final three works reviewed in this section also examine how technology has changed the nature of work, yet they do so by focusing on concrete work situations and specifically analyzing how technology has changed the context of work performance. Giordano (1992) examines the effects of computerization on the structure of work within and among four related manufacturing occupations. She finds effects *within* each of the occupations and in how work is distributed *among* the four occupations. Davenport (1993) takes a broader view that goes beyond the effects of technology on manufacturing work in describing his approach to using information technology to *innovate* any business process. Zuboff's (1988) research on the effects of technology on work is arguably the most comprehensive and detailed of the works reviewed in this section. She has succeeded in both getting at the heart of how technology has changed the nature of work and at exposing the challenges that face organizations pursuing technological change.

Davis and Taylor

Davis and Taylor (1976) provide a comprehensive review of research on the relationship of technology to the nature and organization of work. It examines two important aspects of technology that are often not addressed in research on the topic: (1) the *assumptions* about the relative importance of technology to work, and (2) problems in the *conceptualization and measurement* of technology in research on its effects on the nature and structure of work.

Both of these issues have important implications for the reconfiguration of the many kinds of work currently undergoing technological change. Assumptions about the importance and relationship of technology to sociocultural and other organizational factors guide the ways technology is selected and adopted by organizations. Problems in conceptualizing and measuring technology leave those interested in its effects in the workplace unable to make valid comparisons among alternative technologies and among technical and non-technical approaches to reorganizing work. This section of *Technology and Work* will examine important considerations in both of these areas as developed in the research reviewed by Davis and Taylor.

Assumptions about technology and work. According to Davis and Taylor, the influence of technology on the nature of work had its historical beginnings in England over 160 years ago. Five important developments led to the introduction of technology as a major factor in shaping the structure of work: (a) men and animals were replaced as the essential power sources for carrying out work, (b) the nature of the new power source required that groups of men be brought together around the power source giving rise to the factory system, (c) some manual skills formerly performed by workers were displaced by mechanical tools and devices, (d) workers and machines had to be coordinated, and (e) the foregoing changes provided new opportunities to organize and rationalize the ways in which people worked.

With the industrial revolution came the birth of a perspective on the importance of technology known as *technological determinism.* This view of the preeminence of technical considerations when reconfiguring the ways in which work is done has been singularly persistent throughout the century and a half since technology became a major

shaper of work structure. According to Davis and Taylor, technological determinism is the belief that

> . . . technology evolves according to its own internally derived logic and needs, quite independent of social environment and culture. Further, it holds that to use technology effectively and thus secure its benefits for society, its development and application must not be inhibited by any considerations other than those determined as relevant by its developers--the engineers or technologists. (p. 380)

For most of this century technological determinism has been successfully invoked to maintain the institutional "status quo" through adherence to the traditional industrial model of how work should be done. The key ideological element here is that organizational structure and work behavior are predetermined by the technology itself and unalterably locked into its needs. Simplistic as this sounds, reliance on this notion is still surprisingly prevalent today.

The strength of claims based on strict technological determinism was weakened considerably with the acknowledgement that even the best technology operates under stochastic, not deterministic, conditions. Automated work systems not only require monitoring and occasional adjustments, they can sometimes function unpredictably and, worse yet, fail completely. As the supremacy of the machine began to be questioned, technologists had to acknowledge a shift in the importance of the worker's role from one of a peripheral appendage to the machine to one of a regulator of work systems, an adjuster of malfunctions. Not all conditions of production could be predetermined; the worker would have to provide interventions that were not programmable.

As technology became more sophisticated and assumed an expanded role in the control *and* processing of production, the complexity of the technical difficulties it generated also increased. The potential severity and unpredictability of technical difficulties required a larger repertoire of responses from workers and again compelled managers to reevaluate the worker-technology relationship. Breakdowns were inevitable in the increasingly complex (and costly) technical systems in which management had invested. For economic reasons, these breakdowns had to be overcome as quickly as possible, which meant that workers had to possess certain capabilities. Not only did workers require a broader range of skills,

but if malfunctions were to be quickly corrected, often in the absence of supervision, workers also had to possess the willingness and initiative to use these skills in the service of the organization. Management's realization that the worker's role in maintaining production was more important and complex than they had previously acknowledged formed the basis for an important shift in thinking about how technical and human systems should operate. Davis and Taylor lay out the following chain of rationale to explain how this elevation of the role of the worker was justified by management:

1. If the production system collapses, the economic goals of the organization will not be met.

2. If appropriate responses are not taken to stochastic events, the production process will collapse.

3. If the organization's members are not committed to their functions, the appropriate responses will not be made.

4. Commitment cannot be forced or bought; it can only arise out of the experiences of the individual with the quality of life in the working situation, i.e., in the job.

5. Therefore, automated industries tend to seek to build into jobs the characteristics that will develop commitment on the part of the individual. The major characteristics are those of planning, self-control, and self-regulation; that is of autonomy.

This rationale was part of a long-term evolution in thinking about the relationship of man to machine that slowly recognized the unique role of the worker in maintaining the productivity of work systems. The overall goal of work design slowly but irrevocably shifted from one of replacing human involvement with "reliable" automation whenever possible to one of designing systems to capitalize on the unique capabilities of workers to adapt to unforeseen events of production. Ideas for improving the productivity of work systems slowly evolved from being machine-centered to a broader effort to optimize the productive capacities of both the worker *and* the machine.

Research on the influence of technology on the worker (rather than emphasis only on what the worker could do to improve the output of the machine) slowly began to appear after World War II. In the late 1950's researchers explored the notion that the effects of technology on work behavior and business outcomes were probably not directly linked but

were mediated by the organization's culture. This position, called *cultural determinism,* maintains that cultural factors such as management style, employee-management relations, and degree of employee autonomy in decision making, are critical determinants of the success of any effort to innovate work. A large body of current research continues to support the importance of carefully addressing cultural factors as organizations prepare to adopt or change their work systems.

It is clear from reviewing these ideologies about the relationship of technology to social and other organizational factors that the use of technology in the workplace is inevitably based on important values and assumptions, whether they are made explicit or not. These assumptions form the initial conception for how human and technical systems should be integrated, and therefore, they should be treated explicitly as important determinants of how the work will ultimately be accomplished. Based on Davis and Taylor's review, three basic conclusions can be offered about technology in the workplace and the assumptions that should guide its use.

First, despite the persistence of technological determinism as a basis for emphasizing the technical considerations of new work systems, a wide range of studies indicate that organizations have considerable flexibility in the use of new technology and need not constrain the design and organization of work by exclusively honoring the technical dimensions of system proposals.

Second, decisions regarding the selection and integration of technology in organizations are complex and multi-dimensional. Decision makers must carefully weigh the relevant economic, social, and technical implications of *any* reconfiguration of a work system, including the adoption of advanced technologies. Success in achieving the desired business outcomes is determined as much by how and why the technology is adopted as by the properties of the technology itself. Decisions that precede and underlie the use of technology are at least as important as the technical capabilities a new work system provides. Important questions to be addressed within a broader context than the immediate environment of the technology. These questions include:

- Is the introduction of new technology the best way to achieve business objectives?
- How and when will the requisite skills be developed to take advantage of the technology?
- How should the organization be prepared for the change brought about by the "ripple effect" of new technology on the structure of jobs, work groups, and the organization?

It should be noted that these considerations assume that the technology is capable of doing what it's supposed to do.

Third, the longitudinal perspective offered by the authors provides a clearer than usual view that technological advance is dramatic, ever broadening in scope, and on-going. Yesterday's technological breakthrough is continually eclipsed by today's. Technology evolves at a rapid pace. Yet, corresponding shifts in social values about technology occur more slowly. For example, the technology for the electronic transfer of money has been refined to a high level of accuracy and safety, yet many are as yet unwilling to allow their money to be transferred using electronic technology. Similarly, workers who now begin and end their workday at a computer terminal are not happy about having a computer deliver their day's work assignment and monitor their progress from task to task until the end of their shift. As these examples show, it generally takes more time to achieve social acceptance of technical advances (if acceptance is achieved at all), than it does to develop the technology itself.

Methodological problems in technology research. It is disturbing when reviewing studies on the effects of technology in the workplace to confront frequent problems with how the technology of interest is conceptualized and measured by researchers. Davis and Taylor examined three common sources of methodological difficulty in the conceptualization and measurement of technology. First, investigators often study only one case of the adoption of technology. They describe the technology and the way work is affected in considerable detail. They are quite clear about what they mean by "automation," "mechanization," or "computerization," and ample information is provided about how the present work is changing as technology is adopted. Little or no information is provided,

however, about viable alternatives to the technology described for achieving the same outcomes. Are there rival technologies that are also feasible and worth exploring? What about non-technical options for accomplishing the same work? Is the issue of technology central to achieving business objectives, or is it more of a peripheral concern in the reconfiguration of work processes? This methodological problem in studies of technology focuses on one case of technical change to the exclusion of all others.

A second difficulty in technology research involves the use of categories or classifications of technology. Empirical studies of this type attempt to distinguish among technologies on the basis of degree of sophistication. Investigators are interested in the effects of technology on work design or business outcomes, yet the technology itself is never fully conceptualized or measured directly. Although basic differences between more and less sophisticated technology are described in these studies, without specifically examining the nature of the technology itself, differences in degree of sophistication of the technology may mask important differences in the *kind* of technology. The results of these studies are often not comparable for two reasons. What may be classified as "advanced technology" by one investigator may be viewed as "traditional automation" by another investigator or the reader. Additionally, discrete classification of technologies assigns cases that may be in the interstices between traditional automation and high technology to either one category or the other; this can also include technologies in one category which may be valid assignments, but which also require different capabilities of workers.

Third, the distinction between what is a transitional versus an ultimate or final technology is not clearly explicated. This involves studies which examine technologies located at different points along the continuum of technological refinement. Although differences in degree of technical sophistication may be apparent among the technologies, incomparability of results is again an issue because technologies are at different stages of maturity in the course of reaching their ultimate capabilities.

Davis and Taylor conclude their review of research on technology and work by recalling a fundamental premise underlying the technology-work relationship which has been a perennial theme in organizational research in this area:

> . . . technical systems and social systems [must be considered as] joint systems with elements of one system residing in the other. The consequence then is that in designing organizations or jobs, these two systems have to be jointly optimized if we are to see a mutually effective organization or job result. (p. 412)

Adler

Adler (1992) puts the influence of technology on work into a meaningful perspective by identifying the themes that emerge from four generations of research on technology and work that have evolved since the Second World War. Adler's perspective is useful because it allows us to view the present skill-technology challenge as a complex mix of new issues and of recurring issues concerning technology and work that have been with us for decades.

Early research on automation and work done in the 1950's and 1960's reflects a generally optimistic view of technology's influence on work. Automation was seen as broadening the skills and expanding the jobs of workers compared with the narrow demands of assembly line work. The impact of technology in broadening the skill requirements of those involved in continuous processes such as chemical refining and power generation represented the potential of technology for upgrading the skills required in these and other industries.

A more pessimistic view of technology's influence was reflected in the next generation of research done in several western nations which all seemed to converge on the same theme: automation's potential to expand skill requirements was often not realized. Much of this research appearing in the late 1960's and continuing through the next decade was inspired by Marxist philosophy and implicated a dark side of technology. It held that capitalist enterprises tend to de-skill work in their efforts to lower production costs and gain greater control over a potentially uncooperative workforce.

Adler observes that the third generation of research on technology and work "veered away from the 'big generalizations' and from the question of broader trends" (p. 7). This was a "contextualist" generation of research for which no valid generalization was possible regarding long-term trends in skills or the technology-work relationship. This skepticism

about the existence of any meaningful patterns in the relationship between technology and work stimulated valuable research about the notion that the distinction between workers who are *skilled* and *unskilled* is often more political and ideological than technical. What is considered "skill" may also reflect a number of local factors (e.g., unionization, market factors, political concerns). Yet, for the research of the late 1970's and early 1980's, no overriding theme of technology's influence on work had emerged. As Adler states, "the dominant image of the future of work in this research is that of a kaleidoscope of complex patterns, constantly shifting and forming no overall tendency" (p. 8).

Although Adler acknowledges that the present generation of research is still in the process of defining its identity, valid generalizations are emerging from recent research on the relationship of technology and work that must increasingly account for global technical and economic developments. The focus of this research is on the strength of competitive pressures to adopt more productive work systems and on the corresponding long-term trend toward the upgrading of skill requirements.

Although this theme of technology's skill upgrading effects is similar to that of the first generation of research of forty years ago, today's research retains some important lessons from the intervening work. For example, current research reflects understanding of the fact that in the context of a market economy skill upgrading tendencies often manifest themselves in a somewhat chaotic manner, leaving pockets of de-skilling and layoffs. From the "contextualist" research which offered no generalizations about the technology-work relationship, the present research reflects sensitivity to the importance of variations across national and organizational contexts. It also acknowledges the importance of mediating variables in the technology-work relationship.

Adler concludes his overview of the distinctive traits of the successive generations of research on technology and work by identifying two key themes within current research in this area. One theme addresses what should constitute the present notion of worker *competence* if we are to use advanced technologies effectively. Recent research suggests that the notion of competence should not only refer to the use of higher-order skills--the ability to perform more sophisticated tasks, but it also means the assumption of broader roles--the performance of a greater number of more varied tasks. The kind of worker

competence needed in today's technically sophisticated workplace necessarily includes both higher skill and broader roles. Adler maintains that prior research and the more practice-oriented literature focuses on one of these dimensions to the exclusion of the other. Development of both the breadth and depth of worker capabilities--new skills and broader roles--is what current research indicates is required to use new technologies most effectively.

The second key theme identified by Adler is related to the organization's capability to develop this kind of worker competence. The current generation of research has focused on the need for reconfiguring organizations to support a process of continuous learning. Although the research offers different reasons for how and why a learning focus should be established, they converge on the common theme that the link between continuous learning and the achievement of business objectives is strengthened if organizations can take advantage of two distinctive features of today's technologically-enhanced work. One feature is that present technology is more programmable and flexible than previous types. Flexible technology that remains static for lack of competent programmers is of limited use. It can only be used for competitive advantage if employees are able to extend the applications of this technology on a continual basis. A second characteristic of today's workplace that increases the need for continuous learning is the accelerating rate of change in both technological development and in the overall business environment. Organizations must increasingly rely on continuous learning by all employees to adapt rapidly to the introduction of new work tasks and technologies. Moreover, these work changes are occurring within a rapidly changing business environment.

Both of these themes, a broader conception of worker competence and the importance of continuous learning, represent key areas of emphasis in today's research on technology and work.

MIT Commission on Industrial Productivity

In 1986 a select group of sixteen MIT faculty from the fields of economics, management, engineering, and public policy formed the MIT Commission on Industrial Productivity to follow MIT president Paul Gray's charge to identify what went wrong with

American industrial productivity and identify ways the U. S. economy can get back onto the path of high productivity growth. *Made in America: Regaining the Productive Edge* is the comprehensive and well balanced report of the MIT Commission on Industrial Productivity (1989) after two years of intensive study of American industrial practices in the manufacturing sector. Unlike other broad, top down examinations of American business performance, the Commission rigorously followed a bottom up approach which focused on the production system of U. S. manufacturing. While continually linking their findings to larger macroeconomic issues, the Commission sought to examine the strengths and weaknesses of industrial *practices* in manufacturing--how American production systems actually function from product conception to customer delivery. This involved hundreds of interviews on three continents and detailed research into eight major manufacturing industries from textiles to computers. As expected, the judicious use of technology was prominent among factors identified by the Commission as central to the success of manufacturing strategies.

The recurring weaknesses in industrial practices found by the Commission include short term horizons and a preoccupation with short-term returns, outdated manufacturing strategies that still focus on mass production, technological failures in translating research innovations into marketable products, neglect of human resources, and a public policy environment that is frequently at cross-purposes with industry.

With regard to the use of technology, the Commission sounded a now familiar theme in their criticism of American manufacturing practices: technology has not been effectively integrated into the rest of the business, including an absence of cross-functional strategies for the adoption of technology by manufacturing, marketing, and human resources. While there was no shortage of evidence supporting the failure of firms to use technology for strategic advantage, such as the well known failure of General Motors to coordinate technology strategies with manufacturing and human resource policies in their early high-technology plants, the Commission also found encouraging evidence of technology being well integrated across all aspects of the business in firms such as Levi Strauss, the domestic apparel manufacturer, which can now ship popular slacks and other garments to customers three days after the fabric arrives at its plants for initial manufacturing. This

"quick response system" is largely based on effectively integrated information technology which closely links the needs and responses of supplier, manufacturer, and customer.

Despite the volume and detail of the industry data analyzed by the Commission, their report summarizes in a clear, matter-of-fact way the key performance and behavioral practices that have weakened America's industrial position. The Commission concludes their report with an admonition to interested groups throughout industry, government, and the educational system to examine ways of collaborating to improve the nation's productive performance. While they acknowledge the scope of this challenge, they also offer concrete suggestions for how this should take place.

Commission on the Skills of the American Workforce

The Commission on the Skills of the American Workforce (1990) issued a warning to the nation after studying the changing patterns of work and employment in the United States and the ways in which we do and do not adequately prepare people for work in this country. The warning was simple and direct: it is no longer possible to be a high wage, low skill nation. We must decide now whether we wish to be a nation of high skills (and high wages) or low skills (and low wages). Thus, the challenge offered in the title of their comprehensive report on education, employment, and economic development: *America's Choice: High Skills of Low Wages!*

The Commission's report offers a comprehensive analysis and description of how the nation's workforce is prepared for employment. The report clearly demonstrates the difficulty the Commission encountered in trying to trace coherent, long-term "systems" for preparing people for work when, in fact, our educational system is largely a patchwork of unconnected programs. The report shows how our country's systems for work preparation are fraught with gaps and dead ends, especially for the non-college bound. It implicates business leaders, educators, and public officials alike for their inattention to the need for system-wide integration of our fragmented approaches to workforce development.

The report presents two cases at the organizational level of the kind of critical decisions the nation faces in dealing with a workplace undergoing rapid transformation by a number forces, including technology. The examples illustrate the plight of two production plants of

major American firms both in financial trouble and each facing shut down if a major turnaround in operations could not be accomplished.

One organization, a maker of electrical control panels, addressed the need to reduce costs and boost productivity by gradually replacing well paid workers by outsourcing major production functions and by importing product components made in a low-wage foreign country. The production that remained in the plant was further automated with computer-based technology that reduced labor costs even more.

The other domestic production facility also faced similar financial and competitive pressures and had to reorganize their work systems, but did so in a fundamentally different way. They undertook an organization-wide reorganization of people and processes that included a comprehensive program of skill upgrading that eventually allowed all workers to take a significantly larger share of responsibility for how production work is planned and carried out. Through major initiatives in new work systems, the effective use of work teams, and the on-going development of job skills at all levels of the organization, the plant was able to achieve a five-fold improvement in product quality, a 200 percent increase in productivity, and reduce costly inventory levels by 40 percent.

In both examples, major cost reductions and productivity improvements had to be achieved for the plants to become competitive. But the choices made were fundamentally different. The electrical control panel plant achieved 75 percent of its savings by cutting labor costs and eliminating workers. The other plant achieved 90 percent of its improvements through a comprehensive strategy for work reorganization and skills development with no net loss of jobs. Admittedly, the scope of change required for the kind of turnaround demonstrated in the later example is not easily achieved. Fundamental changes in how organizations operate and in how our workforce is prepared will be needed in order for the *high skills* approach to work performance to become a more common path for achieving productivity and profitability.

Included in the Commission's recommendations for accomplishing the kind of sweeping change needed in our approach to education and employment are two proposals aimed at allowing the nation to take better advantage of technology in the workplace. One recommendation is for the development of a comprehensive system of Technical and

Professional Certificates and associate's degrees for the majority of students and adult workers who do not pursue a baccalaureate degree. Another recommendation is for stronger incentives for employers to invest in further education and training of their front-line workers and to pursue high productivity forms of work organization.

While acknowledging that these and other recommendations for fundamental change in our systems for preparing workers will not be easily accepted or quickly implemented, the Commission confronts all who are concerned about our economic future with a clear, compelling choice: do we remain indifferent to the "low wage" choice made by many companies which are becoming alarmingly common, or do we provide real incentives for our leaders to make "high productivity" choices?

Giordano

Giordano (1992) conducted an in-depth investigation of the effects of computerization on four occupations employed by a major defense contractor. The occupations--drafters, design drafters, process engineers, and machinists--were studied for the effects of computerization on the nature of the work and the skills required of job holders. Giordano also examined the changes in the overall scope of jobs brought about by work reorganization due to computer technology. (The author also studied the use of quality circles and its influence on work and social relations in the organization. As the focus of this section is on technology and work, the present discussion is limited to the author's examination of the effects of computerization on the nature of work.)

With regard to computerization's effect on the skill levels of jobs, Giordano found that it was not a simple matter of de-skilling *or* skill upgrading within jobs influenced by computerization. The results of the research indicate a relationship that is complex and seemingly contradictory in that skill changes within a job can shift simultaneously in both directions. For example, as computerization automates the work traditionally performed by a machinist, two distinct types of machining expertise become apparent: the skills that have historically defined this occupation; and the abstract, cognitive processes now needed by machinists to process computerized information. Although automation simplifies and, in effect, deskills parts of the machinist's job, the overall effects of computerization on

machining increase the skills required of machinists who must now program and operate advanced machine tools.

Moreover, Giordano found that the influence of computerization is not limited to its effects within the job. As work tasks become more sophisticated, there are broader effects which can catalyze the reorganization of work. For example, Giordano notes increasing polarization between highly skilled machinists who plan, program, and operate advanced machine tools, and lesser skilled operators who monitor jobs in progress. She feels that the result of this trend toward the polarization of machinists' skills will eventually lead to a two-tiered occupation. As technology enhances (or diminishes) the sophistication of work *within* jobs, increasingly there are larger effects on the reorganization of work *among* jobs.

Another example of the effects technology on work is the work redistribution that may someday occur between process engineers and machinists. Process engineers use CAD/CAM (computer assisted design/computer assisted manufacturing) exhibit much of their work planning and programming expertise. As this technology becomes capable of storing and integrating increasingly diverse design and production information, opportunities for the rearrangement of tasks, and even the reclassification of jobs, become more apparent. The production system becomes a more continuous process with CAD/CAM technology linking each phase of design and production. It is conceivable that the machinist's role, long crucial to basic manufacturing operations, could be eliminated as engineers become capable of programming and operating machine tools from their computer terminals! Again, technology not only upgrades the capabilities within a job, it reshapes the distribution of work at a higher level as related jobs are combined, expanded, or eliminated.

Fortunately, Giordano maintains that the traumatic effects on people of such work reorganization can be mitigated through the larger social context in which technology is introduced into the workplace. Giordano found that the effects of computerization on the expansion or elimination of jobs were contingent upon the powerful influences of what she calls the "social relations" within the organization. Technology both influences and is influenced by social factors, which include management-labor relations, management's leadership style, and the nature of the industry. For example, even though the introduction

of technology may improve productivity, managers may hold back from full-scale adoption of technology if adverse effects on jobs and employment would result.

While computerization provides a range of possibilities for the restructuring of tasks, jobs, and work processes, Giordano maintains that decisions makers, who are strongly influenced by social considerations, ultimately define what the structure of work will be. Technology generally provides a range of choices regarding its use but, as Giordano states, "they are primarily organizational decisions, not technical imperatives which re-shape and restructure the labour process" (p. 202).

Davenport

Davenport (1993) distinguishes between process *innovation* and process *improvement.* Process improvement efforts take the existing process as the starting point and seek to increase process efficiency and effectiveness to achieve quality improvement and cost reduction. Organizations may seek simultaneous improvement across multiple processes; within each process, change is continuous and incremental.

Process innovation starts with a relatively clean slate. Managers identify core business objectives and attempt to temporarily disengage the objectives from the existing means for accomplishing them. As the catalyst for innovation, Davenport encourages managers to ask, "Regardless of how we have accomplished this objective in the past, what is the best possible way to do it now?" (p. 11). As process innovation seeks to truly *innovate* the ways in which work is done, processes undergo fundamental, rather than incremental change with process innovation. Unlike the continuous, incremental change of process improvement, process innovation is discrete and radical.

Process innovation and process improvement both require the active involvement of employees at all levels of the organization. But because process innovation requires senior managers to get beyond the interests of those invested in current processes, process innovation needs strong direction and is typically requires more top down initiative than process improvement efforts. The fundamental reengineering of processes requires a broad, cross-functional perspective of how work flows throughout the entire organization. More so than with process improvement, managers have to acknowledge the need for

major changes in the organizational structure to implement process innovation.The nature of innovation may require massive change in how work is accomplished, and corresponding changes in management practices and skill requirements associated with them.

Davenport urges organizations to take advantage of the power of information technology to enable the innovation of business processes. Yet, he sounds an important note of caution in his criticism of how managers have implemented information technology in organizations to date. The business investment in information technology in the last two decades has far exceeded capital expenditures in other areas. For example, in early 1988, investments in information technology capital across U. S. industries accounted for 42% of total business equipment expenditures. Yet, despite the enormous investment in information technology, there has been no indication that this has positively influenced important business outcomes. Davenport cites Lester Thurow's (1991) observation that

> . . . there is no clear evidence that these new technologies have raised productivity (the ultimate determinant of our standard of living) or profitability. There is evidence, in the United States at least, that the investment in the new technologies has coincided with lowered overall productivity and profitability. (p. v)

The problem, according to Davenport, is not the information technology itself, but the way it is applied without being thoroughly integrated into major business processes.

Information and information technology are not the only elements crucial to the success of process innovation. Equally important are how organizational structure and human resource policy are handled as the organization undergoes the radical changes involved in process innovation. Structural, cultural, and human resource factors are at least as powerful as information technology in bringing about process change. According to Davenport, the long-term success of process innovation requires the adoption of practices such as empowering employees to handle entire processes (particularly at the customer interface), establishing autonomous work teams, and creating new, more process-oriented organizational structures. He encourages managers to carefully integrate these organizational and human resource factors with information technology as enablers of process innovation.

Organizations cannot achieve dramatic improvements in business outcomes without fully exploring the potential of information technology to change the way work is done. This reexamination of an organization's work systems is a challenging and painstaking process. It requires managers to look beyond present methods and technologies for accomplishing work in which substantial investments have been made. The fundamental reexamination of how an organization's work is accomplished is at the core of process innovation, and is an important prerequisite to using information technology in ways that will achieve the economic outcomes sought by organizations.

Information technology is not only an *enabler* of process innovation, it is also used to *implement* process change once the new process has been designed. The enabling and implementing roles of information technology are reflected in the following steps which Davenport maintains are necessary to bring about process innovation:

- defining business strategy;
- creating a process vision consistent with strategy;
- understanding the structure and flow of the current process;
- measuring the performance of the current process;
- designing the new process;
- prototyping the new process;
- implementing and operationalizing the process;
- communicating ongoing results of the innovation effort; and
- building commitment toward the process and associated systems.

For example, if we were to apply process innovation to an insurance company seeking to streamline its underwriting processes, as many are eager to do, we might first identify the information technology and information enablers for the innovation of underwriting such as computers and programs for decision making applied to underwriting. Successful innovation also requires that organizational and human resource enablers of the innovation of underwriting be identified. For example, case management structures for certain categories of underwriting, autonomous work teams, and training should be carefully considered as important prerequisites to the *innovation* of the underwriting process. Information technology is a key enabler of process innovation in this case as the

organization shifts from an essentially linear, labor-intensive underwriting process to one primarily composed of expert computer-based systems for underwriting decision making and dramatically fewer clerical intermediaries. The cross-functional integration of networks for computing and the linkage of individual work stations show how information technology *enables* the innovation of this process.

Information technology can also be used in this case to *implement* process change once the process has been designed. After the new underwriting process based on systems for expert decision-making has been designed, further steps toward innovation listed above, such as the prototyping and operationalizing of process components, must be carefully addressed to assure that the innovation is fully integrated across major business processes. Information technology is used in this case to facilitate these implementation activities. It is then both an enabler and implementer of process innovation.

Davenport acknowledges that process innovation may be difficult to achieve due to the radical nature of the organizational change it involves. Process innovation is a distinctly new way to change business processes, and at this point, Davenport suggests that process innovation remains more of an art than a science. He provides a five-step framework for addressing the structural, technical, and cultural considerations that must be attended to for process innovation to work. Yet, Davenport acknowledges that the specific methods of process innovation, and even the sequence of the steps he offers, may vary depending on a number of organizational factors.

Despite the degree of change and high risk it entails, Davenport maintains that process innovation is a highly appealing approach to business transformation because it can be undertaken at low cost, the design of new processes can be completed in a matter of months, and innovations that yield as much as tenfold improvements in process performance have been achieved.

Zuboff

Shoshana Zuboff (1988) undertook an extensive study of the ways in which information technology is changing how we work. Her study followed a bottom-up approach to the examination of eight organizations within several industries which were all

undergoing significant technical reorganization of their basic work systems. Based on the research for her doctoral dissertation, *In the Age of the Smart Machine* has become a major chronicle of how information technology has fundamentally changed the ways in which organization accomplish work.

Zuboff was able to take advantage of what she calls a narrow "window of opportunity" by analyzing changing work patterns and capturing workers' perceptions of the changes at a time in the early 1980's when many workers at all organizational levels first began using computers to perform their work. Zuboff's research took her into the factories and offices of a telephone company, a paper mill and two pulp mills, a major stock brokerage firm, the claims unit of a large insurance company, an international banking firm, and a large pharmaceutical company. She attempted to uncover fundamental changes in how people work that were common to a wide variety of work systems undergoing technological change within the companies in her sample. In an effort to capture the essence of change due to information technology, Zuboff sought the views of workers who would be able to see the effects of technology on their work. She sought workers

> . . . who had experience accomplishing the same tasks in both the context of an earlier technology--pneumatic controls, paper and pencil, face-to-face interaction, mechanical equipment--and the context of information technology--integrated information and control systems, on-line transaction systems, real-time information systems, and computer-conferencing systems. (p. 13)

Zuboff saw the importance of eliciting workers' perspectives while their experiences with how information technology had changed their work were still fresh.

This review of Zuboff's work focuses on her examination of three important features of how work systems throughout organizations can be transformed through information technology. Each of these features requires managers to undergo a fundamental shift in their thinking about how work is accomplished and the ways information technology is changing the structure of work and their authority over it. The first section of this review addresses the need for managers to recognize the full potential of information technology to not only automate work systems, but to fully integrate systems formerly thought to be too diverse for direct linkage. Acknowledging the nature and interrelationship of the dual roles

of technology (what Zuboff calls technology's *automating* and *informating* roles) is necessary if information technology is to enable major gains in business productivity. The next section examines the importance of developing "intellective" versus "action-centered" skills if workers are to use information technology in truly innovative ways. Full exploitation of information technology's power to innovate business processes requires managers to address the need for those at all levels of the organization who have more sophisticated skills and can see the systemic implications of their work. The final section of this review examines a central dilemma for managers struggling with the magnitude of change involved in transforming work systems with information technology. For managers to enable workers to use information technology, they must relinquish control of information that has for so long supported their claim to authority. Each of these dynamics--technology's dual capacities for *automating* and *informating* work, the increasing need for *intellective skills,* and the magnitude change involved in reorganizing work through information technology--must be accounted for in a comprehensive strategy for organizational change if the power of information technology for business innovation is to be fully exploited.

The dual roles of information technology. Zuboff acknowledges that the present era of information technology is not the first time that technology has catalyzed changes that have revolutionized the way work is done. The machinery of the industrial era allowed an unprecedented expansion of production and changed forever both the meaning and content of work. In order to expose the unique influence of information technology on work, Zuboff asks, "What essentially distinguishes information technology from earlier generations of machine technology?"

Older machine technology epitomized by the automated assembly line and the present generation of computerized information technology both reproduce, extend, and improve human capacity for productive work. Yet, information technology offers a benefit that goes beyond the task it has automated--it simultaneously *informates* the task. Zuboff coined this term to describe information technology's ability to integrate diverse and complex business functions. The mechanisms that automate work by translating

programmed instructions into productive actions also record data about these automated activities that represent comprehensive and detailed histories of work transactions. Zuboff cites many instances of work systems that now simultaneously *automate* and *informate* work through the power of information technology. For example, computer-numerically-controlled (CNC) machine tools and microprocessor-based sensing devices not only use programmed instructions to direct the operations of equipment or processes, they also convert these operational events into data which can be used for other purposes. Laser scanners in supermarkets not only automate the checkout process, they simultaneously produce data that can be used for inventory control, the scheduling of employees, and market analysis. The same systems that automate factory and office processes also produce data that, when integrated with similar data from other functions in organizations, allow a comprehensive overview of an organization's operations. Thus, information technology creates new possibilities for work synergy beyond its automating effects.

Most managers are now aware of the automating and informating roles of information technology and seek ways to take full advantage of them. Yet, as they are discovering, the availability of sophisticated technology is one thing; it is quite another to develop deftness in its use. Information technology has immense productivity-enhancing potential. But this potential cannot be realized, Zuboff maintains, without the development of more sophisticated work skills among those at all organizational levels who use must use it.

"Action-centered and intellective skills." Zuboff makes an important distinction between two broad categories of skills present in today's workplace: traditional *action-centered* skills and the skills increasingly needed for informated work which Zuboff calls *intellective* skills. Although no hard and fast distinction exists between these two types of skills, Zuboff's research indicates that more technically sophisticated work has driven a gradual shift from action-centered to intellective skills.

Action-centered skills are characterized by hands-on, face-to-face interaction between the worker and the immediate work environment. These skills develop around tangible work where sense is developed about what is happening based largely on physical cues--workers see, hear, and feel concrete changes in the work and respond accordingly.

Regardless of whether the purpose of the task is managerial or operational, tasks in action-centered work are discrete, well-defined, and of relatively narrow scope. Action-centered skill derives its name from the notion that work expertise is implicit; the knowledge and skill crucial to competence is embedded in the experience of worker and is made explicit only through the execution of the task.

Intellective skills, on the other hand, enable the worker to perform tasks from which they may be physically and temporally removed. Task performance is based on more abstract cues, such as symbols on a computer screen, rather than the physical characteristics of products or specific customer requests. Unlike the procedural nature of action-centered thinking, intellective skills are based on systemic thinking needed for the kind of non-repetitive problem-solving characteristic of more complex, informated work systems. In organizations where separate departments are now closely linked through information technology, the problems that confront individual workers who now interact with many more departments are complex and cross-functional. Because of this, corrective actions often lie outside prior response patterns and call upon the intellective skills of the worker to hypothesize new solutions.

Although Zuboff indicates that the increasing technical sophistication of work has driven a gradual yet perceptible shift from reliance on action-centered to intellective skills, the diffusion of information technology throughout the workplace does not, in itself, necessarily promote the development of intellective skills. Many examples in the organizations Zuboff studied support the notion that technology has both "deskilling" and "skill upgrading" effects on the capabilities required of workers. Moreover, the variable effect of technology on the skill requirements for work can be demonstrated in jobs representing both ends of the job complexity spectrum. The diffusion of information technology through all levels of the organization does not necessarily raise the demand for intellective skills. Information technology has deskilled office work by narrowing the job purpose to one primarily of data entry. Yet, it has also upgraded the skills needed by office workers who now use computer-mediated information systems that are cross-functionally integrated. Processing this information requires a more systemic understanding of the business than did traditional, paper-based tasks.

Likewise, in more complex types of professional and managerial work, information technology has both reduced and enriched the skills required of workers. The work of bank loan officers provides an interesting example of the deskilling effects of technology in more sophisticated work. Loan application approvals have traditionally been based on the loan officer's skill in developing a "feel" for the customer, the nature of the loan, and the risk it involved. Decisions have been based more on professional judgment (i.e., loan officers' gut-feelings) than on an explicit, data-based rationale. The work has primarily demanded skills involving the personal analysis of loan application data and face-to-face banker-customer interactions, which Zuboff characterizes as "action-centered." However, information technology has reduced the "art" of approving loans into a series of computer-generated reports and decision points. Consequently, much of the loan data analysis and preliminary decision making is now performed by paraprofessional loan processing workers. Information technology has enabled much of the "art" of approving loans to be systematized, and has thereby deskilled a substantial portion of loan officers' work. As computers acquire the capability to process increasingly complex technical data that could once only be processed by loan officers themselves, there is concern that people will eventually lose touch with important aspects of the business because they are no longer required to deal with them directly. Computerized technology has encroached upon the implicit expertise of these workers and has explicated and systematized the analytical and decision making processes that were formerly dealt with through "professional judgment." These capabilities now reside in the technology, not in the worker.

On the other hand, information technology can also facilitate the comprehensive understanding of one's own work because it makes explicit work methods and the rationale underlying them. Computer monitors linked by organization-wide information networks allow a fuller view of the assumptions and logic underlying work tasks than was possible with verbal and written means of transferring task-related information. For the loan officer, information technology puts the value of loan and non-loan banking products into perspective, and can proactively show how changes in one banking service will affect others. The cross-functional integrating power of information technology allows the loan officer to see the implications of loan approval decisions within and beyond the loan itself.

In this way, the intellective skills of loan officers and others working in an informated environment are nurtured as they must increasingly adopt a systemic perspective of their work to make sense of the multi-dimensional data to which they now have access.

The development of intellective skills is critical to the innovative use of information technology, yet an environment in which widespread intellective competence can develop is not easily created. Those in a position to unleash the informating power of technology must first examine their willingness to *share* the knowledge carried through information technology. The sharing of knowledge does not come easily to managers who see knowledge as an important basis of their authority.

Informating the organization and managerial authority. Zuboff encourages organizational leaders seeking to exploit the tremendous informating potential of technology to develop the intellective skills of their employees at all levels of the organization. She acknowledges many prerequisites and contingencies for developing a work environment where intellective competence flourishes at all levels. Yet, the most formidable obstacles to the development of intellective skills relate to managerial authority and how it is exercised in organizations. Management has traditionally been extremely protective of what it has seen as the legitimate source of its authority: exclusive control of the organization's knowledge base. For those outside the organization, knowledge crucial to competitive advantage is closely guarded as "proprietary information." Inside the organization, sensitive information is selectively shared with members on a "need-to-know" basis. Hierarchical structures and patterns of communication safeguard management's prerogatives of command, and carefully control the ways in which information will be shared with employees.

But the hardware and networks of information technology cannot, in themselves, carry the burden of responding to the competitive challenges businesses face. Zuboff maintains that the informating power of information technology can only be fully exploited by developing the intellective skills of the employees at all organizational levels who use it. Herein lies the central dilemma for organizational leaders struggling to take full advantage of the power of the "smart machine" yet encountering obstacles to change embedded in the

organization's present structure and authority. In order to exploit the unique power of information technology to integrate data and work systems across the organization, management must relinquish control of the knowledge base it has so long protected as a central source of its authority. Computer technology can only provide the kinds of information it has been programmed to process, and can only deliver the information to those who have been empowered to use it. The power of information technology to integrate knowledge across time and space can only be realized in an environment that promotes information sharing among employees at all levels. Yet managers are unwilling to lose control of information that has for so long supported their claim to authority.

Among the organizations Zuboff studied, managers faced with this information sharing dilemma have seriously struggled with the divergent choices presented by the use of information technology. Most managers could see how workers can visualize their work and see the broader implications of their work using the information sharing capacity of computer technology. Office and factory workers could receive feedback about their performance and learn the cross-functional implications of their actions through on-line terminals in computer-mediated processes. Managers could see the opportunities for increased employee autonomy in the data-rich environment made possible by information technology.

However, Zuboff found that most managers bypassed these opportunities to enhance productivity through information sharing and opted to use the technology's process monitoring and informating features to further increase their control of information. Computerized process surveillance and data collection were often used to document individual productivity and assign blame for production errors, rather than as a means for reflection on one's work and an opportunity for learning. Zuboff found that in most organizations the threat to managerial control posed by the sharing of knowledge outweighed its long-term benefits. Even where managers were supportive of information sharing, the result was more often a piecemeal technical restructuring of isolated business functions, rather than an organization-wide effort to innovate business processes through information technology . Other long-term initiatives to cross-functionally integrate

business processes through technology failed after promising beginnings became ensnared in local resistance and corporate infighting.

In the final analysis, none of the eight organizations Zuboff studied fully succeeded in exploiting the opportunity for organization-wide innovation of business processes provided through information technology. These shortfalls, Zuboff says, were due to the absence of a comprehensive strategy for real, long-term innovation of organizations' basic work systems. Consistent with a narrative style that illustrates the broad developmental patterns of organizations with specific events from the eight organizations she studied without judging their value or intent, Zuboff offers no prescriptive strategy for business innovation through information technology. Instead, she has laid out the successive dilemmas leaders face in their efforts to fully exploit the benefits of information technology: acknowledging the demand for intellective skills in today's informated workplace; managing the apparent paradox for managers who, in order to enhance workers' productive capacities, must relinquish their control of the organization's knowledge base; and discovering alternative forms of work organization that further blur the distinction between managerial and operational roles. Comprehensive strategies for business innovation through information technology must acknowledge the interdependencies among these dilemmas, and will often need the full weight of leadership commitment to fundamentally reshape organizational structures and authority if organization-wide informating strategies are to succeed. As Zuboff witnessed in the organizations she studied, without the direction and constancy of such strategies, people will find ways to use technology to preserve personal control and authority, but the technology will be of little, long-term strategic value to the organization.

Work Roles and Role Theory

The theory and empirical research on *jobs* and *roles* have developed separately and remain two distinct, non-overlapping literatures. These literatures encompass much of the same theoretical domain for several reasons. First, there is much overlap in the functions of jobs and roles as well as in the outcomes with which both literatures are concerned.

Ilgen and Hollenbeck (1991), whose work on role conflict and role ambiguity will be reviewed in this section, acknowledge that there *are* important distinctions between the orientations of job and role that ought to be emphasized and preserved despite any attempts to integrate these constructs. This section on "Work Roles and Role Theory" is presented to examine the nature of roles and role theory, and to contrast the notion of work *role* with the traditional notion of *job* as discussed throughout this study.

Biddle

Biddle (1979) offers an integrative exposition of roles and role theory. Biddle's theory of roles is intended to explain roles and role phenomena in any social context--from the narrow, well-defined roles of two persons engaged in a simple sales transaction to the broad, often ambiguous roles we all hold as humans who must coexist on the same planet. Biddle uses a diverse set of contexts to explain and interrelate the many variables used to build his comprehensive theory of roles. Although Biddle uses an occupational context in which he describes the phenomena of *role changing,* the contexts used most often are historical, communal, organizational, and familial.

This review will focus first on the major constructs of Biddle's role theory. Several role constructs are of central importance to role theory and have broad applicability to many social contexts, including work roles. The major role constructs of Biddle's role theory will be examined first. Then, the phenomena of *role changing* is described because it is an important phenomena in role theory and because it is one of the few phenomena Biddle explains in an occupational context.

Major constructs in Biddle's role theory. Biddle's role theory is built around a notion of *role* that is determined by the essential constructs of behavior, expectation, position, and identity. A role is that set of behaviors characteristic of one or more persons in a particular social context. First and foremost, roles are behavioral. Biddle's concept of role is defined by those overt actions and performances that can be observed and that characterize the person(s) observed in performing the role. The role of an elementary school teacher usually involves preparing and presenting lessons, directing classroom learning activities,

correcting assignments, and managing the classroom environment through specific rewards and sanctions of student behaviors. Explicitly included in the definition of role are those things that teachers characteristically *do*-- actions and performances which constitute the typical behaviors of an elementary school teacher. Excluded from this conception of role are nonbehavioral characteristics of teachers such as their gender, race, or national origin and the attitudes, values, and interests of teachers, even though some of these may shape the teacher's role or affect it in some way. Some of these nonbehavioral characteristics that do affect the role of teacher are role expectations, yet these lie outside the notion of role from a conceptual standpoint. A role, then, is the set of behaviors performed by persons holding a particular role. This notion of role is appropriately applied to as few as one person and as many as the entire human race.

A powerful and essential determinant of roles in Biddle's role theory are expectations for role behavior. Role performance is shaped by the role expectations of others and one's own expectations of a role. Within the construct of expectations, Biddle defines the subject person as the one who holds an expectation of the role and the object person as the one to whom the expectation refers. The object person is often the role holder and the subject person is someone with role expectations who may not hold the same role, although the two concepts often come together in the case of the self expectations of the role holder. In addition to subject and object persons, Biddles's construct of expectation includes the notions of content, modality, and form. The content of the expectation is the specific role behaviors to which the expectation refers. The modality is the strength of the expectation (i.e., prescriptive expectations are requests or demands which often take the form "you should or must do such and such," whereas more affectively neutral expectations are simple assessments or descriptions of expected behavior which are expressed as "you can or may do such and such"). The form the expectation takes can be one of three types: expectations covertly held by the subject person, expectations that are openly expressed in oral form, or those that are openly expressed in writing.

These five conceptual elements of an expectation can be applied to an important expectation of a motor vehicle operator. I (subject person) have an expectation of you, the motor vehicle operator (object person), in reference to your diving speed (content of

expectation) that is quite prescriptive in nature (modality), and I tell you so--"You must slow down, or I will no longer ride with you" (form). For Biddle, expectations are important determinants of role performance.

Biddle maintains that the most common notion in role theory is that roles are associated with social positions. Why, he asks, are the behaviors of those who are members of a social position similar? Similar behaviors are exhibited because: (1) position members enter a particular social context that frames the position and the behaviors associated with it; (2) position members develop similar conceptions of their positional behaviors (shared positional expectations); and (3) non-members of the position also influence patterns of behavior within the position (expectations of others).

One's position is combined with other roles one holds within a social system to form the broader construct of one's identity. Biddle cites Klapp (1969) to define identity as an abstraction or symbol that indicates "all the things a person may legitimately and reliably say about himself--his status, his name, his personality, his past life, and thus any generally satisfactory answer to the question, Who am I? (Who are you?)" (p. 5). One's identity, therefore, necessarily includes the positional role or roles one holds. Yet, identity is a broader concept than position because it includes non-positional roles in which the rules of membership are not clearly defined. Non-positional roles are transitory (e.g., participation in a riot), ambiguous (e.g., the social role of a "radical liberal"), and only incidentally part of a social structure (e.g., the role of a communist sympathizer). A position, then, is a particular identity associated with persons who share common experiences, expectations, and membership in an established social structure. The position may be familial, occupational, communal, or organizational in nature.

Role changing. Biddle defines *role changing* as the phenomena that occurs as a person accommodates new positions and roles, and he discusses role changing in an occupational context. According to Biddle, occupational role changing occurs through four interrelated processes: selection, personal change, system change, and winnowing. Three of these processes involve role-related change primarily for the person undergoing a role change,

and the fourth, system change, involves role changes affected by the person that take place within the social system itself.

Selection into social systems occur through two analytically distinct selection processes: social selection and personal selection. Social selection operates when the social system into which the person is to enter controls those who are allowed to enter and those who are not. Universities use matriculation tests and standards for academic records for student selection; the military uses measures of intelligence, health, and physical ability for selection; organizations use a variety of assessments to select employees and assign the right person to the right job. Personal selection is the process a person undertakes in determining whether or not he or she is to enter a position. It ultimately involves personal choice of the individual, yet the individual or someone else may have originally initiated the selection process. For example, a promising science student may be recruited to a technical profession through the personal attention of a university professor, but the selection of profession is ultimately based on the personal choice of the individual. Biddle notes an increasing number of organizational systems in which personal and social selection are concurrent processes that are intended to allow mutual selection by the individual and the organization.

Personal change is the process by which we adopt a new pattern of behaviors and develop the knowledge, skills, and attitudes expected of a new role.. Those entering occupational groups or changing roles within them begin to reflect the nature of their work as they don a new uniform, master different skills, and learn a new vocabulary. Personal change involves forces both internal and external to the individual that shape new behaviors. As newcomers are "shown the ropes," they receive inducements to observe behaviors appropriate for the role and learn about the heroes and villains of those previously entering the role. Newcomers integrate these external cues with their own set of role expectations in efforts to satisfy the role expectations of self and others. The personal change of adapting to a new role occurs within a broader framework of socialization as the individual and social system adjust to each other.

Although most social systems have homeostatic mechanisms that protect the system against those who attempt to change it, systemic change can and does occur, albeit at a

painfully slow pace. Efforts to affect *system change* in social systems at the global level have succeeded. Biddle cites changes in socialism in several countries, fundamental foreign policy changes resulting from challenges to the "unjust war," and systemic advances in dealing racial prejudice as examples of the scope and depth of systemic change that has been achieved. Biddle suggests that such change is possible within organizational systems, yet even at a more micro organizational level, change will occur more slowly than those affecting it would wish. For Biddle change within all social systems, large or small, occurs primarily through personal leadership. A leader is simply someone who successfully exerts influence over others. Biddle identifies essential characteristics of those who demonstrate effective personal leadership, and suggests that lasting system change can be affected by individuals.

Biddle's fourth role changing process is a phenomena he calls "winnowing." If after selection into a social system and a period of socialization and adjustment between the newcomer and the system, there is lack of sufficient satisfaction from either or both the individual and system with the other, the process of *winnowing* takes place. Winnowing is the selective departure of individuals from role membership due to a number of reasons including lack of personal satisfaction, actions taken by the systems, or individuals simply going on to better things.

To illustrate these four role changing processes and show how they often interact, Biddle asks why new teacher-trainees seem to be more optimistic, democratic, and progressive than experienced, practicing teachers. He suggests that role changing processes likely explain much of the difference. First, perhaps a more progressive group of teachers are being *selected* for their teaching roles. Second, new teachers may not yet have suffered the indignities *(personal change)* of the educational system. Third, new teachers have not yet had time to *change the system.* Fourth, those who have inappropriate expectations of teaching (i.e., new teachers) have not yet left the system *(winnowing).*

Ilgen and Hollenbeck

In the fifteen years or so since Biddle's role theory was published, a great deal of research has been generated on roles and role phenomena. Ilgen and Hollenbeck (1991)

provide a discussion and critique of recent research on roles as part of a broader examination of the conceptual overlap between *job* and *role* as these concepts relate to work. In this section, Ilgen and Hollenbeck discuss the two constructs that account for most of the research on roles: role ambiguity and role conflict. First, these constructs are defined and distinguished. Then, an important limitation of research on role ambiguity and role conflict identified by Ilgen and Hollenbeck is discussed.

Role ambiguity and role conflict. Although the definition of a role deals with the particular pattern of behavior expected of the person in that role, most of the research on roles and role phenomena focuses on the extent of agreement in the beliefs and expectations about the role among all of those in the role context. Those in the role context include the role holder (i.e., the focal person performing the role), the role sender (i.e., the person or persons who hold a set of beliefs that constitute the role) and others in the immediate role context who have an interest in role performance. The concepts of interest here are those of role *ambiguity* and *role conflict.* Ilgen and Hollenbeck base their definitions of these concepts on the work of Cook, Hepworth, Wall, & Warr (1981). *Role ambiguity* is the level of uncertainty or lack of clarity surrounding a role. Role ambiguity commonly exists when expectations about the role are incomplete or insufficient to guide behavior.

Role conflict involves an incompatibility of role demands facing the focal person. This incompatibility can originate from any number of people, including the focal person him or herself. The nature of conflicting role expectations may be related to time conflicts or logical/ethical conflicts. We face time-related role conflict when the boss expects more output from the role than we perceive there is time to accomplish. An ethical conflict commonly arises for someone in a sales role who is pressured to sell something that is likely not in the best interests of the customer. These definitions appear to sufficiently distinguish role ambiguity and role conflict, but as will be examined next, there is lack of conceptual clarity in the operational definitions of these constructs used by most researchers in this area.

A limitation of research on roles. Ilgen and Hollenbeck examine the constructs most commonly used in the literature as the antecedent and consequence correlates of role ambiguity and role conflict. Antecedent correlates are those organizational and individual characteristics that presumably lead to role ambiguity and role conflict; consequence correlates are those affective and behavioral reactions that would seem to result from them. The authors observe that there is extensive overlap in the constructs used as antecedents and consequences for *both* role ambiguity and role conflict. That is, the same organizational characteristics (e.g., participation, feedback from others, leadership characteristics) and individual characteristics (e.g., locus of control, tenure, age, self-esteem) are often examined in the literature as the factors likely to lead to role ambiguity *and* role conflict. Similarly, the same affective reactions (e.g., job satisfaction, commitment, involvement, propensity to leave) and behavioral reaction (e.g., absence, ratings of job performance) are often examined in the literature as consequences of role ambiguity and role conflict. The authors feel that the imprecise conceptualization of role ambiguity and role conflict is likely the reason so many studies in organizational settings use a single measure of the two variables.

Ilgen and Hollenbeck point out that this problem of weak conceptual distinction between role ambiguity and role conflict is not insignificant. Lack of conceptual clarity in the definition of the variables and the constructs upon which they are based is a major problem in role theory research. They note that all the major reviews of literature examining role ambiguity and role conflict call for more attention to the structure of the network of conceptual relationships among the constructs upon which the two variables are based. Ilgen and Hollenbeck ask role researchers to be more precise in their theoretical treatment of the two constructs themselves.

Ilgen and Hollenbeck specifically refer to three major meta-analytical reviews of research on role ambiguity and role conflict. One of these, the meta-analysis of Fisher and Gitelson (1983), is reviewed here to see how the closely the concepts of role ambiguity and role conflict are related to the same correlates and to each other.

Fisher and Gitelson

Fisher and Gitelson examined the relationships between role ambiguity and role conflict and their eighteen most frequently researched correlates in the forty-three studies they included in their analysis. The authors wished to provide a more accurate picture of the magnitude and direction of relationships among the two variables and their correlates, and determine whether moderator variables may be necessary to identify subpopulations with different correlation values.

They found that, across the forty-three studies they analyzed, role ambiguity was negatively related to the correlates *organizational commitment, job involvement, satisfaction with co-workers,* and *satisfaction with promotion,* and positively related to the correlate *education.* The strongest correlation they found (r = -.34) was between role ambiguity and organizational commitment (i.e., supervisory involvement, availability of work resources and procedures).

Role conflict was negatively related to the correlates *satisfaction with supervisor, satisfaction with co-workers, participation in decision making,* and *organizational commitment,* and positively related to the correlate *boundary spanning* (i.e., individuals whose positions span different functions, hierarchical levels, or organizations). The strongest correlation they found (r = -.37) was between role conflict and satisfaction with supervisor.

The authors introduced a moderator variable, *job type,* in an attempt to explain the significant residual variance among sample results. Job type (or organizational level) was defined as a nominal variable with three levels: *lower, professional,* and *managerial.* Correlates of role ambiguity and role conflict were then reanalyzed by job type. The results of their moderator variable analysis were neither strong nor particularly enlightening. Job type as operationalized by the authors was not a moderator, nor did it produce significantly different mean correlations for most of the relationships between role ambiguity, role conflict, and the correlates they examined.

Fisher and Gitelson's meta-analysis demonstrated the same conceptual overlap between role ambiguity and role conflict that Ilgen and Hollenbeck noted. Role ambiguity and role conflict are shown to be related to the same correlates--job involvement, satisfaction with

co-workers, organizational commitment--*and* to each other. Fisher and Gitelson acknowledge that their moderator analysis did little to clarify the relationship between role ambiguity and role conflict. They suggest that reciprocal causation may occur between these variables, and recommend that further research be focused on this phenomena.

Work Design and Employee Effects

Models of work design, such as Hackman and Oldham's "job characteristics model," have been criticized for not adequately addressing the technological and social contexts within which jobs exist (Hall, Goodale, Rabinowitz, and Morgan, 1978; Rousseau, 1977, 1978; Salancik & Pfeffer, 1977). This section will examine the Hackman and Oldham's "job characteristics model," other psychology-based perspectives on work design, and criticisms of this approach to work design, including the works cited above.

Hackman and Oldham

The best known and most complete theory for explaining worker responses to job design interventions is Hackman and Oldham's *job characteristics model.* According to Hackman and Oldham's (1976) theory, any job can be described in terms of the following five core job dimensions:

(a) *Skill variety*-- the degree to which a job requires a variety of different activities in carrying out the work, which involves the use of a number of different skills and talents of the person.

(b) *Task identity*-- the degree to which a job requires completion of a "whole" of identifiable piece of work--that is, doing a job from beginning to end with a visible outcome.

(c) *Task significance*-- the degree to which a job has a substantial impact on the lives or work of other people--whether in the immediate organization or in the external environment.

(d) *Autonomy*-- the degree to which a job provides substantial freedom, independence, and discretion to the individual in scheduling the work and in determining the procedures to be used in carrying it out.

(e) *Feedback*-- the degree to which carrying out the activities required by a job results in the individual obtaining direct and clear information about the effectiveness of his or her performance. (p. 253)

These five core job dimensions are seen as influencing three psychological states of workers. The experienced meaningful of work is said to be high when the job contains high skill variety, task identity, and task significance. The experienced responsibility for work outcomes is theorized to be affected primarily by the amount of autonomy in the job, while knowledge of results of work activities is a function of feedback.

According to the job characteristics theory, job which can be characterized as having relatively high degrees of these three psychological states are seen as being more motivating and satisfying, and more likely to lead to favorable work outcomes: high work productivity, and low absenteeism and turnover. The theory further suggests an important role for a moderating variable, individual growth need strength. The theory asserts that people with high growth needs are more likely to experience the psychological states with motivating jobs than are people with weaker growth needs.

Hackman and Oldham (1976) tested their theory using data from 658 workers in 62 jobs in 7 organizations. They found that jobs which are high on the five core dimensions tend to be associated with high levels of both personal and work outcomes. Their findings also suggested that this effect may be strongest for persons with high growth need strength. The need for the intervening critical psychological states, however, has not been well supported and documented. Indeed, most of the subsequent job design research of this type has examined only the direct link between the five job dimensions and the desired outcomes.

Hackman and Oldham's (1980) job characteristics model has made a significant and lasting contribution to the job design literature. Yet, they have not attempted to oversell their model, nor have they ignored or attempted to hide its shortcomings. Hackman and Oldham have acknowledged the model's value and have noted that, "while there is support

in the literature for the basic job characteristics model, it would be inappropriate to conclude that the model provides a correct and complete picture of the motivational effects of job characteristics" (p. 97).

Rousseau

Rousseau (1977) took the research exploring the effects of job characteristics on employee satisfaction and motivation pioneered by Hackman and Oldham (1976) a step further by examining the influence of technology as an intervening variable in this relationship. Rousseau wished to explore the influence of level of technology on job characteristics (i.e., skill variety, task identity, task significance, autonomy, feedback, and other characteristics prescribed by job design and sociotechnical systems theories). A major research objective was to determine the effects of degree of technological sophistication of the work one performed their work on the relationship between job characteristics and employee satisfaction and motivation. She reasoned that, because more sophisticated technology required greater discretion and problem-solving on the part of employees, levels of employee satisfaction and motivation would vary across technology due to differences in job characteristics *mediated by* the degree of technical sophistication of the work. More technically sophisticated jobs, Rousseau hypothesized, should result in greater employee satisfaction and motivation.

Rousseau surveyed 201 employees from nineteen production units in thirteen organizations. She classified these production units into three technological categories based on Thompson's (1967) classification of work technology. The three categories of technology are:

(a) *Long-linked or Serially Interdependent Technologies.* The mass production assembly line model where tasks must be performed in a prescribed order. Long-linked or serially interdependent technology is based on the predictability of cause--effect relationships with production methods producing predictable changes in raw materials. A high degree of structuring of jobs and work processes characterizes long-linked technologies.

(b) *Mediating Technologies.* Mediating technologies operate through standardized processes, sorting inputs or clients into groups for application of prescribed procedures based on categorization. Such unit are characterized by the choice among a variety of processes, each suited to a particular segment of the inputs to a unit, such as product engineering firms, banks, and insurance claims units.

(c) *Intensive or Custom Technologies.* These involve customized application of a variety of techniques to an input with the selection of methods based on feedback from the object. Low cause--effect knowledge exists and thus discretionary behavior is required to refine the treatment of inputs as work progresses. Such units are characterized by few standardized procedures and a predominance of problem-solving activity as, for example, in research and development functions and hospitals. (p. 16)

The overall results of the study confirmed Rousseau's expectations. She found statistically significant differences between job characteristics, employee satisfaction, and motivation across the three categories of technology studied. However, one of her findings was contrary to what was hypothesized and this prevented a clear demonstration of the influence of technology on job characteristics. *Mediating technologies* showed higher levels of skill variety, task identity, task significance, autonomy, and feedback than *intensive technologies,* the most sophisticated level of technology, which should have had the highest job characteristics values. These findings challenge the construct validity of the 3-level technological classification scheme as used in the study. The findings also call into question the sampling methods used in the study. For example, hospital nurses, whose autonomy and discretion in decision making are often in question, were included in the *intensive technologies* --the high employee discretion category, whereas those involved in bank credit and trust operations, who may have more relative autonomy than nurses, comprised the *mediating technologies* category.

Despite these methodological flaws, Rousseau's research confirmed the important influence of job design on behavioral outcomes and provided a useful test of the job characteristics-employee motivation relationship in work at different levels technological sophistication.

Salancik and Pfeffer

Salancik and Pfeffer took a less optimistic view of the ability of needs satisfaction models, such as Hackman and Oldham's "job characteristics model," to effectively explain the relationship between job characteristics and worker satisfaction. Salancik and Pfeffer (1977) examined needs satisfaction models of job attitudes and found that, despite their popularity and ubiquity in organizational psychology research, there have been few attempts to disprove needs satisfaction models through rigorous testing.

According to the authors, an important deficiency in needs satisfaction models is that they suggest that attitudes, such as job satisfaction, are a function of the presence or absence of positively valued job characteristics. The premise is that the higher the person's need for a certain characteristic, the higher the correlation between the presence of that characteristic and motivation or job satisfaction. Instead of asking people about their desired job characteristics and how much of each characteristic they perceive in their current jobs, these models ask people about their jobs, about job satisfaction, and about their higher-order needs (i.e., Hackman and Oldham's "growth need strength") which are presumably met by the various job characteristics that are measured. An interaction is presumed to occur between higher-order need strength and the relationship between job characteristics and job satisfaction, although this interaction has only rarely been explicitly tested through research. Job satisfaction measures are correlated with individual job characteristics, yet the determinants of job attitudes are not fully specified. Job attitudes could be a function of the number of job characteristics present; job characteristics could interact to affect attitudes; or some job characteristics could be stronger determinants of attitudes than others. The research the authors reviewed did not fully answer these questions.

Salancik and Pfeffer speculated that needs satisfaction models persist despite these theoretical shortcomings for three reasons: (a) needs satisfaction models are consistent with other theories of rational choice behavior, (b) needs satisfaction models are elegant and have aesthetic value that appeals to many researchers , and (c) needs satisfaction models offer the possibility of higher worker motivation if the proper constellation of job characteristics can be designed.

Hall, Goodale, Rabinowitz, and Morgan

Hall, Goodale, Rabinowitz, and Morgan (1978) studied the effects of changes in departmental and job characteristics on workers' perceived effort, psychological success, job involvement, job satisfaction, and performance in a Canadian transportation ministry operation. The author's most consistent finding was the negative effects of departmental changes on job involvement and job satisfaction. This finding was observed even when the workers reported that the departmental change was positive. Although positive correlations were found between changes in job characteristics and the dependent variables, these relationships did not hold up in a longitudinal analysis (i.e., after a ten month interval) of the same data. The authors' work suggests that changes at the departmental level have a greater effect on employee attitudes than do changes in employee's perceptions of their jobs. Because departmental changes have a direct effect on individual behavior, and a stronger impact on job attitudes than changes in job characteristics, the authors conclude that: (a) more emphasis should be placed on departmental and group-level processes, and (b) less attention is needed in the area of job enrichment.

Rousseau

Rousseau (1978) observed that organizational theory is adopting more of a systems perspective that views human behavior in the contexts in which it occurs, and is moving beyond a separation of micro approaches that assess individual differences from macro approaches that assess attributes of organizational settings. Since both micro and macro variables are relevant to employee attitudes and behavior, Rousseau's study challenged the traditional approach of examining attitudes and behaviors in relation to individual-level variables without also examining the organizational settings in which employee responses occur. Consequently, Rousseau combined the assessment of the attributes of organizational contexts with the assessment of individual differences in her study of the relationships of the characteristics of departments, positions, and individuals on employee attitudes and behavior.

Rousseau examined the characteristics of departments, positions, and individuals for nearly three hundred employees in nineteen departments of two organizations for their

effects on employee attitudes and behavior. She found that the effect of organizational position on an employee's attitudes and behavior appeared entirely attributable to the characteristics of the job he or she performed. Job characteristics also acted as mediators between departmental structure and technology and employee attitudes and behaviors. On the other hand, Rousseau found that job characteristics failed to explain the relationship of individual characteristics to attitudes and behavior, and suggested that it may be necessary to look outside the organization for a satisfactory explanation of this relationship. Overall, individual characteristics (i.e., need growth, need for role clarity, age, and sex) were the best predictors of employee attitudes and behavior.

Campion and Thayer

Campion and Thayer (1985) took a truly interdisciplinary approach to research on job design by integrating perspectives on job design from four different disciplines:

(a) a motivational approach from industrial/organizational psychology;

(b) a mechanistic approach from classic industrial engineering;

(c) a biological approach from work physiology and biomechanics; and

(d) a perceptual/motor approach from experimental psychology.

Campion and Thayer developed a corresponding taxonomy of job outcomes based on these four perspectives on job design. The most pronounced distinction (i.e., the widest difference in intercorrelations among the four perspectives) was between the motivational and mechanistic approaches to job design. The motivational and mechanistic approaches make nearly opposite recommendations in terms of job complexity and mental demands. The mechanistic approach strives to develop equipment and jobs that are simple, safe, reliable, and minimize the mental demands required of workers. Conversely, the motivational approach stresses that more challenging jobs with greater responsibilities are more rewarding to workers, and that more sophisticated job designs should be encouraged for this reason.

Campion and Thayer also developed a multimethod job design questionnaire (MJDQ) that reflected these four approaches to job design. They state that "most of the practical implications of this study relate to the use of the MJDQ in applied job design research"

(p. 40). Campion and Thayer emphasized the following practical uses of the MJDQ:

(a) to determine if problems exist with the design of jobs;

(b) to redesign jobs and help identify jobs that need redesign;

(c) to serve as a guide for job design recommendations during the work system development and evaluation phases.

As no single disciplinary perspective can account for all job design outcomes, the most valuable aspect of Campion and Thayer's study is likely its contribution of an interdisciplinary approach to this kind of research. For, as the authors state, "an interdisciplinary perspective is needed to integrate major theories of job design" (p. 39).

Gresov, Drazin, and Van de Ven

Gresov, Drazin, and Van de Ven (1985) developed an "organizational assessment model" of work unit design that offered a central hypothesis: optimizing the fit between *task contingencies* (i.e., task difficulty and task uncertainty) and work unit *structure* and *processes* will lead to increased worker job satisfaction. The organizational assessment model applies to both the low and high extremes of task difficulty and uncertainty. Low task difficulty and uncertainty presumably requires less task-related expertise, coordination, and interdependence among workers than high task difficulty and uncertainty. A work unit is the smallest collective group in an organization, and consists of a supervisor and all personnel who report directly to that supervisor. Work unit *structure* is the amount of employee and supervisor discretion in the work unit and the degree of work specialization and standardization reflected in the work unit. Work unit *processes* are written and verbal communication, the frequency of conflict, and the method of conflict resolution used by the work unit. Worker job satisfaction was assessed through written responses to questionnaires by both workers and their supervisors.

The "organizational assessment model" of work unit design was tested in 629 work units of Department of Labor unemployment offices in California and Wisconsin. Results provided support for the contingency effects of task variability and work unit design optimization on worker job satisfaction. That is, optimizing the fit between task difficulty *and uncertainty and work unit design variables resulted in higher reported job satisfaction,*

Loher, Noe, Moeller, and Fitzgerald

Loher, Noe, Moeller, and Fitzgerald (1985) used meta-analysis procedures to statistically determine the relationship between job characteristics and job satisfaction, and to test the role of growth need strength as a moderator variable in the job characteristics-job satisfaction relationship. The authors examined 28 studies that addressed the job characteristics-job satisfaction relationship and that explored the role of growth need strength as a moderating variable in this relationship. Meta-analysis procedures were used to estimate the "true" relation between these variables by identifying the extent to which variance in observed correlation coefficients across the studies was due to statistical artifacts such as sampling error and unreliability in measurement.

Loher, Noe, Moeller, and Fitzgerald obtained moderate support (a correlation of .39) for the overall relationship between job characteristics and job satisfaction. The correlation between each of the core job dimensions (i.e., skill variety, task identity, task significance, autonomy, and feedback) and job satisfaction ranged from .32 (task identity) to .46 (autonomy). The study's most interesting finding involved the role of growth need strength and revitalized its importance as a moderator of the job characteristics-job satisfaction relationship. The relationship between job characteristics and job satisfaction was stronger for employees higher in growth need strength. However, for low growth need strength employees, certain external situational characteristics (e.g., work group or management support for job enrichment activities) appeared to be more important than growth need strength in determining job satisfaction.

Work Design and Work Reengineering

This section addresses two distinct views of work design: the traditional *industrial engineering* approach to designing work and the contemporary notion of *work reengineering*. Industrial engineering in primarily concerned with the design of work from a physical requirements perspective. Workplace layout, the flow of information and materials, and the man-material interface are important engineering variables to be

integrated to maximize the efficiency and reliability of work systems. The newer domain of work reengineering is more broadly applied to the entire organization and takes a top-down approach to how the corporation ought to be structured for the most efficient and effective achievement of future business objectives. The domains of industrial engineering and work reengineering are examined together in this section because their effects on work design are predominantly structural. Although the scope of the work to which each is applied differs, both approaches to work design seek to alter the structure of work to improve efficiency. The first part of this section examines the influence of industrial engineering on work design. The second part of this section presents perspectives on work reengineering and the design of work.

First, the industrial engineering approach to work design is explored in two ways. The philosophical and historical context of industrial engineering is introduced through an observation on the philosophical orientation of the industrial engineers, a look at the developments that shape an industrial society, and a review of the early contributions of Frederick Taylor to industrial engineering. Then, some basic concepts of the engineering design of work are examined.

The design of work from an engineer's perspective is quite different from that of the behavioral scientist. The industrial engineer uses formulas, flowcharts, and production functions to maximize the reliability and efficiency of performance from a physical requirements perspective. The behavioral scientist is more likely interested in maximizing the job incumbent's motivation to work on the job for reasons associated with the job itself. The first part of the discussion of industrial engineering addresses the philosophy and history of engineering approaches to work design. The section begins with an observation by Finch (1960) that contrasts how basic scientists and engineers differ in the philosophical orientations that guide their work. Finch also identifies basic conditions necessary for the development of industrial society. The section concludes with a summary of the contributions of Frederick Taylor to the early development of industrial engineering.

The second part of the discussion of industrial engineering provides an overview of some basic concepts of work design from the engineer's perspective according to Konz (1979). Konz describes the kinds work design problems that engineers address and

provides a generic problem solving method that engineers use to arrive at a solution. In addition, two concepts that influenced the development of the engineering design field, *method and time measurement* and *evolutionary operation of processes*, are described.

Finch

Finch (1960) makes a distinction between the overall role of the basic scientist and the role the engineer in terms of the most basic question each asks. The basic scientist asks "Why?" whereas the engineer asks "How?" Those engaged in basic scientific inquiry have long maintained that those who seek to discover new scientific understandings with useful or practical applications are doomed to disappointment. The basic scientist pursues science for science's sake and finds rewards in the discovery of further knowledge of nature and nature's laws. The engineer's approach is exactly the reverse. The engineer's purpose derives from the goal of effectively and efficiently meeting the material needs of civilized life. Finch characterizes the value of scientific inquiry to the engineer as follows:

> The findings of science have value to him only to the extent that they enable him better to meet his professional obligations. He is the "doer," spurred on by the creative instinct in man but laboring under the limitations imposed by the material, human, and technical resources at his command and the social demands of his day. (p. 524)

This important distinction is made as Finch concludes a comprehensive historical survey of engineering and its accomplishments that began with the Great Pyramids to modern skyscrapers.

Certain conditions must exist in modern society as the foundation upon which industrial innovations evolve. According to Finch, the conditions necessary for the development of industrial capacity are *specialization of labor, mechanical and electrical power, standardized and interchangeable parts, the assembly line,* and *mass production and mass consumption.* Each of these conditions is briefly examined next. Ultimately, they come together as conditions vital to the development of an industrial society.

It is not commonly recognized that the notion of *specialization of labor* is an idea that had as much utility in antiquity as it does today. Ancient building construction, food production, and boat manufacturing benefited from the efficiencies of a specialized

workforce. As society has become more technologically advanced, the specialization of labor has become more widespread. Yet, the notion of specialization in the labor force is nothing new. The social benefits of having those with specialized expertise in a variety of fields has been long recognized.

Prior to the Industrial Revolution, power came from harnessing the potential energy in wind, water, and human and animal strength. Horse-drawn vehicles, windmills, and waterwheels were basic sources of energy. Yet, not until the introduction of *mechanical and electrical energy* made possible by the internal combustion engine and electric motor could we achieve enormous magnification of physical effort. Today the telephone and computer continue this magnification of energy in ways that go beyond increasing physical effort.

The value of *standardized and interchangeable parts* for manufacturing was not appreciated until accurate machine tools could be made to achieve the precision necessary to produce such parts. Standardized parts were first used in England in the early 1800's for shipbuilding components, and later in the century they were used in the United States for textiles, clock making, and gun manufacturing. The diffusion of standardized and interchangeable parts throughout manufacturing occurred slowly. Initially there was fear that standardization would mean that there would be no choices (e.g., original Model T Fords were only available in the color black). Due in part to the efficiencies achieved over the years in manufacturing standardization, today many feel that, if anything, there are too many choices in products!

Once these three capabilities--specialization of labor, mechanical and electrical power, and standardized parts--were available, they were brought together to form the most significant innovation in the history of industrial engineering--the *assembly line.* Unlike prior methods of production and construction where workers and machines were moved around the product, assembly lines enabled products to be systematically moved past sequences of workers and machines. The assembly line was the culmination of the three prior capabilities, and the assembly line, in turn, enabled the development of the last phenomena of industrial society--*mass production* and *mass consumption.*

Mass production and *mass consumption* are mutually reinforcing--one will not continue without the other. Without mass production product costs are too high, and consumption is inhibited. The mass consumption concept was first studied by early economists who realized that even large numbers of people with low incomes would not stimulate growth in production-consumption cycles--potential customers needed at least the wealth to afford basic purchases. Henry Ford acknowledged that without purchasing power the masses would not be able to buy products, and ultimately, manufacturers would not be able to sell them. With this in mind, he doubled the wages of his employees at all levels of production. Ford's ideas about how to achieve major efficiencies in manufacturing were built upon newly developed principles for increasing worker efficiency and effectiveness studied by Frederick Taylor.

Taylor

After twenty years of analyzing work tasks and fractionating jobs, Charles Babbage was the first to provide systematic observations of how jobs could be deliberately fractionated so that unskilled people could do it. Sixty-five years later, Frederick Taylor (1912) rediscovered what Baggage had originated a hundred years earlier and developed his own methods of breaking down work tasks to achieve "scientific" efficiencies in the use of men and machines to accomplish work. Taylor's *scientific management* paved the way for mass production technologies and provided the present basis for organizing industrial work throughout the western world.

Frederick Taylor gained extensive practical experience by working his way up from a part-time clerk to the chief engineer in a steel company. At the same time, he studied engineering in night school and eventually received an engineering degree. This combination of practical experience and theoretical study proved quite beneficial to Taylor. His seminal work on *scientific management* grew out of his ability to link theory with practice. Taylor's approach to analyzing and designing work began with a basic question that he directed at all types of production tasks, regardless of how they were configured. He simply asked, "What is the best way to do a job?" (Taylor, 1912).

Engineers and inventors in the late nineteenth century provided advanced tools and machines for the factories of the emerging industrial era. Machine operators were used to having discretion in the maintenance and operation of their machinery. New machinery was being used by operators who had only been used to older methods. Yet, little had been done to improve the efficiency and effectiveness of how workers used the new machines at their disposal. Taylor's principles of scientific management addressed this need. He realized that in order to increase the efficiency of production tasks, all the major elements of production would have to be addressed. This meant not only the workers and the machines, but those who managed these production elements as well.

His conception of the ideal production system was far more comprehensive than other inventions and innovations of the industrial era. For the first time he combined work measurement techniques, instructional aids for those performing specific tasks, and incentives for meeting preset performance goals in a way that improved work efficiency. Taylor felt that both the physical structure of the work *and* the motivational needs of the workers would have to be addressed simultaneously if significant gains in productivity were to be achieved. In addition, Taylor's scientific methods included: tools and methods for conducting *time studies* of work; *functional foremanship* for specialized supervision versus the old-fashioned single foreman; *standardization* of all tools and equipment used in the plant; the importance of a function dedicated to planning work; and a modern *cost accounting* system to measure work efficiencies.

In the next section Konz' work is reviewed to provide an overview of the methods engineers use to design work and of the kinds of design problems to which these methods are applied. Two concepts that Konz highlights as important to the design of work from the industrial engineer's perspective, *method and time measurement* and *evolutionary operation of processes,* are also described.

Konz

Konz' work is a comprehensive outline of the fundamental principles of industrial engineering used for work design. Industrial engineering takes a normative approach to the way work should be designed and seeks to integrate physical, mechanical, and ergonomic

factors in ways that maximize production efficiency and systems reliability.

Konz organizes the levels of work design from the engineer's perspective from macro- to micro-level considerations. At the broadest level, engineers analyze the overall organization of work among plants and facilities. Then, engineers must consider the layout of departments and intra-departmental workflow, followed by the physical design of workstations. Next, the biomechanics and anthropometry of the worker-workplace interface is considered. And finally, the engineers must design the smaller forms, tools, and other hand-held objects needed for work. According to Konz, work design engineers are responsible for analyzing, and if necessary, integrating design considerations across *all of these work levels* to insure coordinated and efficient patterns of productions. Konz offers a five-step method for addressing work design problems derived from the scientific method to assist engineers in achieving this goal. The five steps of the method are: *define* the work design problem; *analyze* work design needs, constraints, and resources; *develop* options for patterns, sequences, and layouts of work; *evaluate* design options; and *specify* work design solutions.

Konz emphasizes two additional concepts that are important for designing work from the industrial engineer's perspective: *method and time measurement* and *evolutionary operation of processes.* Method and time measurement is the process of breaking a work task down into its most fundamental elements, assigning time values to each element, and summing the element times to arrive at a total time to accomplish the task. Evolutionary operation of processes is a way of thinking about the work process as producing not only the product, but also important information about how to improve the way the product is produced. Each of these concepts is briefly described next.

Method and time measurement (MTM) is a form of operations analysis that consists of breaking down any manual task or method into the basic motions required to perform it, assigning predetermined time values to each motion based on the nature of the motion and the conditions under which it is made, and specifying the total time required to perform the entire task or method (Niebel, 1972). Two separate forms of industrial engineering analysis, *motion studies* and *time studies,* contribute to the computation of summary time values for the performance of tasks. *Motion studies* analyze the physical motions that

constitute a task for the purpose of improving the motion patterns by shortening the effective motions or eliminating the ineffective motions. The basis for motion studies was established by Frank and Lillian Gilbreth who originally analyzed the work of bricklayers to improve their productivity. They were primarily responsible for demonstrating the importance of rigorous analysis of the actions of workers to improve the overall efficiency of performing physical work. They coined the term *therbligs*-- the 17 micro motions (e.g., select, grasp, reach, move, and release) into which all physical motions can be broken down. They also emphasized the importance of instructing workers in the best method of performing a task or operation. *Time studies* attempt to establish a time standard for the performance of a discrete task. Time studies are based on analysis of tasks performed by experienced workers under normal production conditions. Specific criteria have been developed to define worker *experience, normal* conditions, allowances for *fatigue* and *unavoidable delays,* and other variables necessary for producing reliable time measurements.

Evolutionary operation of processes (EVOP) is the simple yet powerful notion that a work process actually produces two things: a product for sale and information about the process that can be used to improve it (Konz, 1965). The significance of EVOP to work design at this time was twofold. First, the product was not the only thing of value generated by the process. Information could be gathered and analyzed for the purpose of improving the efficiency of the process. (The concept of EVOP was first introduced by Box and Hunter (1957), and although this notion is similar to the statistical study of process variation pioneered earlier by Walter Shewhart, these developments proceeded independently.)

Secondly, and of more significance to the study of work design, there was the realization that production of saleable products would not have to be disturbed in order to generate useful information about the process. Care would simply have to be taken to avoid interfering with the production process when making changes in process variables. The power of the EVOP notion of experimentation was that, if process changes were properly designed, valuable information for improving processes derived from

experimentation could be generated at little or no cost since the production of useful products would not be interrupted.

Industrial engineering in primarily concerned with the design of work from a physical requirements perspective. It focuses on workplace layout, the flow of information and materials, and the man-material interface as they contribute to efficient and reliable work systems. The newer domain of *work reengineering* is more broadly applied to the entire organization and takes a top-down approach to how the corporation should be structured for the most efficient and effective achievement of business objectives. The work reengineering approach to work design is examined next through a review of four recent works on the topic. Each of the four works takes a different view of the work reengineering's purpose and methods. These works are reviewed in the order in which they were published, with earlier works examined first.

McLagan

McLagan (1990) offers an approach to flexible job modeling that "focuses on outputs (products, services, programs, information) as the *major* building blocks of organization design, rather than positions, organization structure, or type of technology" [italics in original] (p. 369). Job design based on outputs, rather than the traditional structure of the position, the expertise of the job incumbent, or the technology used to perform the job, represents an important and potentially controversial departure from current approaches to job design. Assigning or reassigning outputs to jobs based on the organization's current or future needs allows organizations the flexibility to pursue competitive business strategies, but it also requires those at all levels of the organization to use a broad range of skills and incentives to perform jobs that may change as the organization and its business environment change. McLagan takes an open-systems view of organizations and the environment, and challenges organizations to adopt a flexible job design approach if they wish to meet future organizational requirements.

The adoption of flexible job modeling promises the user five major products. First, it requires the development of a statement of assumptions about the current and future context within which the business must operate or jobs must be designed. The statement of

assumptions becomes a major source of information for describing the work that must be done within jobs. Second, output menus are produced that specify the desired outputs from a group or function. Output menus list all the products, services, programs, and/or information that the organization must provide, or that people within the organization must exchange if the organization is to meet its business goals. Third, competency menus must specify the knowledge, skills, and abilities required to produce the outputs. Panels of experts can be used at this stage (and during each of the other four components of flexible job modeling) to derive the required competencies through a series of carefully structured expert judgments about the capabilities needed by people to produce the outputs. Fourth, generic job or role models are produced. These are general descriptions or frameworks for a role or job that specify "the outputs and the competencies that are the most likely and generally desirable requirements of people in that role or job" (p. 375). Finally, the individual job model is developed. As the term for this approach to job design suggests, the individual job model is flexible in that it allows individuals to shape their jobs as they increase or reduce the scope of their output responsibilities.

McLagan has accomplished an important objective in the short space of a book chapter. She has stimulated the fundamental rethinking of the basis upon which job are designed at a time when the structure of jobs and the nature of work are undergoing profound change. Scholars and practitioners of all the many fields served by work analysis and job design cannot afford to ignore the innovative approach to job design that McLagan offers.

Rummler and Brache

A great deal of attention has been given to developing models for improving work performance in organizations in recent years. A theme that occurs frequently in these models is the delineation of "levels of performance" within the organization as a way of organizing performance improvement strategies. Performance improvement strategies that are organization-wide are far broader and more long-term than those focused on the process or individual levels. More than any other authors in recent years, Rummler and Brache can be credited with bringing the notion of improving performance at the organization, process, and individual levels to the forefront of the discussion about performance improvement.

The book describing their model for improving performance at the organization, process, and individual levels is already a classic (Rummler & Brache, 1990).

The book takes a practical, step-by-step approach to diagnosing performance problems at the organization, process, and individual levels that one might expect from authors who draw on more than forty years of combined experience as consultants specializing in the design and development of organization performance systems. They acknowledge that, although most managers understand the performance problems they face, they fail to understand the important variables that enable performance at the organization, process, and individual levels. To address this need, Rummler and Brache offer a comprehensive model for improving performance in organizations at the three levels of organization, process, and individual that is carefully explained and illustrated with examples drawn from the authors' consulting experiences.

Rummler and Brache take a systems perspective on improving performance, and start with the premise that one cannot improve performance within any single level of the organization without addressing the performance needs within the other two levels. The authors have formulated key questions to be answered at the organization, process, and individual levels of performance that address the goals, design, and management of performance at all three levels. To use their model, one must systematically analyze the performance goals, work design, and performance management at all three levels of performance. Although this involves collecting a great deal of data that must be integrated from level to level, Rummler and Brache clearly explain how the pieces of their model fit together and what to expect if their model is effectively applied.

Although Rummler and Brache base very little of their work on research, their model for improving performance provides a rich framework from which to formulate testable hypotheses about improving performance in organizations. A number of theories of organizational behavior, process improvement, and individual performance could be applied and tested within the Rummler and Brache model. The current lack of research base for the model should not prevent it from being studied and applied, for scholars will largely recognize where the model comes from.

Nadler, Gerstein, and Shaw

Nadler, Gerstein, and Shaw (1992) take a systemic view of the structure of organizations and the ways in which organizational structure is changed. The authors start from the premise that those interested in changing the organization's structure, the organizational designers, effect change to improve organizational effectiveness. The authors maintain that, if design change is to have this effect, organizational designers must attend to design change within three major dimensions of the organization--the *formal organization,* the *informal organization,* and the *design of senior management.*

This review of the authors' work is focused primarily on designing the *formal organization.* The formal organization is the term the authors use for all the functions, processes, and methods that are formally created to induce people to perform the work tasks needed by the organization. Organizational designers must also attend to the other two major dimensions of the organization--the *informal organization* and the *design of senior management.* The *informal organization* is reflected in the values, norms, and informal patterns of communication and influence among people in the organization. The *design of senior management* addresses issues including the selection of managers, the development of executive teamwork, and the design of effective management processes. Lasting design change will occur only if organizational designers simultaneously shape the *formal, informal,* and *senior management* design dimensions of the organization.

The importance of following the authors' comprehensive design strategy which includes the formal, informal, and senior management design dimensions of the organization cannot be overemphasized. However, it is within the authors' notion of the "formal organization" that we find the work tasks, work flows, and structural components that form the organization's basic work systems. Work design efforts at this level are directed at the organization's most *basic* work units--the teams of people and resources that are the building blocks of Nadler et al's "formal organization." Because the authors' specifications for organizational design at this level--the level of the basic work unit--is most relevant to this study, this review will focus primarily on the authors' "formal organization."

In developing a model that is useful for designing organizations, Nadler, Gerstein, and Shaw acknowledge the challenge of finding meaningful ways of describing organizational processes, simplifying complex workplace phenomena, and identifying patterns in what often seems to be random work activity. To address this challenge, they begin their model by laying a conceptual foundation that characterizes the organization as having four essential components. These components help explain how organizations transform all of their resources and energy from inputs into outputs. These essential components are work, people, the formal organization, and the informal organization. Each of these components and their interrelationships are briefly described next.

The four major organizational components. *Work* is the basic tasks to be done by the organization. The authors emphasize the importance of defining work in specific terms and in a way that describes its inherent characteristics. (Although the authors do not specifically define what is meant by the "inherent characteristics" of work, they emphasize the importance of work analysis that describes basic tasks, work flows, the critical time demands of work, and cost constraints inherent in the work itself. The authors state that these aspects of work are more important than "the characteristics of work resulting from how the work is structured in a particular organization at a particular time" (p. 49)]. Task analysis procedures are used to describe basic work (what specifically people *do)* and work flows (how work tasks are *interrelated).* Additional relevant features of the work include the knowledge and skill required to perform the work, the rewards inherent in the work itself, and the performance outcomes of the work (given that the work contributes to a business strategy).

People are those who perform work tasks. The authors emphasize that this component should identify the characteristics of employees that are relevant to how they accomplish the work. In addition to demographic factors such as age, sex, and ethnic/cultural background that influence work behavior, individuals come to work with sets of needs and preferences, knowledge and skills, and perceptions and expectations that are important variables to be considered in the design of work. Designers of work should try to maximize the fit between individual capabilities and the performance demands of work tasks.

The *formal organization* is composed of the various structures, processes, and methods that are formally created to induce people to perform work tasks. The formal organization has traditionally been structured around groups of people and resources brought together to accomplish specialized functions. These structures are often formalized and depicted on an "organizational chart." Other examples of the formal organization are accepted channels of communication, budgets for controlling the use of resources, the physical work environment, and a system of rewards and incentives for achieving organizational goals. The organization's most basic work unit--the teams of people and resources used to accomplish essential tasks such as designing, producing, and selling products--are the building blocks of the authors' "formal organization."

The *informal organization* is less tangible than the structures and systems of the formal organization. Despite any given set of formal methods or channels for accomplishing the organization's work, another set of arrangements tends to emerge over time that is usually implicit and undocumented. The informal organization primarily evolves through informal patterns of communication and influence between and among people. Although all organizational members potentially contribute to establishing the norms, values, and climate of the organization, those in leadership roles are especially influential in shaping the informal organization. Also called the organizational culture, the informal organization may complement the formal organization and strengthen formal initiatives to achieve the organization's goals, or having developed as a reaction to the formal organization, it may work against the formal organization and operate in ways that hinder organizational performance.

Nadler, Gerstein, and Shaw acknowledge that there are other equally valid ways to describe the essential components of organizations. Yet, it is less important what these components are called, they maintain, than how the components interact and work together to produce the distinctive outputs of the organization. Consequently, they emphasize that designers of organizations must attend to the *congruence* or fit among these components if organizations are to be structured for optimum effectiveness. The authors maintain that the greater the total degree of congruence among these four components of an organization, the more effective the organization will be. They define effectiveness as the degree to which

actual organizational output is similar to planned or expected output as specified by organizational strategy.

Designers often sidestep the challenge of achieving congruence among organizational components, and instead, take an easier route such as designing the technical system to match the capabilities of people, or fitting people to the system. The authors maintain that meeting the challenge of achieving congruence is easier if organizational designers have a meaningful way of thinking about how the process of organizational design occurs. They address this need by offering designers several work design principles and a process to apply them.

Work design principles. No lasting change in the organization's work design can be made without attending to the interdependence among the organization's basic components--the work, people, formal organization, and informal organization. To assist designers in achieving congruence or fit among these, the authors drop down to the level of first component--the essential *work* the organization must accomplish at the level of those who perform it, and examine this component in detail. They offer a prescriptive method for designing work systems in a way that integrates the work, the people doing it, and the necessary information and technology for accomplishing work. Designing work in this way results in what the authors call *high performance work systems* (HPWS). This term is used because these types of systems achieve high performance in terms of effective responses to customer requirements and other environmental demands and opportunities. The authors' design method for achieving HPWS is composed of several *principles* for designing work systems and a *process* for applying these principles. This section examines the work design principles, and the next section describes the process for applying them.

The authors describe ten design principles. Three of these principles address broad issues such as the organization's management structure and management planning systems. Two other principles emphasize the need for customer- and environmentally-focused designs for work. While these five principles are relevant to the overall design of organizations and major business processes, the authors provide five additional design

principles that offer more specific guidance for the design of work at the level of work tasks, work flows, and basic work systems. The design principles described next are these latter five design principles that address the design of work at the level of the organization's most basic work unit--the teams of people and resources that are the building blocks of the authors' "formal organization."

The first design principle specifies that organizational units are best designed around complete units of work--complete products, services, or processes--where a set of employees is responsible for all aspects of how they will do the work. Teams, rather than individuals, are the basic organizational building blocks. Rather than breaking work down into the smallest units that can be performed by an individual, the team decides how individual and collective effort will contribute to the work outcomes for which the unit is responsible. This design principle, which the authors call *empowered and autonomous units,* seeks to maximize interdependence within work units,while minimizing interdependence among work units. Although coordination among separate work units is still necessary, the goal is the creation of loosely linked units which are capable of managing their own intra-unit relationships. As the name implies, empowered and autonomous units require minimum specification of the methods and resources to accomplish work, such as time, money, information, and decision making authority.

The design principle of *control of variance at the source* fits well within the notion of empowered and autonomous work units. Consistent with principles of continuous quality improvement, the authors maintain that work processes should be designed in such a way that errors and quality problems can be detected and remediated at the source, rather than outside the work unit. Proponents of continuous quality improvement have long maintained that it is much less costly to detect and correct variance at the source than later on. Work designed in such a way requires that those working in the unit be provided with the information and resources to detect variance, and be empowered to take action to maximize the quality and consistency of the work unit's output.

Socio-technical integration is a work design principle that emphasizes the effective integration of the social and technical components of work. The organizations's *social system* is composed of individuals and groups that, while engaged in productive

interaction to achieve the goals of the organization, also seek to derive personal satisfaction and fulfillment from their work. The *technical system* includes the flow of information and materials and the specific methods and technologies used to produce desired outcomes. Rather than select people who are well suited to work with the technical system, or design the technical system specifically for the people, the goal of *socio-technical integration* is is to achieve joint optimization between the two elements for work designed to meet both worker and environmental needs.

The design principle of *enriched and shared jobs* combines the desirable characteristics of work identified in the work design research of Hackman and Oldham (1980) with the benefits of cross-training. Jobs designed so that workers have broad responsibility for task accomplishment lead to greater job satisfaction and internal motivation for work. In addition, as individuals understand the nature of the work performed by others, their ability to participate in the design and management of the entire work process is enhanced. Those who understand how work functions interrelate and who are cross-trained in a variety of skills enable the work system in which they operate to achieve an important dynamic: the capacity to reconfigure.

The *capacity to reconfigure* is a characteristic of work design that should result from the application of the preceding work design principles. Work units that are truly empowered and autonomous should be capable of collecting relevant information, formulating plans of action, and identifying the consequences of actions on their work and on related processes across the organization. These capabilities enable work units to reconfigure--to change their basic structure and work methods--in response to changes in customer requirements and environmental opportunities. The capacity of work units to reconfigure is an important design feature of organizations seeking to enhance their competitiveness.

A process for work design. These principles of work design are applied through a *process* for designing work which the authors acknowledge is similar to work design processes developed by other designers of high-performance work systems. Processes for designing work, including the design process of Nadler, Gerstein, and Shaw, follow a consistent logic and sequence. They all include steps for analyzing, designing,

implementing, and improving the work system. More than other designers, however, the authors emphasize that analyzing the work system should focus on a precise description of the work tasks and work flow and should address the inherent requirements of work, as opposed to the work requirements resulting from how the work is structured in a particular organization at a particular time. For as the authors state, "Because we organize to get work done, it is critical to understand the nature of that work" (p.49).

Because even new, innovative work systems can become rigid and unresponsive over time, it is important that the design process has a built-in capacity to shape and reconfigure the work design as customer requirements, work technology, and other environmental factors change. Therefore, the final step of the design process--improving the work system--is a continuous activity of assessment and reflection for the purpose of reconfiguring work systems over time.

A model for organizational design. The authors maintain that organizational designers should design work systems that achieve high performance in terms of meeting customer requirements and responding to environmental opportunities. Designers can produce *high performance work systems* when congruence is achieved among the people, technology, information, and other resources that must come together to accomplish work. To assist designers in creating these work systems, the authors offer work design principles and a process for applying them.

Yet, without a full appreciation of how the authors frame their organizational design model, it seems too simplistic and prescriptive for a methodology directed at the complex process of effecting structural change in organizations. It might seem that designers need only incorporate the design principles as they follow the design steps in order to bring about a fundamental change in the organization's structure.

Fortunately for those who seek the concrete guidance provided by the authors' model, but who also appreciate the complex realities of contemporary organizations, the authors place their prescriptions for work design within a much broader framework for organizational change. Lasting change in the overall design of organizations only occurs

when designers attend to the *formal organization,* the *informal organization,* and the *design of senior management.*

This review of the authors' work is focused primarily on designing the formal organization. Yet, as emphasized previously, organizational designers must also attend to the other two major dimensions of the organization: the *informal organization* as reflected in the values, norms, and informal patterns of communication and influence among people in the organization; and the *design of senior management*-- the selection of managers, the development of executive teamwork, and the design of effective management processes. Lasting design change will only occur if organizational designers simultaneously shape the *formal, informal,* and *senior management* design dimensions of the organization.

Hammer and Champy

Of the models of work redesign reviewed for this study, Hammer and Champy (1993) offer by far the most radical approach to the reorganization of work. They encourage business executives seeking to redesign work in pursuit of improvements in work quality, service, and speed to start over by literally redesigning work from scratch. Their "no holds barred" approach to work reorganization extols top managers to completely scrap existing structures for organizing work, and employ their techniques for fundamentally *reengineering* how the organization structures work. They define *reengineering* as "the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical contemporary measures of performance, such as cost, quality, service, and speed" (p. 32).

Although Hammer and Champy agree with proponents of total quality management (TQM) that focusing on work *processes* offers the most fertile opportunity for improving work quality and efficiency, several features of work reengineering set it apart from the TQM approach to process improvement. Hammer and Champy characterize their approach to work reorganization as "fundamental," "radical," and "dramatic." Those exploring new work designs should take nothing for granted and literally ignore existing patterns of work organization. The radical redesign of work means disregarding current structures and procedures, and reinventing completely new ways of accomplishing work. To offer

dramatic improvements in work performance, efforts to reengineer work must go beyond the incremental improvements of TQM and cut right to the core of an organization's most basic business requirements. "Dramatic improvement," the authors state, "demands blowing up the old and replacing it with something new" (p. 35).

Hammer and Champy offer principles for designing "something new"--the reengineered business process. Most business processes that have a linear, assembly line pattern can be streamlined to eliminate the multiple "handoffs" between workers as parts of a project are processed by one worker and then passed along to next worker for further processing. Guided by a more efficient flow for the process, formerly distinct jobs and tasks are integrated and combined into one job. This integration of tasks and streamlining of the process eliminates the errors, delays, and rework that are associated with having different people do different parts of the same process. It also means that the same process is now accomplished by fewer people. When it is not possible to combine steps of a lengthy process or the steps must be processed in different locations, the process may be reshaped to reflect a *case work* format. *Case work* allows a single person, the case manager, to provide a central coordinating function for lengthy or geographically-dispersed processes. The case manager also facilitates the sharing of information and resources among related processes, and most important from the perspective of the ultimate consumer, provides a single point of contact for questions and concerns from the customer.

Of course, in order for this kind of reorganization of a process into fewer jobs--what Hammer and Champy call the *horizontal* reorganization of work--*vertical* reorganization of work must also occur. That is, those employees who remain to accomplish the process after jobs are eliminated must deal with broader issues and make more decisions. The vertical reorganization of work means that, at the points in a process where workers used to consult those further up in the management hierarchy for the answers to problems, workers now must make their own decisions.

The streamlining of business processes to eliminate having different people do different parts of the same process cannot be done without reorganizing work *across* traditional organizational boundaries. Most work in organizations is still organized around functional specialists in the offices and on the factory floor who work within specialized departments,

such as accounting, marketing, and manufacturing. These departments, which are still the most common units into which the functional capabilities of a business are organized, are referred to by the authors as "functional silos" to reflect the constraints departmental boundaries have traditionally placed on the flow of work across the organization. To get beyond the narrow, departmental perspective of those working within "functional silos," work must be reorganized *across* traditional departmental boundaries.

For example, processing customer orders for products can be reorganized into a single cross-functional process that eliminates the need for people in separate departments to perform separate tasks to insure that the customer receives the order. A cross-functional process for "order processing" integrates separate tasks formerly accomplished within separate departments: writing customer orders (Sales), locating products (Inventory), generating replacement products (Manufacturing), delivering products to customers (Shipping), and producing invoices for billing (Accounts Receivable). Reorganizing work across departmental boundaries emphasizes the primary importance of organizational and customer requirements, rather than departmental goals, and improves the overall performance of key business processes.

Although Hammer and Champy emphasize that major opportunities for improving work quality and efficiency can be realized through the reengineering of business *processes,* they point out that these gains cannot be achieved without redesigning the jobs and organizations that support reengineered processes. The authors admit that the dramatic improvements in performance achieved through reengineering will not occur without strong direction from the top of the organization and a willingness to undergo a dramatic change in the organization of work. Those who redesign the work must realize at the outset that they cannot possibly undertake "radical" reengineering of work without making anybody unhappy. However, the authors understate the human price to be paid for the benefits of reengineering. They say, "Reengineering isn't to everyone's advantage. Some employees do have a vested interest in current operations, some people will lose their jobs, and some workers will be uncomfortable with their jobs post-reengineering" (p. 212).

Indeed, each of these three certain side-effects of reengineering on the organization's people involves a substantial cost that management may not feel it can incur to achieve a

more efficient organization. Yet, aside from warning that there will be stiff resistance to reengineering efforts and that those who remain after reengineering will need training to handle the increased responsibilities they have, the authors offer little to address the fundamental adjustments that people face in the wake of reengineering. Employees must adjust emotionally to a major reduction in the workforce and adjust technically to an increase in work that is invariably more sophisticated than their pre-reengineering work. Ultimately, the efficiencies of reengineering translate into the necessity of doing more with less--less time, scarcer resources, and fewer people.

Process Analysis and Process Improvement

The literature reviewed in this section has been organized and grouped into three areas of process analysis and process improvement that have relevance to this study. First, the concept of a work *process* will be defined. Then, process analysis and process improvement will be addressed by examining the basic techniques used to study and improve processes. Finally, a variety of organizational structures and practices used to pursue process improvement goals that have appeared in recent literature will be reviewed. Because of the logical development of ideas that this organization of the literature allows, the literature in this section is not reviewed by author, as it has been in previous sections of the "Review of the Literature."

What is a Work "Process"?

Schultz and Schroeder (1990) define a *process* as "a collection of cause factors which can be translated into a sequence of tasks, activities, or functions to produce a given output. The cause factors typically include people, machines, materials, methods, and environment. The translation of these cause factors leads to various stages of the process. Each of the stages could itself be considered a process" (p. 2). Schultz and Schroeder consider the people, machines, materials, methods, and environment as inputs to the process. They also recognize that a process can be composed of various stages, with each

stage itself considered a process. These dimensions of Shultz and Schroeder's definition--the *inputs* to a process and the *stages* or *component processes* that constitute the overall process and the *outputs* --can be illustrated using the example of the process of running a printing press.

In printing operations, running a job on a printing press is a production *process* that uses inputs, is composed of component stages, and produces outputs. The major inputs for the process of running the press include the press operators, the press, the paper, the ink, and the "plates" that carry the images to be printed, the methods and techniques used to operate the press, and the environment within which the press is operated (the immediate environment is the "pressroom"). Although the emphasis in press operation is on performing the press run itself (when the ink literally meets the paper), the printing process is composed of component stages, one of which is the crucial "makeready" stage during which the press is *made ready*--that is, prepared, for the press run. The "makeready" process is itself an important stage or component process of the larger process of operating the press. The outputs of press operation are printed products.

Running a printing press is a process that occurs predominantly in a single functional area. That is, although the inputs to and outputs from press operation link it with adjacent functional areas (i.e., inputs to the press may come from a Pre-Press operation and printed outputs may continue along to other operations for further processing), nearly all of the work of operating the press itself occurs within the functional area of the pressroom. Similarly, in the restaurant industry, the process of food preparation in a restaurant is predominantly a function that occurs in the kitchen, even though major inputs for preparing food (e.g., customer orders for food and the unprepared food itself) originate in other areas. Food preparation predominantly occurs in a single functional area, the kitchen. Baggage handling for the airlines is another process that may be initiated by those who are not primarily baggage handlers (i.e., the agent at the check-in counter), yet the bulk of the work of baggage handling is done by those who work within the baggage handling process. These examples all involve fairly discrete work processes that occur predominantly within a single functional area. Yet, these three examples illustrate work processes that are essentially linear processes of modest size. Larger, more complex work

processes often cross the boundaries between functional or departmental units in organizations.

Work processes vary in size and scope. Work processes in contemporary organizations are becoming more sophisticated and increasingly cut across the boundaries of separate organizational functions. Although relatively small, discrete processes continue to occur within single functional areas, such as those mentioned above, major processes such as customer order processing and new product development require activities that draw on multiple functional areas. Davenport's (1993) definition of a process reflects this cross-functional dimension. He defines a process as "a structured, measured set of activities designed to produce a specified output for a particular customer or market. . . . A process is a specific ordering of work activities *across time and place* [italics added], with a beginning, an end, and clearly identified inputs and outputs: a structure for action" (p. 5). Davenport's notion that work activities can span "across time and space" is an important dimension of a *process* in contemporary work organizations. It expands the scope of a work process beyond its traditional locus within a single functional area. Indeed, the definitions of *process* offered by both Schultz and Schroeder (1990) and Davenport (1993) indicate that work processes vary in their size and scope.

Work processes can range from the relatively small, discrete processes that are accomplished within a single functional area to more elaborate processes that span "across time and space," that is, the larger processes that cut across several functional areas of an organization. Examples of relatively small processes have been introduced above. The initial baggage handling process of assigning and routing a traveler's suitcase to a particular flight is a stage or component process of the larger process of baggage handling. Similarly, the preparatory "makeready" process is a stage or component process of the overall process of running the printing press. On the continuum of process size and scope, these are examples of relatively small processes.

Sophisticated work processes that cut across several functional areas of an organization, *cross-functional* processes, are becoming increasingly common in today's organizations. The role of cross-functional processes in improving organizational effectiveness has

recently been given much attention (Davenport, 1993; Hammer & Champy, 1992; Rummler & Brache, 1990). Work processes that are *cross-functional* in nature typically require activities that draw on multiple functional areas. For example, the process of filling customer orders spans the boundaries between several functions that have traditionally been separate departmental units in organizations. The cross-functional process of filling customer orders can be described in the following way.

An order for a particular product is taken from the customer and documented by a Sales office. The order is sent to both Production Control to generate the product and to the Finance office for credit approval and invoicing. Production Control may draw down on inventory to fill the order and/or schedule further production to replace the product. They also activate the Shipping and Distribution function to insure that the product gets to the customer. Meanwhile, if the customer's credit is satisfactory, an invoice for payment is generated. The product and the invoice are then shipped to the customer. The customer receives the product and pays for it. Once the Finance office receives payment and credits the customer's account, the *cross-functional* process of filling the customer's order is complete.

In summary, work processes have identifiable inputs and outputs, they vary in size and scope, and are composed of stages or component processes. Each stage or component can itself be considered a process. Larger, more complex processes that span the boundaries between organizational units are called cross-functional processes. Thus, the notion of *process* provides an important conception of how work is accomplished and flows through contemporary work organizations.

Understanding the structural basis of work processes is the key to successful efforts to improve or redesign them. There must be agreement as to what constitutes the process, that is, the work activities that are specifically included in the process, before the process can be analyzed, improved, or redesigned. Unless people can agree on the way work is currently structured, it will be very difficult for them to systematically improve the design and efficiency of that work. Work processes that have an identifiable flow or structure, whether they are small, discrete processes or more elaborate, cross-functional processes, can be analyzed and measured.

Process Analysis and Process Improvement

Work processes can be analyzed and measured. Characteristics of a process that can be measured include the time and cost associated with its execution, and the quality features of the outputs and inputs of the process, such as their consistency, usefulness, variability, and freedom from defects (Davenport, 1993). Quality characteristics should be identified for each of the various stages of a process (Schultz & Schroeder, 1990). For a manufacturing process, these characteristics may include weight, color, length, diameter, weld strength, and so on. For a service process, they may include the response time within which the service is provided to customers, the degree of customer satisfaction, the amount of follow-up support given, and so on. These measures become the criteria for assessing efforts to improve work processes.

Understanding and defining the process. Before changes can be made in a process to improve it, some fundamental characteristics of the process must be understood. In one of the first widely read articles in this country on the process improvement methods that have been so successful in Japan, Gitlow and Hertz (1983) made a convincing case for the use of process improvement methods in U.S. industry. They argued that in order for U.S. managers to reap the benefits of increased productivity and quality and reduced costs that could be achieved through process improvement, they would first have to analyze their work processes to understand the sources of variation within them. They would also have to use appropriate operational definitions to precisely define their products and processes.

Gitlow and Hertz distinguish between *common* and *special* causes of variation in processes. Common causes of process variation are those that are inherent in the process, such as subtle differences among pieces of equipment, normal variation in materials, and routine fluctuations in the physical environment. Because common causes of variation are inherent in the process itself, those who organized the process and have authority over its operation (i.e., management) are considered ultimately responsible for removing these sources of variation. Special causes of variation are more localized in nature and are not part of the overall process. These include materials from new or unreliable sources, untrained workers, and the use improper procedures or equipment. Special causes of

variation should be considered as abnormalities and can be totally eliminated. A major obstacle to achieving high process quality is the failure to adequately distinguish between common and special causes of variation. When special causes are misinterpreted as variation that is inherent in the process, failure to remove them results in continued poor quality. Conversely, actions taken to change conditions that actually arise from normal variation are considered "tampering"--making unjustified changes which throw the process further out of control. The key to process improvement is understanding sources of variation. Process control charts provide a method for accurately distinguishing between common and special cause sources of variation.

Gitlow and Hertz provide detailed explanations and examples that illustrate the construction and use of process control charts. They show how control charts clearly distinguish common from special cause variation and then demonstrate the effects of eliminating abnormal variation from the process. But eliminating unwanted variation from the process has no meaning if managers have not addressed the issue, "variation from what?" The precise level of product or service quality to be attained must be clearly defined before variation from the quality level can be identified. The critical variables and attributes of what the process is intended to produce are precisely specified by *operational definitions.* An operational definition indicates the desired criteria for the product and specifies the measures to use to determine if the product criteria have been met. Without operational definitions to indicate what separates a quality product from a defect, control charts are meaningless as tools for improving process quality.

Other basic process improvement methods. In addition to control charts, other basic tools are used to identify and eliminate sources of poor quality in processes. Mooney (1986) lists seven basic process improvement tools and classifies them loosely into two overlapping categories--behavioral tools and statistical tools. Behavioral tools such as brainstorming or nominal group techniques, cause-and-effect diagrams, and flow charts, foster employee involvement, commitment, and creativity. Statistical tools such as Pareto charts, control charts, histograms, and scatter charts, help to generate ideas and focus them on the goals of product quality and customer satisfaction.

Mooney uses Joseph Juran's three-phase cycle of process improvement (i.e., planning, control, and breakthrough) as a framework for the use of the seven basic process improvement tools. Juran's planning phase is primarily concerned with: (a) identifying a meaningful project on which to focus process improvement efforts; and (b) describing critical product or service characteristics through operational definitions. The control phase is concerned with achieving stable performance of the process. The breakthrough phase is intended to achieve a dynamic, decisive movement to a new, higher level of process performance. The basic process improvement tools are used repeatedly within the phases of Juran's cycle to facilitate problem identification, to analyze data, and ultimately, to change long-standing patterns of behavior. Mooney maintains that if these tools are applied correctly, they lead to a work unit characterized by: (a) a full, open, and accurate description of the unit's work process; (b) a comprehensive list of problems that impede process performance; and (c) a continuing stream of new ideas for process improvement.

Quality improvement and traditional management practices. Analysis of the process to identify and remove sources of poor quality achieves incremental yet steady and continuous improvement. In the long run, product quality is insured through "preventive control" as the causes of quality problems are permanently removed from the process. An alternative view is to focus not on the future benefits of an improved process, but on the costs associated with interrupting production to study the process. A manager holding this view will deal with problems by restoring the process to its original state as quickly as possible. This approach represents "reactive control" of the process. Preventive control follows the philosophy and methods of process improvement and reactive control reflects traditional management methods. From an economics perspective these two approaches to process control each have distinctive sets of related costs and benefits. Managers actually face tradeoffs in efforts to improve process quality without incurring excessive costs.

Marcellus and Dada (1991) examined the preventive control and reactive control approaches to process management by studying the tradeoffs involved in choosing an optimal process improvement policy. Given a production process which produces a defective part at random intervals, Marcellus and Dada demonstrated the economic tradeoff

between the "cost of prevention" (i.e., incremental improvement of the process as one approaches zero defects) and the "cost of failure" (i.e., minimizing process downtime). Their analysis considered the length of the planning horizon for the production process, the costs of process improvement, the costs of imperfect production, and the relationship among discount rates that reflect the future versus present costs associated with process control decisions. They found that although the tradeoff curve between preventive control and reactive control resulted in a nonzero optimal level of product defects (due to decreasing marginal benefit per defect prevented), the overall structure of the tradeoff curve clearly justified pursuing a policy of preventive control (i.e., process improvement) in the management of process quality.

Process Improvement: Organizational Structures and Practices

Great variety exists in the organizational arrangements used to pursue process improvement goals. The structure of employee teams, how they are administered, and the presence of a union all influence the outcomes of process improvement efforts. In addition, total quality management and advanced manufacturing methods seem to be related to a set of compatible human resource management practices which enhance the success of these methods. Other considerations, such as the fundamental differences between Japanese and American systems for doing business, represent obstacles to the adoption of Japanese management practices by U.S. firms that must be understood before the benefits of total quality management can be more accessible to firms in this country.

The literature reviewed in this section addresses these and other types of organizational structures and practices adopted to improve process performance. Themes related to these organizational arrangements are addressed by each of the works reviewed next.

Teams of employees organized to improve quality take different forms and have various stated purposes. Magjuka (1991) studied this issue using survey results from 531 companies. He examined two features of teams of employees organized to improve productivity and quality in their organizations. These features were the teams' *design* and the teams' *purpose*. Although employee teams in all of the companies that responded to the survey were organized to address the general goal of improving quality and productivity,

three terms were used by the companies to reflect the basic design of the teams they had formed: self-managed work teams (SMT), quality circles (QC), and problem-solving groups (PSG).

Forty-four percent of responding firms called their teams "quality circles" (QC) and defined them as groups of employees who meet to improve the performance of work operations in their units, with particular emphasis on improving the quality and reliability of individual and group performance. In 33% of responding firms, the team was defined as a "problem solving group" (PSG), that is, a group of employees who form on an ad-hoc basis and have responsibility for solving problems that have been identified in their work units. In 23% of responding firms, the team was called a "self-managed work team" (SMT). This is a group of employees given substantial responsibility for the planning, organizing, scheduling, and production of work.

To determine the primary purpose of the teams, Magjuka constructed three categories of purposes based on respondents' rank ordering of nine team purpose descriptions which he provided. The three *purpose* categories and the kinds of issues each addresses are: "end-product outcomes" (improving productivity and reducing cost); "employee-centered outcomes" (improving employee satisfaction and communication); and "process improvement outcomes" (improving process dependability and flexibility). The results indicated significant differences in team *purpose* by team *design* (i.e, SMT, QC, or PSG). Self-managed teams were significantly more likely to list "end-product outcomes" as their primary purpose than either quality circles or problem-solving groups. Interestingly, self-managed teams were also more likely to pursue "process improvement outcomes" than either of the other team designs. A significant percentage of quality circles and problem-solving groups reported that their primary purpose was "employee-centered outcomes." Beyond a brief characterization of the organizations surveyed, little or no description of the author's research methodology was provided. As the title of the article suggests, the conclusion drawn from the survey results is that self-managed teams seem best able to achieve continuous improvement objectives.

Unionization and the administrative structure of quality programs affect program outcomes. Cooke (1992) examined product quality improvement in union versus non-

union settings to study the influence unionization an administrative structure on program outcomes. Cooke used two samples of manufacturing firms for the study. A local sample of union and nonunion Michigan manufacturers was used to assess the effect of unionization on quality program outcomes. A second group of union manufacturers sampled nationally was used to examine the influence on program outcomes of joint union-management program administration versus programs administered solely by management. Cooke hypothesized that greater cooperation among managers and workers within both samples should lead to more successful quality improvement programs. A subjective assessment of program outcomes was obtained by asking for managers' perceptions of the extent to which product quality had improved as a result of the programs.

The results of the study confirmed Cooke's hypotheses. Among unionized companies, those with employee participation programs jointly administered by union and management were positively associated with product quality improvements. According to the author, unionized companies appear to achieve their goal of product quality improvement when union leaders are involved in the administration of the program,but not when they are uninvolved. Based on analysis across samples, Cooke estimated that product quality improvements achieved through jointly administered programs in unionized companies were equivalent to those achieved through participation programs in nonunion firms. The author believes that the study supports his contention that the overall labor-management climate plays a key role in determining the success of employee participation programs.

Snell and Dean (1992) studied the relationship between "integrated manufacturing" and human resource management to test theories that links human resource management practices with different levels and types of advanced manufacturing systems. Integrated manufacturing involves the elimination of barriers between stages, functions, and goals of production to create a cohesive, coordinated system of manufacturing. According to Snell and Dean the three prominent innovations that compose integrated manufacturing are advanced manufacturing technology, just-in-time inventory control, and total quality management. Emphasizing the value to producers of integrating these three approaches to manufacturing, the authors state, "these three practices work in concert to change the way goods are produced; in fact, their joint application has dramatically transformed the entire

manufacturing function" (p. 470). Advanced manufacturing technology (AMT) includes a variety of computerized technologies, such as computer-aided design (CAD), manufacturing (CAM), and process planning (CAPP). Just-in-time inventory control (JIT) is a coordinated set of practices for reducing lead time and inventory by receiving and producing materials just-in-time for use in the next step of production. Total quality management (TQM) is characterized by the authors as composed of "a few basic principles--doing things right the first time, striving for continuous improvement, and fulfilling customer needs--as well as a number of associated practices" (p. 470).

Snell and Dean examined four areas of a firm's human resource management practices: staffing, training, appraisal, and rewards. They felt that work in an integrated manufacturing environment would involve a broader scope of employee responsibility for decision making, problem solving, and continuous improvement. Accordingly, they hypothesized that integrated manufacturing would increase the skills required of employees, the amount of discretion they must be accorded, and the impact they have on production. They developed a comprehensive set of measures addressing the components of integrated manufacturing (i.e., firm practices related to AMT, JIT, and TQM) and human resource management (i.e., firm practices related to staffing, training, appraisal, and rewards) and surveyed manufacturers in the metal-working industry to investigate the interrelationships among these factors.

Correlation analysis of the direct and interactive effects among these factors showed that advanced manufacturing technology was positively related to the practices of selective staffing, comprehensive training, developmental appraisal, and equitable rewards in the firms surveyed. Total quality management was also positively related to these same human resource management practices. However, just-in-time inventory control was negatively related to selective staffing and performance appraisal. The two- and three-way interactions among factors all had negative effects.

The authors interpreted these results as suggesting that managers likely do not treat human and technical systems as separate entities, but rather manage them together. Except for the JIT results, which the authors suggested may be due to JIT's limiting effect on individual discretion, the authors felt that these findings support the premise that integrated

manufacturing will be more successful when accompanied by the upgrading of employee skills. Moreover, the study supports what the authors see as a trend across firms in which "integrated manufacturing represents an opportunity for increased employee contribution, which can be nurtured through human resource management investments in human capital" (p. 492).

Young (1992) cites the difficulties American firms experience in their adoption of Japanese manufacturing practices, such as TQM and just-in-time inventory control, in a paper describing a research framework that Young feels would provide the basis for the successful adoption of these and other Japanese practices by American firms. He notes aspects of Japan's unique cultural and geographical history that underlie Japanese assumptions about employee behavior, business relationships, cost management, and performance evaluation systems. Assumptions in this country that are quite different in these areas are at the root of the problems encountered by firms in the U.S. seeking to adopt Japanese manufacturing practices.

Young identifies three strategies currently used to introduce these practices into U.S. firms: (a) maintaining Japanese manufacturing practices as they are, but modifying current features of the U.S. manufacturing environment (e.g., work attitudes and behavior, cost management, business relationships, and performance evaluation systems); (b) modifying some or all of the Japanese practices, but maintaining the current features of the U.S. manufacturing environment; or (c) modifying some or all of the Japanese practices *as well as* modifying current features of the U.S. manufacturing environment. After examining the feasibility of pursuing each of these strategies, Young concludes that modifications to both Japanese manufacturing practices *and* features of the U.S. manufacturing environment should be made before Japanese practices can be successfully adopted.

Based on this conclusion Young offers a research framework composed of six factors related to Japanese manufacturing practices that he states require further study before they can be successfully adopted by U.S. firms. These six factors are: *kaizen* (e.g., layoff policies, types of rewards), *kanban* (e.g., pace of work, level of discipline), TQM (e.g., team orientation, level of skills, level of responsibility), JIT inventory and purchasing (e.g., vendor location, vendor incentives and training), secondary control (e.g., work

rules, group orientation, union sentiment and plant location), and cost management and performance evaluation systems. Young recommends researchers carefully study these factors so they can advise U.S. firms of the best way to successfully implement these manufacturing practices. Ultimately, the difficulties U.S. firms encounter in adopting Japanese manufacturing practices can be ameliorated through systematic investigation of the fundamental differences between Japanese and American systems for doing business.

There is a great deal of overlap in the concepts and methods of TQM and organizational behavior management (OBM). Mawhinney (1992) identifies many areas of quality improvement practice in which the theory and methods of OBM are closely aligned with TQM, and he argues for even further integration of these two disciplines. He contends that management practices which combine these approaches would be superior to either approach used alone.

Organizational behavior management (OBM) is defined by Mawhinney as the application of Skinnerian ideas to organizational analyses and problems. OBM is an extension of the experimental analysis of behavior and applied behavior analysis into the world of organizations. Mawhinney extensively analyzes areas of agreement and disagreement between OBM, as an operant-based approach to performance management, and Deming's views of TQM. He engages in a point-by-point comparison of these two approaches on each of Deming's "14 Points." In a majority of the organizational situations that Mawhinney uses in his comparison, he demonstrates agreement between the TQM and OBM approaches to continuous improvement. However, Mawhinney feels that Deming's views of TQM do not adequately account for the contingencies that should reinforce the work behaviors desired in TQM. In this respect, Mawhinney feels that Deming's approach to TQM is incomplete. Mawhinney states, "there is no reason to believe that action will be taken to correct the problems identified until contingencies of reinforcement are changed to make powerful reinforcers depend on addressing the problem. Interventions aimed at implementing TQM should be much improved when effective and reliable contingencies of reinforcement support them" (p. 534).

Overall, however, Mawhinney finds that TQM and OBM are far more in agreement than they are in conflict. As the title of the paper suggests, Mawhinney argues for further

integration of the two approaches and states that, ultimately, interventions that combine OBM and the Deming philosophy are superior to either approach used alone.

Work Performance and Training Needs

The literature reviewed in this section is primarily drawn from the training literature on needs assessment. In addition, although two of the works reviewed here deal for the most part with training design (Campbell, 1990a; Kennedy, Esque & Novak, 1983), they were included in this section because they also have important things to say about training needs and performance outcomes. The literature examined next is reviewed in the order in which it was published, with the earliest literature reviewed first.

McGehee and Thayer

McGehee and Thayer's (1961) seminal work, *Training in Business and Industry,* provides an extensive treatment of training needs assessment. McGehee and Thayer were among the first to develop a systematic model of training needs assessment that reflected the complexity of contemporary organizations. Their needs assessment model has three interrelated phases. For each phase, the authors identify the kinds of data that should be used, and discuss the issues of reliability and validity in collecting the data. The three phases of McGehee and Thayer's needs assessment model are: (a) organization analysis, (b) operations analysis, and (c) man analysis.

Organization analysis is focused on determining where training emphasis should be place in the organization. McGehee and Thayer believe that training can affect the organization, and that the organization can affect training. Organization analysis embraces the entire organization, and includes an examination of the organization's objectives, resources, and how the organization allocates its resources. Organization analysis consists of four steps: (a) stating the organization's objectives, (b) analyzing human resources, (c) analyzing indices of efficiency, and (d) analyzing the organizational climate.

The second phase of McGehee and Thayer's needs assessment model is operations analysis. Operations analysis consists of determining the contents of training in terms of what an employee must know and be able to do to perform effectively on the job. Operations analysis focuses on the tasks to be performed, regardless of who will perform them. This analysis is intended to provide the following job-related information:

- performance standards for the job;
- identification of the tasks that comprise the job;
- the procedures to follow to perform the task; and
- the knowledge, skills, and attitudes required to perform each procedure and task.

Information for the operations analysis can be collected by reviewing records, and through the use of observation, interviews, questionnaires, and by actually performing the job.

The third phase of McGehee and Thayer's model of needs assessment is man analysis. Man analysis consists of summarizing how well an individual performs their current job, and of determining the extent to which current work behaviors must change in order to meet the performance requirements of the job. The analysis must also identify the new skills, knowledge, and attitudes to be acquired if the individual is to perform a new or different job. As with the operations analysis, information for the man analysis can be collected by reviewing records, and through the use of observation, interviews, questionnaires, and by actually performing the job.

This three-phase training needs assessment model of McGehee and Thayer was designed to provide a systematic and accurate determination of training needs. Both the model's phases and data collection methods are interrelated. Although this model is over thirty years old, it remains an excellent example of an integrative needs assessment process.

Harless

Harless' (1975) book, *An Ounce of Analysis (Is Worth a Pound of Objectives),* is a self-instruction text which is frequently cited in the training needs assessment literature. Front-end analysis, a term coined by Harless, is viewed as an important phase of a larger instructional process. Harless defines front-end analysis as "all the smart things a manager does before addressing a solution to a human performance problem" (p. v). *Front-end*

analysis is a term Harless uses to describe the procedure for determining the symptoms and indicators showing that a problem exists, what the performance problem is, and the relative value of solving the performance problem. A problem is defined as "the difference between the actual situation and the model situation" (p. 22). Harless calls this difference a "deficiency."

Harless' analysis process is intended to get at the root of the problem. The steps to follow to perform Harless' front-end analysis are: (a) narrow the problem; (b) describe the problem; (c) hypothesize causes (e.g., lack of knowledge and skill, low motivation, environmental or system deficiency); (d) test each hypothesis; (e) determine solution alternatives; and (f) select the best alternative. After first recognizing that there is a problem, the performance problem is defined by specifying desired and actual performance, comparing the two, and then precisely describing the deficiency. Causes for performance problems are hypothesized from three categories: knowledge/skill deficiencies, motivation-incentive deficiencies, and environmental deficiencies. Only knowledge/skill deficiencies can be satisfactorily addressed by training solutions. Other performance problems usually require a combination of training and nontraining solutions. Although this distinction between training and nontraining solution appears self-evident, determining the causes and solutions of performance problems in practice is often a complex and challenging task. If more than one cause of the problem is hypothesized, evidence is gathered for and against each hypothesis, alternatives are generated, and the most promising alternative is selected.

Gilbert

Thomas Gilbert is rightfully credited with being one of the first scholars to integrate principles of organizational performance with human capital theory (Jacobs, 1989). Gilbert's contributions to the basic concepts and measurement of human performance have become an important foundation for the emerging field of human performance technology. His seminal work, *Human Competence: Engineering Worthy Performance,* is frequently cited in the human performance technology and human resource development literatures.

Gilbert (1978) defines worthy performance as the ratio of the value (or worth) of an accomplishment to the cost of the actions that produced the accomplishment. An accomplishment is measured by multiplying the quantity times the quality of what is produced and dividing that product by the cost. With this formula, worthy performance is measured by accomplishment rather than by behavior.

Gilbert developed a performance audit composed of seven steps that can be used to analyze performance. Performance measures are based on accomplishments, so the first step in the process is to identify the accomplishments. The second step is to identify performance requirements such as the demands of the system. The third step is to identify exemplary performance. Exemplary performance in the area of the accomplishment is worthy performance that is sustained. The fourth and fifth steps are to measure exemplary performance and typical performance. The sixth step is to compute the performance improvement potential (PIP). The PIP is the ratio of the exemplary performance to the typical performance. The difference, as measured by the PIP, is called either a deficiency or a potential. In general, the larger the PIP, the greater the opportunity to improve performance. The seventh step is to translate the PIP into stakes, or measures of economic potential. Decisions about improving performance can be made by analyzing the PIP.

To measure performance, Gilbert suggests that the analyst begin with the most general measures first, and then proceed to the specific measures. For example, he recommends measuring the institution's accomplishments, then the job accomplishments, and then the task accomplishments. He notes that beginning with specific measures will only cause confusion and wasted time. When measuring performance, it is important to classify the conditions of performance accurately, but precision is less important in quantifying the performance. According to Gilbert, precise measures of performance are not required because the goal of the exercise is to identify opportunities to improve performance. Differences are seldom so small that they need to be confirmed statistically.

Kennedy, Esque, and Novak

Kennedy, Esque, and Novak (1983) analyzed task analysis procedures used for designing instruction to determine what methods and components of task analyses were the

most common across all of the task analysis procedures they reviewed. The methods and components that emerged as common to the majority of task analyses they reviewed were categorized into two phases of task analysis: task description and instructional analysis. Common components of task descriptions were found to be task inventories, task sequencing, and refinement of the task descriptions. Generic components of instructional analyses were the specification of needs, goals, objectives, learning hierarchy, learning taxonomy, training considerations, and product development specifications. Having identified these common components of task analysis procedures, the authors were then able to formulate a generalized model of task analysis.

Although a generalized model of task analysis was developed and contained a consensus of procedures comprising educational and business/industrial task analysis applications, the authors conclude that, on the whole, task analysis procedures have not evolved systematically. The greatest differences in task analyses found by the authors were between educational and business/industrial task analyses. Educational task analysis techniques focused on goals which were then analyzed into tasks and subtasks. Business/industrial task analyses divided jobs into sub-skills which were identified as actions, not as concepts. Kennedy, Esque, and Novak interpret this as meaning that educational applications operate at the cognitive level, while business/industrial applications operate on a directly observable of behavior. They state that business/industrial applications of task analysis stop short of the cognitive analysis found in educational applications.

Kennedy, Esque, and Novak provide a comprehensive functional analysis of the many task analysis procedures used to design various types of instruction. However, their interpretation that business/industrial task analyses do not include the cognitive level of analysis does not reflect the current state of task analysis in business/industrial applications (i.e., work analysis in human resource development). Most analyses of the work of technicians, supervisors, professionals, executives, and other middle and upper level employees in organizations reflect the non-observable, cognitive skills that these individuals need to perform nearly all of what they do on the job. Educational task analyses are not alone in reaching the cognitive level. Tasks performed in educational

contexts *and* occupational contexts are based on the cognitive, psychomotor, and affective domains of learning. The authors' interpretations of their data should somehow account for this basic relationship between task performance and the learning domains that support performance.

Mager and Pipe

Mager and Pipe (1984) have written a concise and readable book that addresses the core causes of performance problems. According to Mager and Pipe, underlying all performance problems are the human factors of motivation, ability, knowledge and skill, the adequacy of practice and feedback, and a variety of non-human factors such as equipment, raw materials, obstacles in the workplace, and so on. Only by systematically addressing these factors can the true cause(s) of performance problems be identified.

Mager and Pipe's book is organized around a comprehensive flowchart that addresses each of the human and nonhuman performance factors in the proper sequence. This flowchart begins by identifying the discrepancy between actual and desired performance and assuring that the discrepancy is important enough to be addressed in the first place. They use the term *discrepancy* because it does not contain the value judgment implied by the word *deficiency*. The model then focuses on determining the cause(s) of the discrepancy. If the problem is a skill deficiency and if individuals "could not do the job if their lives depended on it," then additional questions are asked to determine why the deficiency exists and what direction the solution should take. If the problem does not involve a skill deficiency, then training is not the solution. Determinations are then made about the incentives and consequences of performance, and any systemic obstacles that impede performance. Mager and Pipe describe the final solution to the performance problem as feasible when "it will be acceptable to the people affected and not harmful (politically or otherwise) to you or to others" (p. 127).

Bjorkquist

A key prerequisite for training needs assessment is identifying an appropriate problem. Distinguishing among training and nontraining problems in organizations would seem to be

an obvious and necessary issue to be addressed at the outset of a training needs assessment. Yet, Bjorkquist and Murphy (1987) suggest that separating training-related needs from other needs is often not well done by those seeking to determine training needs. The primary purpose of the needs assessment may also be unclear to the needs analyst. To help clarify these issues, Bjorkquist and Murphy distinguish among three basic types of needs assessments. Needs assessments for training can be focused on: (a) correcting present performance problems; (b) improving current performance; or (c) addressing future training needs. Because of the complexity of the performance issues involved, Bjorkquist and Murphy suggest that it is best to conduct one type of training needs assessment at a time.

Bjorkquist and Murphy's model for training needs assessment follows a seven-step process that insures that the training priorities that result from the assessment process will address the original need(s). The seven-step needs assessment process is: (a) determine the purpose and objectives of the needs assessment; (b) identify the kinds of information needed; (c) design the approach to data collection; (d) collect data; (e) analyze and verify data; (f) separate training needs from other needs; and (g) set training priorities. Because worker knowledge and skills is one of several key determinants of improved performance in the workplace, collecting relevant data and verifying the original need are particularly important aspects of Bjorkquist and Murphy's model for training needs assessment.

Lewis and Bjorkquist (1992) have provided new perspectives on the original needs assessment model. The discrepancy approach to determining training needs has been a central feature of traditional needs assessments. The discrepancy model identifies a need as a discrepancy between two positions--"where we are now" and "where we need to be." Expressed in another way, desired results minus current results equal the need. Lewis and Bjorkquist argue that the discrepancy model of identifying training needs is inadequate because: (a) it does not account for expert behavior, and (b) organizational problems are typically too ill-defined and shrouded in ambiguity to be meaningfully captured by the discrepancy model. In real organizations, the existing and desired states of performance cannot always be clearly articulated. Lewis and Bjorkquist suggest that the needs assessment process should include an examination of expert practice in the area that training

is to address. Only be examining the skills of expert problem solvers can a needs assessment hope to capture the level of expertise needed by those who will participate in training.

Rossett

Rossett's (1987) work is devoted solely to the topic of training needs assessment. She clearly describes the relationship between needs assessment and the other phases of the instructional system development process. She emphasizes the importance of the "initiating situation" in providing valuable direction and focus to the needs assessment process. While acknowledging that there are a variety of ways in which new projects arise in organizations, Rossett classifies "initiating situations" for needs assessment into three types: (1) new policies, programs, initiatives, and technologies; (2) mandates; and (3) performance problems. Each of these situations shapes the focus and direction of training needs assessment in different ways.

As change occurs in organizations *new policies, programs, initiatives, and technologies* provide the context and direction for gathering training needs information. For example, the introduction of significant technological change in the organization can be facilitated through acquiring information focused on identifying and giving operational definition to what key personnel see as desired technological perspectives, skills, and knowledge. *Mandates* are initiating situations in which needs assessment and the training itself are in some way required, whether due to government legislation, the request of a key company executive, or historical precedent. Whether or not training mandates are grounded in the needs or priorities of the organization and its members, the response from the training function is usually compliance with the mandate. *Performance problems* provide another frequently encountered initiating situation for needs assessment. Performance problems in the workplace are of many types and vary in importance, yet have their origins in a limited number of important causes. If the initiating situation involves work performance problems, the concept of *causes or determinants* of performance should then guide the process of scanning for training needs information.

Rossett (1990) emphasizes the importance of systematically planning a training needs assessment because several potential obstacles to needs assessments exist in organizations. The analyst should identify the purpose of the needs assessment and determine who wants the problem solved and who does not. Needs assessment planning also includes determining the amount of available time and money, and gaining a sense of the politics of the situation. Without an accurate determination of the problem, its cause(s), the stakeholders, and the resources related to the potential training need, organizational forces in support of the status quo may prevail, and no change in behavior--with or without training--will occur.

Campbell

Campbell (1990a) offers a model for training design that follows a sequence of eight phases. The first two phases of Campbell's model address determining the need for training. The core question that guides Campbell's process for designing training is Gagne's, "What is to be learned?" Each of Campbell's eight steps for training design is systematically linked to assure that training ultimately answers this question.

The first step of training design is to assure congruence between organizational goals and job design. If the outcomes of jobs are not linked to the operational goals of the organization, then training within those jobs will be of little value. Second, training needs must be accurately determined. Of the determinants of job performance (i.e., ability, motivation, knowledge and skill, and non-worker performance factors, such as equipment and raw materials), which are deficient *and* would benefit from training. Third, training objectives are specified that state the behaviors to be learned and the level of proficiency to be achieved. (The training objectives should formally answer Gagne's question). The fourth step of training design specifies the content of training. Content is derived from the objectives and is the substance of training from which worker knowledge and skills are enhanced.

Campbell's fifth step of training design identifies the learning methods and media which will be used to carry out the learning events. The emphasis here is on correctly specifying the methods that will allow learners to actively produce the capabilities to be learned.

Sixth, training design should account for individual differences in ability, experience, learning styles, and motivation. The seventh step of training design is to specify the conditions of learning that will best promote mastery and retention of the content. Learning conditions to be addressed include inducing learners to generate the capability to be learned, providing guidance during learning, allowing practice, and providing ample feedback about the performance of learners. Finally, the outcomes of training are evaluated. Evaluation criteria are derived directly from the behavioral objectives that guided the design of training.

Sleezer

Sleezer (1991) developed a research-based model of training needs assessment to address the following problems she identified in the literature on training needs assessment: the lack of relevant research; the difficulty practitioners have in moving from theory to practice; and, the frustration needs analysts face when the assumptions of the models and theories they are using do not fit the realities of the environment. The training needs assessment model Sleezer developed in response to these problems goes well beyond intuitive approaches to determining an organization's training needs, and provides an important research base for the study of determining training needs. Sleezer examined a constellation of elements that affect training needs assessment as the basis for developing her model. Sleezer's needs assessment model is composed of three major components: organizational characteristics, decision makers characteristics, and analyst characteristics. The factors that affect decisions about training needs identified by Sleezer were the distinguishing traits, features, and qualities of the *organization* (e.g., politics, resources, and strategic plans), of *decision makers* (i.e., those who make determinations or judgments about training programs), and of the *analysts* (i.e., those with information-gathering skills and expertise in performance analysis).

Job and Work Analysis

Due to the broad interest in analyzing work from a diverse group of disciplines, a wide variety of approaches to the analysis of work exists. These approaches to job and work analysis can be grouped into three relatively homogeneous clusters: the *industrial engineering* or *human factors* approach; the *motivational* approach; and the *job analysis* approach.

Analyzing the components of jobs has been an important part of industrial engineering since the work of Frederick Taylor, Henry Ford, and the Gilbreths (Taylor, 1912; Finch, 1960). Industrial engineering is concerned with the design of jobs and the distribution of tasks required by a work system to maximize system efficiency and reliability (Konz, 1979). Industrial engineers take a normative approach to the way work should be designed based on adherence to principles of efficiency and ergonomics (i.e., the interface between the worker and the workplace). Human and nonhuman components of work are viewed as belonging to a common pool of work design elements, and are evaluated equally in their potential contributions to workflow efficiency. Work analysis provides the basis for integrating mechanical, physical, and human factors into the design of work systems that maximize reliability and efficiency of performance. (Several principles of work design from the industrial engineering perspective are reviewed in the "Work Design and Work Reengineering" section of Chapter 3).

The motivational approach to work analysis is based on assumptions about the needs and values of workers. The motivational perspective begins with a normative theory about how work should be designed to maximize outcomes such as worker satisfaction, employee turnover, or worker productivity. It is focused on the determinants of the willingness of workers to invest time and effort in the job over extended periods of time in order to perform it effectively. These interests have guided the ways in which industrial psychologists use work analysis, and have led to prescriptions for optimum work design (Hackman & Oldham, 1976; Ilgen & Hollenbeck, 1991; Salancik & Pfeffer, 1977).

Job analysis perspective is an inductive approach to analyzing work that begins by collecting data on job content through some combination of observation, interviews,

questionnaires, and the review of documents. From these sources of data, job content is determined and the overall structure of the job can be established. The ultimate criterion from the job analysis perspective is descriptive accuracy. There should be a high level of agreement among job incumbents and supervisors about the specification of job elements that is produced from work analysis. From the job analysis perspective, a job is "a set of task elements that are objective, bureaucratic, quasi-static, and grouped together by the prime beneficiaries or their agents" (Ilgen & Hollenbeck, 1991).

The literature on job and work analysis reviewed next primarily reflects the *job analysis* perspective rather than the *industrial engineering* or *motivational* perspectives on work analysis. Of the three perspectives, the *job analysis* perspective is most congruent with the work analysis methods that the "Theory of Work Analysis" is intended to support. In addition, two sections of the *Review of Literature* already address the other two perspectives on work analysis: "Work Design and Work Reengineering" discusses the *industrial engineering* approach to work analysis, and "Work Design and Employee Effects" addresses the *motivational* approach to work analysis. The literature examined next is reviewed in the order in which it was published, with the earliest literature reviewed first.

Fine and Wiley

Sidney Fine conducted research on job analysis for over twenty-five years. His early work involved the development of a systematic classification of occupations that was the basis for the third edition of the U.S. government's *Dictionary of Occupational Titles* (DOT). Originally this work was intended to improve job placement and counseling for those seeking work through local employment service offices. Fine recognized the need for a uniform and consistent way of describing what workers in specific jobs were expected to do. Therefore, he first focused his efforts on standardizing the language of job descriptions. He drew a distinction between the language of worker behavior (what the worker does) and the outcomes of behavior (the results of the worker's action). Worker behaviors (expressed with action verbs and objects of the action) and outcomes (expressed as products and/or purposes) used together in a sentence are the basic components of

Fine's task statements. For example, a typical task statement using Fine's language is, "Correctly positions the patient in order to take an orthostatic blood pressure reading."

In the course of his research on several thousand job descriptions, Fine established that what workers do in their jobs, they do in relation to Things, Data, and People. Within each of these three categories, there are a limited number of distinct functions arranged in a hierarchy from simple to complex. For example, in the Data category, the simplest function is "comparing," followed by "copying," "compiling," "analyzing," "coordinating," and finally, the most complex function, "synthesizing." Based on this hierarchical and ordinal ranking, if a worker's job includes a function in the middle of the scale, such as "analyzing," the job would also be expected to include supporting functions lower on the scale (e.g., "comparing"), but exclude higher worker functions (e.g., "synthesizing"). Fine's system for describing tasks also requires the analyst to rate the relative involvement of the worker in terms of Things, Data, and People functions. This "orientation" dimension of Fine's scale is expressed as a percentage in incremental units of five applied to each of the three functional categories, totaling to 100% (Fine & Wiley, 1971).

These hierarchical scales for describing and rating job tasks are the core elements of Fine and Wiley's *Functional Job Analysis* (FJA) system. FJA provides the basis for the primary job analysis method used by the United Stated Employment Service, and appears in the fourth edition of the DOT (U.S. Department of Labor, 1977). Each job described in the fourth edition of the DOT is accompanied by functional ratings of its component tasks in terms of Things, Data, and People.

McCormick

Ernest J. McCormick has made numerous contributions to the field of work analysis during his more than forty years of experience in job analysis research and practice. Two of his most noteworthy contributions are discussed here. They are a job analysis instrument called the "Position Analysis Questionnaire," and his widely read book on the subject, *Job Analysis: Methods and Applications* (McCormick, 1979).

The "Position Analysis Questionnaire" is a job analysis instrument consisting of 187 worker-oriented job elements. The job elements are organized into six categories: information input, mental processes, work output, relationships with other persons, job context, and other job characteristics. To analyze a job, each of these six elements is rated on a scale considered appropriate to the content of the element. Examples of these rating scales are "extent of use," "amount of time," "importance to the job," and "possibility of occurrence." For example, the "information input" element of a bus driver's job would include visual discrimination of road and traffic conditions. On the scale of "importance to the job," the bus driver's visual discrimination of traffic conditions would be rated very high. Although this job analysis instrument was originally developed twenty years ago, it has very high interrater reliabilities (.80 and above), and continues to be widely used for job analysis in the public and private sectors.

McCormick's popular book on work analysis, *Job Analysis: Methods and Applications,* has been an important reference for work analysis practitioners and researchers since it was published in 1979. It outlines the uses of job-related information, and describes different methods of job analysis, including questionnaires (e.g., the Job Analysis Schedule used by the U. S. Employment Service), work measurement (e.g., motion and time studies), task analysis (e.g. the breakdown of jobs into component tasks), and methods for classifying aggregate job data (e.g., "functional job analysis" used in the *Dictionary of Occupational Titles* and the "occupational analysis inventory" used to classify jobs for educational purposes). The book also includes chapters that address vocational choice, work adjustment, establishing job requirements, and evaluating the design of jobs and the performance of job incumbents.

Griffin

Task Design: An Integrative Approach (Griffin, 1982) frames nearly all aspects of work analysis at the task level. Griffin refers to work analysis as "job evaluation and analysis," which he defines as the objective assessment of task content for the purposes of developing relevant selection criteria, determining job training needs, and setting appropriate levels of

compensation. Griffin discusses job evaluation and analysis in two sections: one is entitled "Job Analysis," the other is entitled "Work Measurement."

The two essential components of job analysis are: (a) the specification of behaviors and tasks needed to produce the outputs of the job, and (b) the determination of the knowledge, skills, and abilities needed to carry out the job-related behaviors and tasks. Griffin describes an approach to job analysis that incorporates both of these components into one analytical method. The "job specification" describes what tasks the job entails and specifies what skill requirements are necessary for successful task accomplishment.

Whereas job analysis is concerned with the *behavioral properties* of tasks, Griffin distinguishes this from work measurement, which is focused on the *operational properties* of tasks. The three work measurement techniques described by Griffin are time study, work sampling, and flow charting. Time study involves the direct observation of tasks to determine how much time should be allotted for the completion of specified tasks. Work sampling involves performing selected job activities to estimate the proportion of time that should be allocated to each major job element. Flow charting is a technique that uses process and operational diagrams for analyzing the larger work system within which one or more jobs exist. Griffin states that the objective of all three of these work measurement methods is the determination of the most time- and cost-efficient methods for performing job tasks. Consequently, work measurement is best conducted by trained specialists, such as industrial engineers or work efficiency experts.

Gael

Gael's (1983) book is devoted to describing a single job analysis method, the work performance survey system (WPSS). This method of job analysis was developed by Gael for his employer, American Telephone and Telegraph (AT&T), to meet several AT&T job analysis needs. Unlike smaller and more geographically centralized companies, AT&T needed to analyze numerous jobs at facilities located throughout the world. The project also called for input from a large sample of employees which was expected to result in a high volume of specific job data. Gael gives these reasons for why he developed the

WPSS rather than use an existing method of job analysis. The WPSS can accommodate large amounts of job data gathered on many jobs from different sites.

All aspects of the WPSS are computerized, which enables the system to handle data on hundreds of jobs from multiple facilities. Computerization of WPSS questionnaires and job data also allows job information to be retrieved and updated at any time. Once the goals for a job analysis project are established, task statements for target jobs are developed by the analyst and verified by job incumbents. Questionnaires with accurate task statements are then distributed to supervisors and large samples of employees to obtain quantitative data about tasks and job content. The data is then analyzed by computer and interpreted by the analyst for the immediate purpose of establishing accurate descriptions of tasks and job content. Further uses of job data are linked to the original goals of the job analysis project such as defining current jobs so that future jobs can be designed, determining job training needs, establishing job selection criteria, and setting appropriate compensation levels for jobs.

Fleishman and Quaintance

Fleishman and Quaintance's (1984) work began as an attempt to develop an overarching taxonomy for classifying work tasks that would meet the full range of needs for information about work tasks. Fleishman and Quaintance's broad-based effort included all kinds of work tasks, especially those they considered integral to most jobs. Despite their monumental work, which remains the most thorough compilation of taxonomies for describing human tasks to date, they found that the demands on a taxonomic system for task descriptions are simply too diverse to be met by a single system. After a comprehensive review of task classification systems developed by earlier researchers, Fleishman and Quaintance organize their work around three fundamental approaches to describing work tasks: an *ability requirements* approach, a *task characteristics* approach, and a *task strategies* approach.

The *ability requirements* approach has received the most attention and is the most fully developed of the three approaches. It describes work tasks in terms of the human capacities required to perform the tasks effectively. These include workers' abilities, skills,

and motivation to perform tasks and the many techniques used to measure these capabilities. Revisions to Fleishman's own *Manual for Ability Requirements Scales* (MARS) have resulted in a total of fifty-two visual, auditory, motor, and speech abilities for which rating scales have been developed (Fleishman & Quaintance, 1984).

The *task characteristics* approach describes work tasks in terms of the procedures, techniques, and variables of the tasks themselves, rather than focusing on the abilities required to perform them. Farina and Wheaton's (1973) have developed a conception of "task" which exemplifies the task characteristics approach to task description. Their notion of a task reflects the immediate work situation and includes the task components of a goal, stimuli, procedures, responses, and stimulus-response relationships. Farina and Wheaton's model appears later in this study as the one around which the concept of "work task" is developed for use in the "Theory of Work Analysis."

The *task strategies* approach characterizes tasks in terms of task context and task environment. This approach is focused on the transactions between the worker and the task environment. It implies that, in addition to reflecting the overt behavior of the worker, tasks can be described as a sequence of transactions between the worker and the environment. This means that even when the worker is held constant, every task sequence is unique. Characteristic terms can serve as indicators that the task strategies approach is being used to describe work tasks. They include words such as "search," interpret," "transmit," "plan," and "test."

Fleishman and Quaintance acknowledge that all taxonomies--those for describing tasks, jobs, and other human activities and attributes--are established in an arbitrary fashion. The value of a taxonomy depends on the extent to which it is useful for the purposes to which it is applied. Although Fleishman and Quaintance's work was unsuccessful in providing a single taxonomy that met everyone's needs for information about work tasks, it laid a singular and valuable foundation for future researchers.

Swanson

Swanson (1994) makes the strongest case among the works reviewed in this section for work analysis as a necessary foundation for efforts to improve work performance. Unlike

other authors who present work analysis as primarily a human resource tool, Swanson makes no assumptions about the underlying causes of work performance problems and the direction that solutions should take. The first half of Swanson's two-part book on work analysis provides the rationale and methods for diagnosing performance issues in organizations. Several interrelated performance factors at three levels of analysis--the organization, process, and individual levels--are offered as the conceptual basis for a systematic diagnosis of performance. The second section of Swanson's is based on the premise that rigorous analysis of the work itself is the true source of improved performance, regardless of whether subsequent interventions involve reengineered work methods, human resource development, or other performance improvement efforts.

Swanson's first section on diagnosing performance addresses the process of defining performance problems and identifying solutions--a process that is almost always more complex than it initially appears. According to Swanson, the work performance problems we address often contain assumptions about causes and solutions that may or may not be accurate. Uncorrected problems of the past are occasionally intermingled with present performance needs, especially in the struggle to adapt to rapidly changing work technology. Even when the problem appears to be well defined, we are frequently confronted with conflicting information about the source of the problem and who or what is responsible for it. Swanson's "performance diagnosis process" handles these complex situations by accounting for all the major performance variables (i.e., mission and goals, systems design, capacity, motivation, and expertise) at the levels of the organization, process, and individual. By specifying performance measures and determining performance needs, the analyst using Swanson's performance diagnosis model is constructing a problem framework that leads to interventions that solve the organization's performance problems. A chapter on the elements of a proposal for improving performance concludes the book's first section on diagnosing performance, and leads into the second section which explains the methods for documenting workplace expertise.

Swanson offers a complete methodology for work analysis that includes a set of work analysis tools and case studies that illustrate how to use them. First, the scope of the job and its component tasks are defined. Then, each task representing a performance

improvement opportunity is further analyzed using one of three tasks analysis methods. The method selected depends on the nature of the task to be analyzed. "Procedural task analysis" is used for straightforward tasks in which workers interact with equipment and materials in a step-by-step manner. "Systems task analysis" is used to analyze the systems that workers operate that range in complexity from basic hardware systems (e.g., metal fabricating equipment) to complex information systems (e.g., advanced communications technology). "Knowledge task analysis" is used for abstract, non-observable knowledge tasks performed by those who primarily work with other people and ideas.

Swanson emphasizes the importance of systems thinking for successful performance improvement efforts in the beginning of the book, and concludes the book in the same way by providing the analyst with a systems framework for assuring that work analysis leads to improved performance. Swanson's "systems model for performance improvement" embeds work analysis within a five phase system that links front-end inputs (e.g., organizational goal and customer requirements) with desired outcomes (e.g., achieving desired performance at the individual, process, and organization levels).

Theory and Theory Building

A majority of research studies in the behavioral sciences offer hypotheses about phenomena of interest and then test these hypotheses using methods of empirical research. The literature reviewed in this section was selected to serve a different purpose. With respect to work analysis, this literature addresses the question "What is the source of hypotheses to test?" An important source of an hypothesis is a theory. This section first examines theory and theory building from the perspective of how they are used in this study. Then, the role of theory in human resource development is described as an example of the purposes served by theory in all of the applied behavioral sciences. Finally, systems theory will be examined as a way of explaining the interrelationships among an organization, its components, and the environment. Viewing an organization and its members in an open-systems context is discussed as an important foundation of human

resource development. A systems perspective is also used later in this study as a component of "A Theory of Work Analysis."

Theory and Theory Building

A theory is a system for explaining a set of phenomena that specifies the key concepts that are operative in the phenomena and the laws that relate the concepts to each other. Theory is an attempt to model some aspect of the real world. It helps us decide what concepts and relationships are worth paying attention to in a given context and what to do about them when problems occur. Robert Dubin (1976), a distinguished scholar of theory and its origins, states that the underlying motives for theorizing are: "(1) that the real world is so complex it needs to be conceptually simplified in order to understand it, or (2) that observation by itself does not reveal ordered relationships among empirically detected entities" (p. 26). A theory tries to make sense out of the observable world by identifying the most important elements of a phenomenon and ordering the relationships among these elements. Applied behavioral scientists and practitioners are guided by a wide range of theories on organizational behavior, work motivation, job satisfaction, leadership styles, and human performance. As is explained in "A Theory of Work Analysis," the main phenomena of interest in work analysis arise from the concepts of the "work environment," the "work task," the "worker," and the interrelationships among these elements.

Dubin (1978) has developed a widely used methodology for theory building accompanied by its own terms which describe the components of the theory building process. The "units" of a theory are the elements or variables that constitute the subject matter addressed by the theory. Dubin maintains that specifying the units of the theory and the laws by which the units interact constitutes the major contribution to knowledge generated by a theory. Dubin's methodology for theory building has eight phases or elements. In addition to the *units* of a theory and the *laws of interaction* among the units, Dubin's methodology also includes the *boundaries* of the theory, the *system states* within which the theory is operative, the *propositions* of the theory, the *empirical indicators,* the *hypotheses* derived from the theory, and finally, *research.* The first five elements of Dubin's methodology represent the development and validation component of theory

building, and the scope of this study. The last three elements of Dubin's methodology represent the process of taking the theory into real world contexts to conduct empirical research.

Research serves an important purpose by linking theory to practice. While providing a convincing rationale for linking theory, research, and practice in the behavioral sciences, Dubin (1976) gives straightforward reasons as to why this has been difficult to do. Theorists and practitioners are responsible for the disjunction in theory and practice, in short, because their goals are different. Theorists seek to model of some aspect of the empirical world that yields a high level of understanding of how variables are related to each other, yet the predictions may not be as good as the understanding the model yields. The practitioner, who has to live with these predictions, remains skeptical of theoretical models, for some of them have been useful in guiding practice, and others have not.

Dubin's methodology for theory building is used to develop a theory of work analysis. Dubin's methodology for theory building is suited to theory building in the behavioral sciences and has been successfully used for building theory in the field of human resource development (Berardinelli, 1991; Jacobs, 1989).

The Role of Theory in Human Resource Development

The roles that theory serves in human resource development are essentially the same as those served by theory in other disciplines. Indeed, theory's potential value for guiding scientific understanding, explanation, and prediction cuts across all professional disciplines. With the help of Campbell's (1990) synthesis of the roles of theory, the following list of the most prominent roles served by theory is offered together with an example of each role in the context of human resource development.

1. Theory provides a means by which new research data can be interpreted and coded for future use. Research is currently generating a great deal of data on the effects of transformed organizational structures (e.g., flatter designs, "downsized" organizations). Organizational behavior theory maintains that as the organizational structure changes, new relationships emerge among the individuals who function within the organization. Theory

is warning us that we must play more attention to changing employee roles as organizations take on new forms.

2. Theory provides a means for responding to new problems that have no previously identified solutions strategy. Technologically advanced work environments that remove workers further from concrete cues to performance increasingly contribute to worker anxiety and operational errors. Theories of work design and human motivation tell us that frequent feedback that is procedure-specific increases worker satisfaction and accuracy of performance. Knowledge form these theories can be applied to new work environments.

3. Theory provides a means for identifying and defining applied problems. Work performance problems are often defined in terms of training solutions. Yet theories of performance maintain that work performance has multiple determinants; knowledge and skill (the primary objects of training) interact with ability, motivation, and environmental factors (determinants which training has little or no effect on) to produce the outcomes of performance .

4. Theory provides a means for prescribing or evaluating solutions to applied problems. Organizational leaders often look to outside agents as the means for effecting change in their organizations. Yet organizational change theory suggests that the direction and commitment for change, and criteria for its success must come primarily from within the organization itself.

5. Theory tells us that certain facts among the accumulated knowledge are important, and others are not. Theories of learning and instruction suggest that the learning goal to be achieved is more important than the speed of achieving it; the match between the instructional method and the capability to be learned is more important than the choice of media; and the type of evaluation is often less important than whether evaluation has even been used at all.

6. Theory gives old data new interpretations and new meaning. Theories of motivation have recast the importance of extrinsic motivators for work such as pay and perquisites. The use of money has had unintended consequences in cases where it has undermined the intrinsic rewards of work (pay displaces intrinsic fulfillment), and in cases where increasing the pay of one person (the CEO) has demotivated everyone else.

7. Theory identifies important new issues and prescribes the most critical research questions that need to be answered to maximize understanding of the issue. An environment of increasingly scarce economic resources portends diminishing investments in human resource development. Yet human capital theory challenges the human resource development profession to reframe this issue into one in which greater depth of human capital contributes to the renewal and expansion of human and economic resources. Questions to be answered deal with how the issue should be reframed in light of short term profits horizons, and how best to marshal evidence in support of human capital investments.

Systems Theory

Systems theory has its roots in the pioneering work on general systems theory done in the early 1950's by Ludwig von Bertalanffy, a German biologist. Within a short time after its introduction, general systems theory was further developed by scholars from several fields. Systems theory was applied to economics by Kenneth Boulding; Anatol Rapoport applied a systems framework to mathematics; Katz and Kahn were the first to formally expand systems theory into the realm of organizational behavior; and Thomas Gilbert is credited with using systems theory to support his original work on human performance technology (Gradous, 1989). The wide applicability of general systems theory derives from a central theme of the theory itself: *any* system can be studied, understood, and influenced by focusing on its key processes, the relationships among its components, and its relationship with the environment.

McLagan (1989) applied systems theory to organizations as a way of explaining these interrelationships among the organization, its components, and the environment. She takes an open-systems view of organizations that reflects an organization's need to undergo constant change if it is to remain responsive to outside influences. McLagan developed a "tiered view of systems" with the organization and its subsystems at the center of a model that shows systems becoming increasingly larger as one proceeds from organization to industry, from industry to socio-economic political system, and finally, from socio-economic political system to ecological system. McLagan's tiered view of systems is used

in "A Theory of Work Analysis" to describe how an organization is related to the external environment. Her systems perspective helps to understand why the external environment includes influences that range from local forces in the community to broader forces in society and the global economy.

Jacobs (1989) was the first to explore systems theory as a unifying theory for human resource development. Responding to the fact that human resource development has no underlying and generally accepted theoretical base, Jacobs proposed that systems theory provide such a foundation. He first established that an underlying theory for human resource development (HRD) is needed because:

(a) theory provides explanations and understanding for complex HRD phenomena;

(b) personal experience alone is not sufficient to guide professional practice;

(c) theory provides a common language and shared understandings for HRD professionals;

(d) theory provides a basis for distinguishing HRD competencies from those that are not; and

(e) theory stimulates further research to improve HRD practice.

Jacobs then showed how systems theory informed Gilbert's pioneering work on human performance technology. Jacobs used Gilbert's ideas on human performance technology as the basis of his own "human performance system," a model organized around the basic systems components of input, process, output, and feedback. Jacob concluded his application of systems theory to HRD by evaluating systems theory as the theoretical basis for HRD using Patterson's (1986) eight criteria for evaluating theory. These criteria are importance, preciseness and clarity, parsimony or simplicity, comprehensiveness, operationality, empirical validity or verifiability, fruitfulness, and practicality. Jacobs concluded that systems theory meets the criteria of comprehensiveness, importance, clarity, and parsimony, but does not meet the criteria of operationality, empirical validity, and fruitfulness.

CHAPTER 4

METHODOLOGY

The methodology by which a theory of work analysis was developed involved the use of research techniques at successive stages of theory development and validation. To simplify the presentation of the research methodology, two visual models have been developed. The first visual model (Figure 1) presents Dubin's (1978) methodology for theory building which was used to develop a theory of work analysis. The second visual model (Figure 2) presents the major phases of the research methodology: the research questions, initial development of the theory, scholarly validation of the theory, practitioner validation of the theory, and synthesis of the final theory.

The major phases of Dubin's methodology for theory building are presented in Figure 1. The first five phases of the Dubin model represent the development and validation component of theory building and the scope of this study. The last three phases of the Dubin model represent the second component of taking the theory into real world contexts to conduct empirical research.

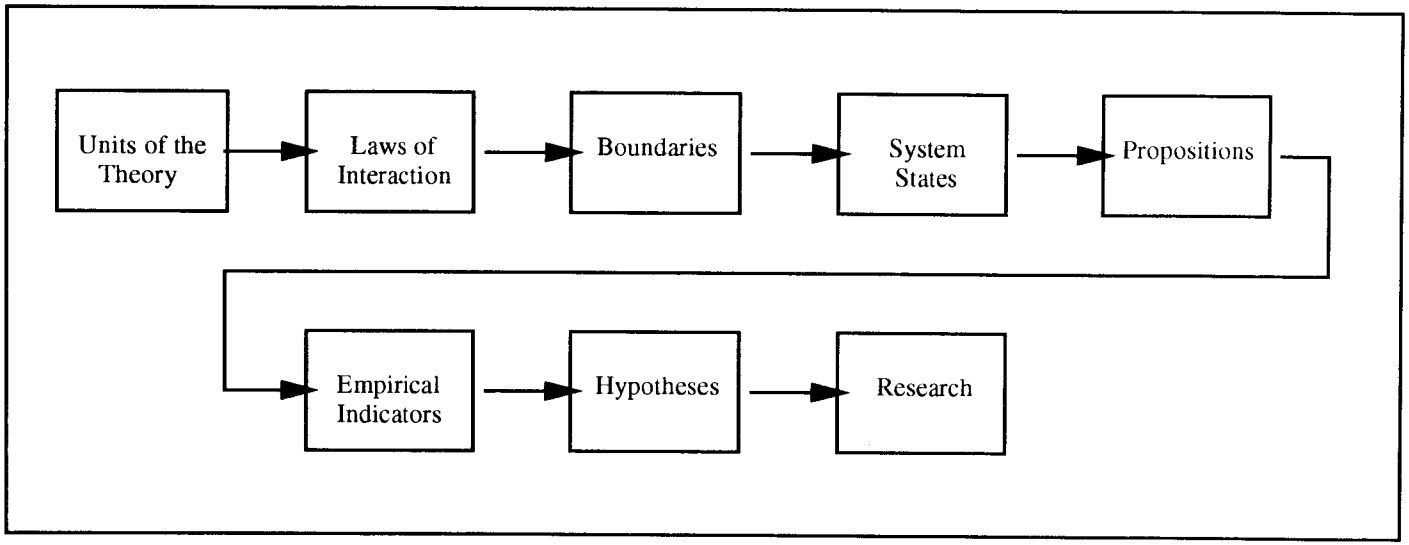


Figure 1. Dubin's Methodology for Theory Building

The specific research methodology for this study is presented in Figure 2.

Research Questions	Initial Development	Scholarly Validation	Practitioner Validation	Theory of Work Analysis
• Main Research Question • 5 Research Subquestions	• Literature	• Experts • Criteria for Evaluating Theory	• Experts	• Synthesis

Figure 2. Phases of the Research Methodology

Figure 2 shows the phases of research encompassed in building a theory of work analysis. The methods followed in each phase of Figure 2 are described in the following sections.

Research Questions

Along with Dubin's theory building model, a major research question and five subquestions guided the research effort. The major research question is: What theory of work analysis evolves from the scholarly literature?

The five subquestions are related to the first five phases of Dubin's methodology for theory building. A theory of work analysis constructed according to Dubin's methodology must address each phase of theory development. Therefore, using concepts derived from the literature on work analysis, the research was focused on developing responses to the following research subquestions:

Subquestion #1: What are the *units* of a theory of work analysis?

Subquestion #2: What are the *laws of interaction* of a theory of work analysis?

Subquestion #3: What are the *boundaries* of a theory of work analysis?

Subquestion #4: What are the *system states* of a theory of work analysis?

Subquestion #5: What are the *propositions* of a theory of work analysis?

Initial Development of the Theory

Dubin's (1978) methodology for theory building was used to develop a theory of work analysis. Dubin's methodology for theory building is suited to theory building in the behavioral sciences and has been successfully used for building theory in the field of human resource development (Berardinelli, 1991; Jacobs, 1989). Given the research questions and using Dubin's methodology, a theory of work analysis was developed from the literature on work analysis. The literature on work analysis included all the subheadings and literature listed in the "Review of the Literature" section of the study. They include:

- Technology and Work
- Work Roles and Role Theory
- Work Design and Employee Effects
- Work Design and Work Reengineering
- Process Analysis and Process Improvement
- Work Performance and Training Needs
- Job and Work Analysis
- Theory and Theory Building

Scholarly Validation of the Theory

Focus Group of Experts

The theory of work analysis was validated through critique from scholarly experts in the field of work analysis using a focus group format (Krueger, 1988). Analysis of expert opinion contributed to the development of the theory's constructs and their

interrelationships. Three scholars, who are all members of the graduate faculty of the University of Minnesota, were selected by the author on the basis of having one or more work analysis-related publications. One scholarly expert was drawn from each of three areas:

(a) Human resource development;

(b) Industrial relations; and

(c) Industrial-organizational psychology.

The scholarly experts participated in a focus group led by the author for the purpose of critiquing the theory. Criticisms of the theory generated by the focus group were then used as the basis for modifying the theory.

Validation using Criteria for Evaluating Theory

The theory of work analysis was also validated against criteria offered by Patterson (1986) for evaluating theory. Patterson's criteria for evaluating theory were selected from among six sources of criteria examined for this purpose (Caws, 1965; Gordon, 1968; Hage, 1972; Kaplan, 1964; Patterson, 1986; and Snow, 1973). The rationale for selecting Patterson's criteria are:

- they were developed as criteria for evaluating theory in the behavioral sciences and are appropriately applied to a theory of work analysis;
- these criteria reflect a high degree of overlap among all the criteria from the six sources reviewed; and
- these criteria best represent the attributes the author seeks in a theory of work analysis.

Patterson's eight criteria for evaluating theory are: (a) importance, (b) preciseness and clarity, (c) parsimony and simplicity, (d) comprehensiveness, (e) operationality, (f) empirical validity or verifiability, (g) fruitfulness, and (h) practicality. "A Theory of Work Analysis" was evaluated against each of these criteria by the author as a second source of scholarly validation of the theory.

Practitioner Validation of the Theory

The theory was also validated through critique from three practitioners who have expertise in work analysis. Practitioner experts were selected by the author on the basis of (a) being full-time practitioners in positions that require an understanding of work analysis, and (b) having analyzed work for one or more of the following purposes:

- as the basis for developing training;
- as the basis for job design or redesign; and
- as an aid to managing and evaluating work performance.

Practitioner experts critiqued the theory through written responses to six questions developed by the author to evaluate the theory. Each practitioner expert was mailed a draft copy of "A Theory of Work Analysis" (see Appendix B), guidelines for critiquing the theory (see Appendix C), and six questions for critiquing the theory (see Appendix D). Written responses to the critique questions from the practitioner experts were analyzed for criticisms of the theory that were used as a basis for modifying the theory.

Synthesis of the Theory of Work Analysis

A "two-axis matrix" synthesis model was used to integrate the validation data obtained from the focus group of scholarly experts, the evaluation using Patterson's criteria, and the responses from practitioners who critiqued the theory. A two-axis matrix synthesis model allows validation data from scholarly sources and practitioner sources to be organized and integrated within a single model (Swanson, 1994). Using the synthesis model, criticisms of the theory were divided into those that resulted in the modification of the theory and those that did not result in the modification of the theory.

CHAPTER 5

VALIDATION OF "A THEORY OF WORK ANALYSIS"

"A Theory of Work Analysis" was developed to answer the research questions presented in Chapter 4. The first draft of "A Theory of Work Analysis" (see Appendix B) was critiqued by scholarly experts, by the author using Patterson's criteria, and by practitioner experts. The validation process resulted in modifications to the theory. "A Theory of Work Analysis," which reflects these modifications, is presented in Chapter 6. The purpose of this chapter is to describe the process of validating the theory.

The central concern in the validation process is with the *construct validity* of "A Theory of Work Analysis." The construct validity of "A Theory of Work Analysis" is the degree to which the theory's constructs and their interrelationships represent the conceptual domains that they are intended to represent. Thus, the validation process is directed at the conceptual development of the theory (i.e., the *units* of the theory, the *laws of interaction,* and the other elements of the theory) using accepted criteria for evaluating theory and critique from expert scholars and practitioners. The three validation components presented in Figure 2 were used to evaluate "A Theory of Work Analysis":

- a focus group of scholarly experts on work analysis;
- critique using Patterson's criteria for evaluating theory; and
- validation of the theory by practitioner experts.

A two-axis matrix synthesis model was used to integrate the validation data obtained from scholars, practitioners, and the critique using Patterson's criteria. A description of each of the three validation components and the data that were obtained from them is presented next.

Scholarly Validation of the Theory

Focus Group of Experts

The theory of work analysis was validated through critique from experts in the field of work analysis using a focus group format (Krueger, 1988). Three scholars were selected by the author from each of three areas--human resource development, industrial relations, and industrial-organizational psychology. Each of these scholars is a member of the graduate faculty of the University of Minnesota and has one or more work analysis-related publications. Members of the focus group had been sent a draft copy of "A Theory of Work Analysis" to review prior to the focus group (see Appendix A , "Focus Group to Critique A Theory of Work Analysis" and Appendix B, "Initial Draft of A Theory of Work Analysis"). The author led the focus group, and began by stating that the purpose of the focus group was to critique "A Theory of Work Analysis" on the basis of: (a) accepted criteria for evaluating theory and, (b) any other criticisms or concerns the members of the focus group might have about the theory. Following Krueger's (1988) guidelines, the author stated that the focus group process would allow open-ended responses to questions in two ways. First, all questions posed by the author would be asked in such a way as to avoid eliciting dichotomous or "yes-no" answers. Second, after questions the author prepared for the focus group had been addressed, members could address any additional criticisms or concerns they might have about the theory. Two methods for recording data generated by the focus group were used: (a) the focus group discussion was tape-recorded with the advance permission of all members, and (b) the author took written notes on points made during the discussion (Krueger, 1988).

The author then offered the following criteria for evaluating theory developed by Patterson (1986) as the basis of critique: (a) importance, (b) preciseness and clarity, (c) parsimony and simplicity, (d) fruitfulness, and (e) practicality. Focus group members opted to proceed directly to their own criticisms and concerns about the "The Theory of Work Analysis." These criticisms dealt with four aspects of the theory:

- the term, "theory," had not been adequately defined;
- the term, "work analysis," had not been adequately defined;

- a discussion of how work analysis methods would change if "A Theory of Work Analysis" was adopted had not been presented; and
- the unit of the theory, the *worker,* did not explicitly include the notion of "worker as manager."

As a result of the focus group, modifications were made to "A Theory of Work Analysis" based on each of these four criticisms. A new section in Chapter 6, The Theory of Work Analysis, was added in which the term "theory" was clearly defined, and a new section was added in which the term "work analysis" was clearly defined. Chapter 7, The Implications of "A Theory of Work Analysis," was written in response to the criticism that no illustration had been presented of how work analysis methods would change if the theory was adopted. The fourth criticism was used as the basis for modifying the unit of the theory, the *worker,* to reflect the idea that "workers" can be managers.

Validation using Patterson's Criteria for Evaluating Theory

In this section, "A Theory of Work Analysis" is validated against criteria offered by Patterson (1986) for evaluating theory. Patterson's criteria for evaluating theory were selected from among six sources of criteria examined for this purpose (Caws, 1965; Gordon, 1968; Hage, 1972; Kaplan, 1964; Patterson, 1986; and Snow, 1973). The rationale for selecting Patterson's criteria are:

- they were developed as criteria for evaluating theory in the behavioral sciences and are appropriately applied to a theory of work analysis;
- these criteria reflect a high degree of overlap among all the criteria from the six sources reviewed; and
- these criteria best represent the attributes the researcher seeks in a theory of work analysis.

Patterson's eight criteria for evaluating theory are: (a) importance, (b) preciseness and clarity, (c) parsimony and simplicity, (d) comprehensiveness, (e) operationality, (f) empirical validity or verifiability, (g) fruitfulness, and (h) practicality. "A Theory of Work Analysis" is evaluated against each of these criteria in the following sections.

Importance. Patterson states that one measure of the importance of a theory is its applicability to more than a limited, restricted situation. He says a theory "should have some relevance to life or to real behavior" (1986, p. xx). Owing to the generous boundaries of "A Theory of Work Analysis" that extend the domain over which the theory holds to that of all human work activities (see Figure 8, The Boundaries of the "Theory of Work Analysis"), the theory is applicable to the full spectrum of activities that individuals define as their work. The boundary distinguishing the domain of work from the domain of work analysis is an "open boundary" to allow for exchange between these domains. Therefore, "A Theory of Work Analysis" has potential relevance to a significant portion of our lives. This broad range of applicability contributes to the theory's importance.

Another measure of the importance of a theory is its persistence over time in the research literature. A theory can be judged as important, in part, because it has commanded the attention of scholars and researchers over a long period of time. This perspective on the importance of "A Theory of Work Analysis" can be addressed with less certainty. Although theories on the nature and meaning of work have enjoyed a long and continuous tradition in the research literature, there have been no prior attempts to develop a theory of work analysis. With respect to the longevity of appearance in the research literature of a theory of this type, "A Theory of Work Analysis" must be judged as only marginally important. However, as greater interest in theory and theory building is generated among human resource development scholars and others interested in the analysis of work, the importance of theories, such as "A Theory of Work Analysis," may increase.

Finally, in Chapter 2, "Significance of the Research," the need for a theory of work analysis was established based on the changing nature of work and the atheoretical origins of current methods of work analysis. There is little doubt that *a* theory of work analysis is important. The degree to which *this* theory of work analysis is important will have to be judged by competent scholars and practitioners in the fields served by work analysis.

Preciseness and Clarity. Preciseness and clarity have to do with how clear and understandable a theory is. If a theory is clear and precise, it "should be understandable, internally consistent, and free from ambiguities" (Patterson, 1986, p. xx). Clarity of

expression and meaning can be tested by the ease with which a theory is related to practice, and by the extent to which a theory yields hypotheses that can be tested. On both of these measures of clarity, "A Theory of Work Analysis" compares favorably. Because the three units of the theory--*work environment, work task,* and *worker*-- were derived directly from the literature related to work analysis, and each unit is composed of elements relevant to work practices, the theory can be easily applied to work situations. For example, at the level of the *work environment,* the theory specifies that as an organization's mission and goals change, there is related change in *work tasks* and in *workers.* When an organization changes its product lines, the methods and materials used to accomplish work tasks must change, and the techniques and skills required of its workers must change. Theories that are precise and clear can be easily related to real world situations in this way.

Patterson also suggests that the preciseness and clarity of a theory can be demonstrated by the extent to which the theory yields hypotheses that can be tested. The source of hypotheses to be tested are the propositions of a theory. According to Dubin, propositions of a theory can be converted into empirical indicators for the purpose of testing the propositions through research. The propositions of "A Theory of Work Analysis" lend themselves to translation into hypotheses that can be tested (see the section entitled "Propositions of the Theory"). For example, two of the theory's propositions are that the worker and the work analyst can be the same person, and that work analysis can be conducted by a team of workers. Each of these propositions can be readily tested through workplace-based research, and could probably both be tested in the same study (e.g., having individuals and teams analyze their own work). Although further evaluation of "A Theory of Work Analysis" may identify areas of ambiguity that are not presently apparent, in terms of its applicability to practice and its potential to yield testable hypotheses, the theory seems clear and precise. With regard to the precision with which the components of the three units of the theory are defined (see Figure 10 for an illustration of the units of the theory and their components), the definitions of each component may need further refinement to improve their conceptual clarity.

Parsimony or simplicity. Parsimony means that a theory contains a minimum of complexity, is economically constructed with a limited number of concepts, and contains few assumptions. Because "A Theory of Work Analysis" requires no major assumptions and is based on a limited number of key concepts and laws of interaction, the theory is quite parsimonious in this regard. However, the opposite is true with respect to the amount of conceptual development the theory requires. The units of the theory and the laws of interaction require the explication of ideas and relationships that are, in most cases, detailed and complex. Although the theory's basic framework of concepts and interrelationships is relatively simple, "A Theory of Work Analysis" cannot be judged as parsimonious because of the extensive conceptual development it requires.

Comprehensiveness. A theory is comprehensive if it completely covers the area of interest. Comprehensiveness means that a theory accounts for all known data in the field to which it applies. The straightforward nature of the application of "A Theory of Work Analysis" to the domain of work analysis makes the theory's comprehensiveness easy to assess. The theory is comprehensive because it applies to the entire domain of work analysis. The extensive conceptual development upon which the theory's units and laws of interaction are based enable the theory to account for all known data about work analysis. Despite whatever else the theory represents, it is comprehensive.

Operationality. Operationality has to do with the extent to which a theory can be reduced to procedures for testing its propositions. Key concepts of a theory must be operationally defined with enough precision that they can be measured. As Patterson points out, however, not all concepts of a theory need to be operationalized; the purpose of some concepts is to indicate relationships and organization among concepts.

Assessing the operationality of "A Theory of Work Analysis" requires that propositions of the theory be identified, concepts of the propositions be defined, and operations for measuring the concepts be applied. The proposition stating that the content of work analysis is derived from all three units of the theory can be assessed as a measure of the theory's operationality. This is done by applying this proposition to a selected method for

analyzing work and defining each of the units of the theory--*work environment, work task,* and *worker*-- so that the work analysis method can be assessed as to whether or not its content is derived from all three units of the theory. By precisely defining the three units--*work environment, work task,* and *worker*-- one would be able to assess the degree to which the selected work analysis method was developed using research data from all three units of the theory. One would measure the number and sources of research data used to develop the work analysis method to see if the sources were from all three units of the theory, and if so, how many sources were from each unit. If this proposition was easily and clearly operationalized and applied to work analysis methods, we would expect to find that very few methods of work analysis were developed to produce analyses that communicated data reflecting all three units of the theory. Most methods produce analyses that primarily focus on one unit of the theory and largely ignored the other two units.

Similarly, the theory's operationality can be assessed using the proposition stating that the worker and the work analyst can be the same person. Again, key concepts would first need to be operationally defined and measured. The characteristics desired in a work analyst would need to be defined. The definition of a worker would need to be offered for all contexts in which work would be analyzed. Outcomes of work analysis and quality measures for each outcome would need to be specified. Ultimately, the operationality of this proposition could be assessed by determining the minimum qualifications needed by workers to produce work analysis of acceptable quality. Presumably these qualifications are related to the work experience and educational backgrounds of workers, and they should provide some indication of the criteria for the selection and training of work analysts. Based on the ease with which the propositions of the theory are applied to practical situations for testing, the operationality of "A Theory of Work Analysis" is judged to be moderately high.

Empirical validity or verifiability. The empirical validity of "A Theory of Work Analysis" cannot yet be assessed because hypotheses or predictions that can be empirically tested through research have not been specified for the theory. Eventually, however, the theory should be subjected to empirical testing to demonstrate support or disconfirmation of

the theory by research. Before research can be conducted, empirical indicators are identified for each of the theory's propositions, and the empirical indicators are then translated into hypotheses. Patterson states that, even if some of the theory's hypotheses are disconfirmed, this may lead indirectly to new knowledge by stimulating the development of a better theory.

Fruitfulness. The potential of a theory to yield hypotheses or predictions that can be tested is known "fruitfulness." The hypotheses or predictions are based on the theory's propositions. Because "A Theory of Work Analysis" offers several unique and important propositions for how work analysis methods should change, the theory's fruitfulness would seem to be relatively high. Two of the theory's propositions are that the worker and the work analyst can be the same person, and that work analysis can be conducted by a team of workers. Two additional propositions of the theory are that the content of work analysis is derived from all three units of the theory, and that work analysis applied to one unit must account for change in the other two units. Each of these propositions contributes to the fruitfulness of the theory and can be tested through workplace-based research.

Practicality. A theory is practical if it is useful to researchers and practitioners in organizing their thinking about the phenomena addressed by the theory. Whether a theory's contribution to thinking and theoretical knowledge is useful or not can only be assessed by the user of the theory. "A Theory of Work Analysis" is judged as being practical because it provides a straightforward conceptual model for organizing thinking about work analysis. The general types and effectiveness of work analysis methods can be quickly assessed against the three-dimensional model of the theory representing the units of the theory--*work environment, work task,* and *worker* (see Figure 10). The theory also allows the rational application of basic principles of work analysis to a wide variety of work situations. It also helps the theory's rating on practicality that there is no other known theory of work analysis to provide this kind of conceptual guidance.

In summary, the evaluation of "A Theory of Work Analysis" using Patterson's criteria yielded mixed results. The theory is generally strong in the areas of "importance,"

"comprehensiveness," operationality," "fruitfulness," and "practicality." The theory is weaker in the areas of "preciseness and clarity" and "parsimony or simplicity." The "empirical validity" of the theory cannot yet be assessed.

Practitioner Validation of the Theory

"A Theory of Work Analysis" was also validated through critique from three work analysis experts. Practitioner experts critiqued the theory through written responses to questions for evaluating theory. Practitioner experts were selected by the author on the basis of (a) being full-time practitioners in positions that require an understanding of work analysis, and (b) having analyzed work for one or more of the following purposes:

- as the basis for developing training;
- as the basis for job design or redesign; and
- as an aid to managing and evaluating work performance.

The three practitioner experts selected to critique the theory hold the following organizational roles: the president of a consulting firm which regularly analyzes work for clients, the director of quality for a regional hospital, and the employee development specialist for a state Department of Employee Relations.

Each of these practitioner experts was mailed a draft copy of "A Theory of Work Analysis" (see Appendix B), guidelines for critiquing the theory (see Appendix C), and six questions for critiquing the theory developed by the author (see Appendix D). Each written response from the practitioner experts addressed all of the six critique questions (see Appendix E for the written responses from the three practitioner experts). Responses were analyzed for criticisms of the theory that were used as a basis for modifying the theory.

Three criticisms from the practitioner experts were identified that resulted in the modification of the theory. Other criticisms and comments on the theory made by the practitioners were already reflected in the theory and, therefore, did not result in the modification of the theory. The criticisms that were used as a basis for modifying the theory are:

- a discussion of how "A Theory of Work Analysis" would be applied to practice had not been presented;
- the "ability" component of the unit of the theory, the *worker,* had not been clearly defined; and
- the unit of the theory, the *work environment,* should reflect the physical characteristics of the work environment.

Modifications were made to "A Theory of Work Analysis" based on each of these three criticisms. Chapter 7, The Implications of the "Theory of Work Analysis," was written in response to the criticism that no example or illustration had been presented of how the theory would be applied to practice. The section on "Worker Ability" in Chapter 6 was rewritten to reflect the thoughtful and accurate criticism that the original discussion of ability was weighted toward genetic determinants and did not reflect experiential and environmental influences on ability. The final criticism identified an important deficiency in the unit of the theory, the *work environment.* As originally developed, *work environment* did not reflect physical characteristics of the environment, such as heat, cold, noise, risk to workers, and other features of the environment. The unit of the theory, the *work environment,* was modified to reflect this important dimension.

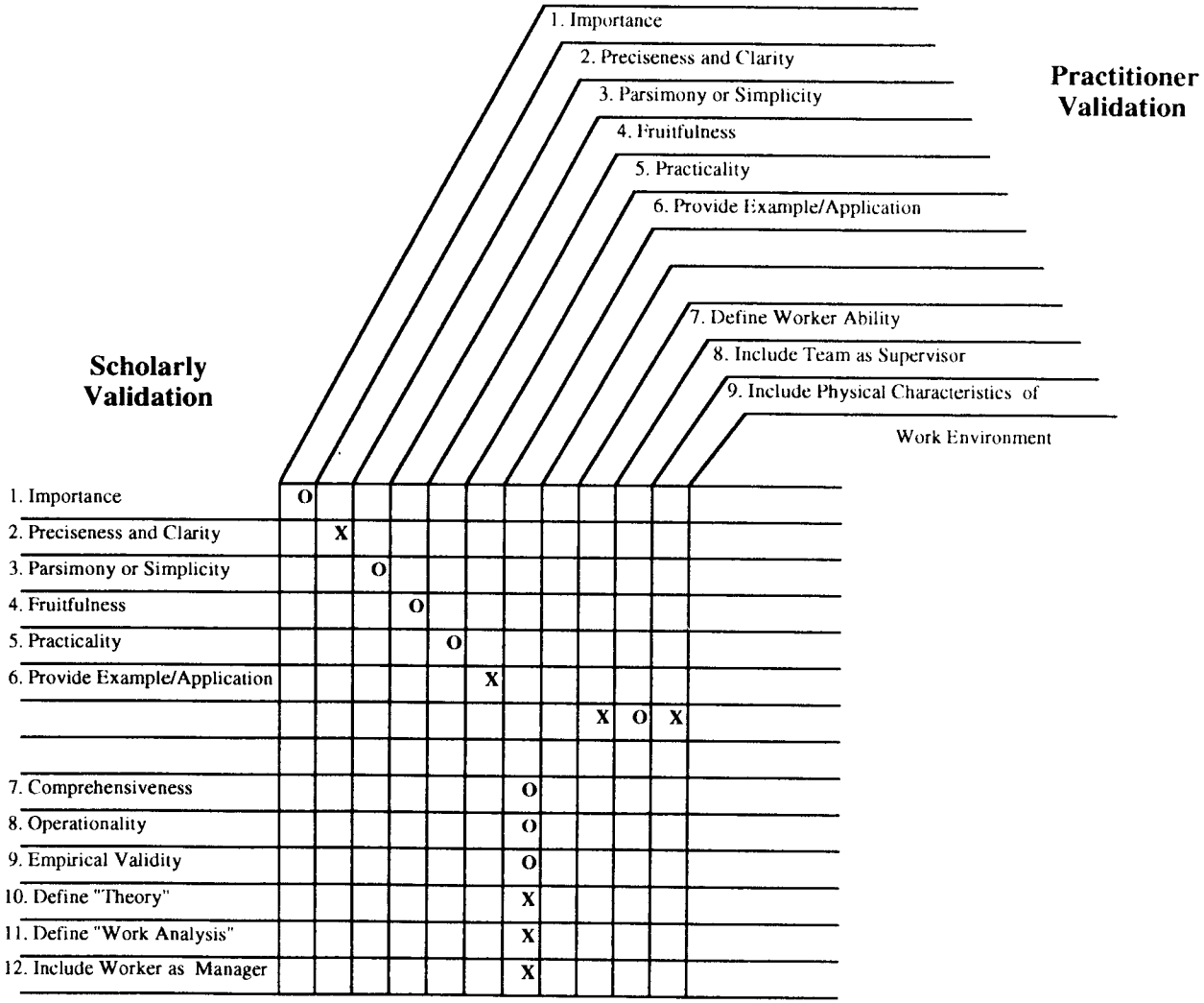
An additional criticism of the theory suggested that the theory should be modified to reflect the notion of "team as supervisor." This criticism is based on the idea that work teams have assumed the functions traditionally served by supervisors. This is an important and accurate observation because one of the greatest benefits of effective teamwork is the self-direction of work it provides. The value of self-directed work accrues to both the organization as a whole and to the team members themselves. However, this feature of teams was already incorporated into the "worker as team" component of the theory based on relevant literature (Cooke, 1992; Makjuka, 1991). It is also reflected in a key statement made in the "Laws of Interaction" section of Chapter 6 about how work tasks are changing due to the self-directed nature of teams, "Work parameters and specifications are developed by the team rather than imposed from outside the team" (p. 159). For these reasons, modification of the theory to reflect this criticism was not necessary.

Synthesis of the Validation Data

A "two-axis matrix" synthesis model was used to integrate the validation data obtained from scholars, practitioners, and the critique using Patterson's criteria for evaluating theory. A two-axis matrix synthesis model was selected because it allows validation data from scholarly sources and practitioner sources to be organized and integrated within a single model. A two-axis matrix is created by arranging one set of variables along a horizontal axis and a second set of variables along a vertical axis. The cells where the two axes intersect can either be filled with symbols and information or may be left empty (Swanson, 1994). The synthesis model used to integrate the validation data from scholarly sources and practitioner sources is shown in Figure 3.

The synthesis model in Figure 3 summarizes the criticisms of the theory and the modifications to the theory based on these criticisms described in the two previous sections. Validation data from the two scholarly sources, the focus group and the critique done by the author using Patterson's criteria for evaluating theory, are arranged along the vertical axis. Validation data from the written responses of practitioner experts to the six questions for critiquing the theory are arranged along the horizontal axis. Appropriate cells of the matrix have been filled with either an "X" or an "O." An "X" indicates a criticism of the theory that resulted in the modification of the theory. An "O" indicates a criticism of the theory that did not result in the modification of the theory.

The first six sources of validation data on both axes can be directly integrated because they address the same criticisms of the theory. Criticisms of the theory's "preciseness and clarity" from both practitioners and the author resulted in concepts of the theory being more clearly defined (indicated by the "X" in the appropriate cell). Criticisms to provide an example or application of the theory resulted in the writing of Chapter 7, The Implications of the "Theory of Work Analysis." It was not necessary to address the other sources of validation data because the theory already reflected these criteria (indicated by the "O"s in the appropriate cells). The diagonal line of "X"s and "O"s through the cells of the matrix indicates the six sources of validation data common to both scholars and practitioners.



KEY: X = Criticism of the theory that resulted in the modification of the theory.
O = Criticism of the theory that did not result in the modification of the theory.

Figure 3. Synthesis Model

Criticisms 10, 11, and 12 on the "Scholarly Validation" axis resulted in substantive modifications to the theory described previously in the section entitled "Focus Group of Experts." Criticisms 7, 8, and 9 on the "Scholarly Validation" axis did not result in the modification of the theory because the theory already reflected these criteria (indicated by the "O"s in the appropriate cells).

Criticisms 7 and 9 on the "Practitioner Validation" axis resulted in substantive modifications to the theory described previously in the section entitled "Practitioner Validation of the Theory." Criticism 8 on the "Practitioner Validation" axis did not result in the modification of the theory because the theory already reflected this criterion (indicated by the "O" in the appropriate cell).

CHAPTER 6

A THEORY OF WORK ANALYSIS

A theory of work analysis is needed to support a broader conception of work analysis. Present approaches to work analysis are deficient in the following ways:

- The notion of a *job* is central to current methods of analyzing work and is the starting point for several methods of work analysis. Yet in today's organizations where jobs are being eliminated, combined, and reconfigured, the *job* is simply too fluid to be a meaningful starting point for the analysis of work.
- The work team is displacing the individual worker as the basic unit of work performance. Yet, current methods of analyzing human capabilities for work are primarily focused on the individual, not the team.
- Although the flow of work in today's organizations is increasingly cross-functional, data collection in current methods of work analysis generally occurs within a single department or function of the organization.
- Current methods of work analysis reflect the assumption that work locations are stable. Yet, advances in communication technology increasingly give rise to "work organizations without location."

Traditional, atheoretical methods of work analysis have been designed for static work environments where organizational structures and the nature of work itself were stable by comparison to today's work environment. The dynamic, continuously evolving workplace of today requires work analysis based on theory that is constant and can support specific work analysis methods as they are updated and revised. As work changes, work analysis methods must change. A stable, conceptually sound theory of work analysis is needed to guide and support this change.

The purpose of this chapter is to present "A Theory of Work Analysis" developed in this study. Before this can be done, several important definitions must be offered. First, the meaning of "theory" will be defined, followed by the definition of "work analysis." Then,

the meaning of the three units of the theory--"worker," "work task," and "work environment"--will be defined using the component ideas from which each concept was synthesized.

The Definition of "Theory"

A theory is a system for explaining a set of phenomena that specifies the key concepts that are operative in the phenomena and the laws that relate the concepts to each other. A theory is an attempt to model some aspect of the real world. It helps us decide what concepts and relationships are worth paying attention to in a given context and what to do about them when problems occur. A theory tries to make sense out of the observable world by identifying the most important elements of a phenomenon and by ordering the relationships among these elements. Practitioners and behavioral scientists are guided by a wide range of theories on organizational behavior, work motivation, job satisfaction, leadership styles, and human performance. For "A Theory of Work Analysis," the main phenomena of interest arise from the concepts of the "work environment," the "work task," the "worker," and the interrelationships among these elements.

The Definition of "Work Analysis"

A theory of work analysis that is intended to guide and support changes in work analysis methods must start with a definition of what is meant by "work analysis." The analysis of work is an important prerequisite for human resource development, industrial engineering, operations management, industrial-organizational psychology and other work-oriented disciplines. In applied behavioral science fields, work analysis is used to define jobs and work roles, to identify the training needs of workers, to design the flow and structure of work, and to plan performance improvement efforts at the individual, process, and organizational levels. Because work analysis serves many purposes within several disciplines, it must be defined broadly enough to encompass the diverse roles for which it is used.

Work analysis is an inductive process for analyzing work that begins by collecting data through some combination of observations, interviews, questionnaires, and by reviewing

documents. From these sources of data, characteristics of the work environment, work tasks, and the workers can be established. Although work analysis is sometimes used to integrate mechanical, physical, and human factors into the design (and redesign) of work systems that maximize the reliability and efficiency of performance, work analysis also reflects the needs and values of workers. Because descriptive accuracy is an important criterion of work analysis, there should be a high level of agreement among those who perform and manage the work on the characteristics of work specified by the analysis. Reflecting a systems perspective, work analysis is a component of a larger systems framework that assures that work analysis leads to the outcomes it is intended to produce. The work-related purposes and contexts for which work analysis is used in this study include:

- work analysis for the purposes of defining, learning about, designing, and performing work;
- work performed by an individual, by a group, or by an organization;
- work analyzed in public or private organizations;
- work in organizations with or without financial profit-seeking goals;
- work conducted in the past, present, or future;
- work conducted in variable locations and conditions (e.g., in the office, field, automobile, home, and other settings).

The Definition of "Worker"

The unit of the theory *worker* is based on the human capabilities required to do work. It is conceptually distinct from the work content (i.e., the *work task)* to which it is applied. That is, the person who performs the work is conceptually distinct from the work task to be performed. The component ideas from which the unit of the theory, *worker,* was synthesized derive from the human capabilities needed to perform work. These capabilities for work are the worker's ability, knowledge and skill, and motivation. In addition, because of growing evidence that the work team is gradually displacing the individual worker as the basic unit of work performance, it is argued that the concept of *worker* must be expanded to include the idea of "worker as team." Therefore, the following component

ideas form the basis for the conceptual development of the unit of the theory, the *worker:* ability, knowledge and skill, motivation, and worker as team.

The Definition of "Work Task"

The unit, *work task,* exists independent of who performs it (the worker). The work task consists of the activities to be performed to achieve work outcomes. The tasks of assembling a product or making a decision exist apart from who performs the assembly or makes the decision. Farina and Wheaton (1973), who have studied work tasks and task components extensively, defined a task as "a complex situation capable of eliciting goal-directed performance from an operator" (p.26). They conceived of tasks as having five task components, each of which possessed certain salient characteristics. The task components identified by Farina and Wheaton are an explicit goal, input stimuli, procedures, responses, and stimulus-response relationships. In addition, the pervasiveness and importance of the concepts of work *process* and *technology* justify their conceptual development as components of the unit of the theory, *work task.*

The Definition of "Work Environment"

A conception of *work environment* that is suitable for a theory of work analysis should capture a number of dimensions of the environment in which work is accomplished. These dimensions should include salient features of the organization in which work is being accomplished and the external environment that is relevant to the organization. *Work environment* should also represent the physical and emotional environment in which work is being performed. The unit of the theory, *work environment,* is therefore, a synthesis of several component ideas that are represented in every work environment regardless its size or the number of workers who function within it. The component ideas selected by the author from which the unit, *work environment,* was synthesized are: organization structure, organization mission and goals, psychological/emotional atmosphere of the work environment, location and physical characteristics of the work environment, and external environment of relevance to the organization. In addition, the pervasiveness and

importance of the concepts of work *process* and *technology* justify their conceptual development as components of the unit of the theory, *work environment.*

Overview of "A Theory of Work Analysis"

"A Theory of Work Analysis" is structured according to Dubin's (1978) methodology for theory building. The first five elements of Dubin's methodology are shown in Figure 4. Each of these five elements represents a necessary phase of theory building that must be systematically addressed according to Dubin's methodology. No single phase, nor any partial combination of the five phases completely captures a theory of work analysis. All five phases taken as a whole constitute "A Theory of Work Analysis."

Consequently, this chapter of the study which presents "A Theory of Work Analysis" is organized according to the five phases of Dubin's methodology (see Figure 4). Each of the sections of this chapter addresses a phase of Dubin's methodology beginning with *Units of the Theory* and ending with *Propositions.* Dubin's methodology requires that key concepts of the theory are identified (Dubin refers to key concepts as "units" of the theory), and that the units are conceptually developed and related to one another. The initial conceptual development of the units is presented in the section entitled *Units of the Theory,* and the units are related to each other in the section entitled *Laws of Interaction.* Because the conceptual development needed for theory building is extensive, the first two sections of this chapter are relatively lengthy. Indeed, the sections *Units of the Theory* and *Laws of Interaction* represent approximately seventy-five percent of the total volume of work in this chapter.

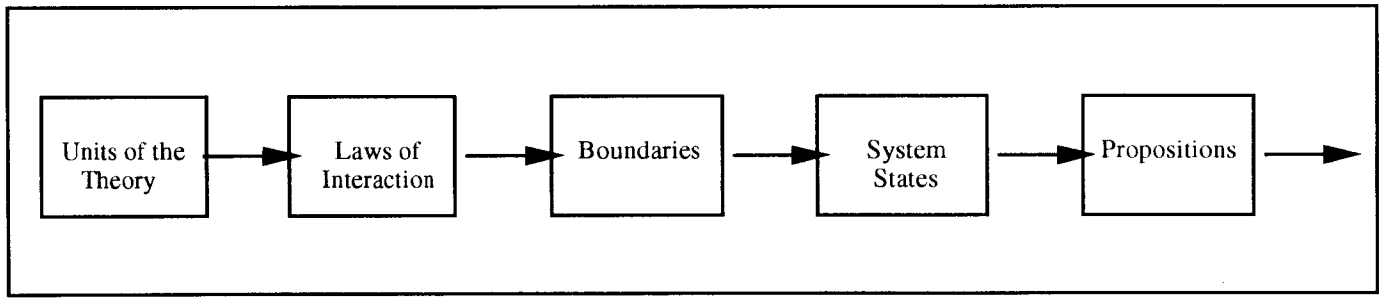


Figure 4. The First Five Phases of Dubin's Methodology for Theory Building

Units of the Theory

The units of a theory are the elements or variables that constitute the subject matter addressed by the theory. The units interact with each other in ways specified by the theory. According to Dubin (1978), the specification of the units of a theory and the laws by which the units interact constitutes the major potential contribution to knowledge generated by a theory.

Herzberg's (1966) two-factor theory of work motivation provides an example of a theory that reflects the first five phases of Dubin's theory building methodology. It will be used as an example as each of the five phases of theory building is discussed in this chapter. Dubin (1976) has used Herzberg's theory to illustrate his own theory building methodology.

Herzberg's theory of work motivation has four variables or "units of the theory:" (1) extrinsic motivation factors; (2) intrinsic motivation factors; (3) satisfaction with work; and, (4) dissatisfaction with work. Extrinsic motivation factors, such as pay, company policies and procedures, and working conditions, arise from outside the worker (Herzberg called these "hygiene factors"), and intrinsic motivation factors, such as achievement, recognition, and advancement, arise in response to needs that exist within the worker (Herzberg called these "motivational factors"). Worker satisfaction and dissatisfaction are reactions to work situations that give rise to such feelings in the worker. Herzberg's theory suggests that worker satisfaction is optimized when addressing "motivational factors" produces satisfaction and addressing "hygiene factors" prevents dissatisfaction. Thus, the four units of Herzberg's theory are extrinsic motivators, intrinsic motivators, worker satisfaction, and worker dissatisfaction. The interrelationships among these four units (the Laws of Interaction discussed in the next section) constitute the majority of Herzberg's contribution to our knowledge of work motivation.

The units of "A Theory of Work Analysis" are the *work environment,* the *work task,* and the *worker.* A major distinction among the units of the theory *work environment, work task,* and *worker* is the conceptual scope of these units. The unit of the theory with the broadest conceptual scope is *work environment.* Within the work environment exist the

units, *work task* and *worker.* Each of these units of "A Theory of Work Analysis" is a synthesis of ideas that the author feels best contribute to a conceptually sound unit that interrelates in a meaningful way with other units of the theory. Each of these unit of "A Theory of Work Analysis" and the component ideas from which each unit was synthesized are described next.

Units of the Theory: The Work Environment

A conception of *work environment* that is suitable for a theory of work analysis should capture a number of dimensions of the environment in which work is accomplished. These dimensions should include salient features of the organization in which work is being accomplished and the external environment that is relevant to the organization. *Work environment* should also represent the physical and emotional environment in which work is being performed. The unit of the theory, *work environment,* is therefore, a synthesis of several component ideas that are represented in every work environment regardless of its size or the number of workers who function within it. The component ideas selected by the author from which the unit, *work environment,* was synthesized are:

- organization structure;
- organization mission and goals;
- psychological/emotional atmosphere of the work environment;
- location and physical characteristics of the work environment; and
- external environment of relevance to the organization.

Each of these five components of the unit *work environment* is briefly described in the following sections and supported by constructs developed by leading authors who have written about work environments. [Five works from which constructs are taken are discussed in the "Review of the Literature" chapter of this study. These works are Nadler, Gerstein and Shaw (1992); Rummler and Brache (1990); Hackman and Oldham (1980); McLagan (1989); and Zuboff (1988)].

Organization structure is the overall design of the organization that provides a framework within which the functions and resources of the organization interact. Nadler, Gerstein and Shaw (1992) use the architecture metaphor for discussing the subject of

organization structure. They take a systemic view of the structure of organizations and the ways in which organizational structure is changed. The authors start from the premise that those interested in changing the organization's structure, the organizational designers, effect change to improve organizational effectiveness. The authors maintain that if design change is to have this effect, organizational designers must attend to design change within three major dimensions of the organization--the *formal organization,* the *informal organization,* and the *design of senior management.*

The organization mission and goals identify the markets and customers the organization wishes to serve, and state the expectations the organization has related to these markets and customers. Rummler and Brache (1990) maintain that organizational performance is enhanced when the organization's mission and goals have been derived from an analysis of external threats and opportunities and internal strengths and weaknesses. The mission and goals should reflect the philosophy and values of the organization and should be based on critical success factors in the industry in which the organization wishes to succeed. Once formulated, the organization's mission and goals should be articulated and clearly communicated to the organization's key constituencies.

The psychological and emotional atmosphere of the work environment reflects the quality of the inter-group and intra-group relationships in the work environment. According to Hackman and Oldham (1980), the psychological and emotional atmosphere of the work environment is increasingly perceived as positive as those who are working in the environment achieve a sense of common purpose. Hackman and Oldham's model of work group effectiveness identifies three criteria that indicate whether or not the desired psychological atmosphere has been achieved. The desired state is achieved when: (a) members' needs are more satisfied than frustrated by a work experience; (b) the capacity of members to work together on subsequent projects is maintained or enhanced; and (c) output of the group meets or exceeds organizational standards of quality and quantity. Hackman and Oldham offer prescriptions for designing the work experiences of groups which they maintain enhance morale and productivity in the work environment.

Location and physical characteristics represent a seemingly straightforward dimension of the work environment. The location of work can be the factory floor, the home, or any

other location that supports the performance of work. When work goals require that the immediate environment varies over time, the general environment of work can include a sales territory or some other geographic region. The physical characteristics of the work environment include heat, cold, noise, level of illumination, degree of physical comfort, risk to workers, and other features of the work environment.

Yet, the location of today's work environment is less stable than in the past. Communication technology has enabled work environments to exist virtually anywhere and has created the notion of an "organization without location" (Weick, 1990). Weick describes technology's influence on work as esoteric, uncertain, and complex due to characteristics of new technologies that include its ability to link together previously inaccessible functions and locations. Weick's notion of an organization without location reflects communication technology's capacity to "knit separate actors, transactions, and locations together into a continuous process" (p. 12). For the individual, work can be conducted in one's office, home, and automobile; for the organization, business can be transacted locally as well as globally.

The external environment of relevance to the organization includes all of the forces external to the organization that influence its mission and goals, and shape the ways it uses its resources to achieve its goals. The external environment can include local forces in the community, forces in the organization's industry, and broader forces in society and the global economy. McLagan (1989) takes an open system view of organizations that reflects an organization's need to undergo constant change if it is to remain responsive to outside influences. McLagan offers a tiered view of systems with the organization and its subsystems at the center of a model that shows systems becoming increasingly larger as one proceeds from organization to industry, from industry to socio-economic political system, and finally, from socio-economic political system to ecological system.

As indicated by the last two components of the unit of the theory *work environment,* "location and physical characteristics of the work environment" and "external environment of relevance to the organization," *work environment* is a construct that extends beyond the environment that exists within the organization itself.

Although no single description of a work environment is best suited as an example of this concept, Zuboff's (1988) work best captures the meaning of "work environment" in the sense that it is used as a unit of "A Theory of Work Analysis." Her research on how information technology has fundamentally changed the ways in which organizations accomplish work brings together analyses of technical and social phenomena both internal and external to the organizations she studied. Zuboff describes work environments in which complex networks of information technology link organizations and revolutionize work through their "informating" and "automating" powers. Her work also features the personal narratives of workers from all organizational levels, and suggests that traditional notions of managerial authority and structure restrict the sharing of knowledge needed by all workers if organizations are to make the most of "informated" work environments. Zuboff's conception of work environment is not limited to a single organization, for she has carefully shown how political, cultural, and economic forces external to organizations as diverse as insurance companies and paper mills have influenced their internal policies and practices and external relationships. Although she does not reduce the notion of work environment to a concise definition, her comprehensive study of eight organizations in several industries develops a rich sense of the meaning of *work environment.*

The *work task* is the next unit of the theory to be examined and is fully developed as a concept in the next section. A work task consists of a discrete set of activities that is normally accomplished by a worker or a group of workers within the context of the work environment. The unit of the theory *work task* is conceptualized as existing within the unit of the theory *work environment.* The unit *work task* exists "within" the *work environment* in the sense that a work task is accomplished within some organizational or environmental structure to achieve work goals. Whether the environment is a small family business or a multinational corporation, work tasks are conceived as essential components or building blocks of the work environment.

For example, in the work environment of the insurance industry, work tasks involve the development of actuarial data and the assessment of insurance risks. In the work environment of overnight delivery services, work tasks involve sorting and routing freight according to precise delivery routes and schedules. As these examples illustrate, a major

distinction between the units of the theory *work environment* and *work task* is one of conceptual scope. The *work task* is conceptualized as an essential component or building block of the *work environment.* The *work environment* is a broader notion that embraces environments that are internal and external to the organization and that, from a conceptual perspective, include the notion of *work tasks,* which are internal to the organization.

Units of the Theory: The Work Task

The unit, *work task,* exists independent of who performs it (the worker). The work task consists of the activities to be performed to achieve work outcomes. The tasks of assembling a product or making a decision exist apart from who performs the assembly or makes the decision. Farina and Wheaton (1973), who have studied work tasks and task components extensively, defined a task as "a complex situation capable of eliciting goal-directed performance from an operator" (p.26). They conceived of tasks as having five task components, each of which possessed certain salient characteristics. The task components identified by Farina and Wheaton are an explicit goal, input stimuli, procedures, responses, and stimulus-response relationships. The relationship among the task, task components and task characteristics is shown in Figure 5.

TASK	TASK COMPONENTS	TASK CHARACTERISTICS
Task	Goal	• Number of output units • Duration for which an output unit is maintained • Number of elements per output unit • Work load imposed by task goal • Difficulty of goal attainment
	Input Stimuli	• Variability • Duration • Regularity of stimulus occurrence
	Procedures	• Number of steps • Dependency among procedural steps • Adherence to procedures • Procedural complexity
	Responses	• Precision • Rate • Simultaneity of responses • Amount of muscular effort involved
	Stimulus-Response Relationship	• Degree of operator control • Reaction time/feedback lag relationship • Decision making

Figure 5. Relationship among Task, Components, and Characteristics

Farina and Wheaton's conception of work *task* was selected as the basis for conceptualizing this unit of the theory because it captures the essence of the immediate work situation rather than the capabilities workers need to perform tasks. Each of the nineteen task characteristics listed in Figure 5 was derived from "task characteristic rating scales" developed by the authors in which subjects rated a wide variety of actual work tasks on these nineteen characteristics. Some examples of the tasks that were rated include:

- Performing an aircraft preflight evaluation;
- Solving trigonometric problems;
- Replacing the mainspring of a wristwatch;

- Balancing equations for basic chemical reactions; and
- Firing an automatic rifle.

As Fleishman and Quaintance (1984) observe, the approach to describing tasks that has been most extensively developed is the "ability requirements" approach, which describes tasks in terms of the capabilities of the worker required to perform them effectively.

Farina and Wheaton's notion of task is quite different, however, in that it conceptualizes a work task as a situation distinct from the worker's abilities, skills, and motivation to perform the task. Farina and Wheaton's notion of task reflects the procedures, techniques, and variables of the task itself, rather than focusing on the abilities required to perform it. This conception of *work task* is important to "A Theory of Work Analysis" because of the existence of the unit of the theory, *worker,* which represents ideas that are similar to the "ability requirements" approach to task description. Choosing an "ability requirements" approach as the basis for conceptualizing the notion of task would result in the units of the theory work *task* and *worker* being too similar to each other for conceptual clarity. Farina and Wheaton's conception of *task* best captures the essence of the immediate work situation and keeps the concepts *work task* and *worker* conceptually distinct from each other.

The concepts of work *process* and *technology*. Two ideas that are central to the nature of contemporary work and how it is analyzed are work *process* and *technology.* The concepts of *process* and *technology* represent distinctly different influences on work. Work *process* is primarily a design construct that communicates how work is organized. *Technology* has a more intrinsic influence on work. Technology shapes the substance of work and embodies the knowledge and means by which work is accomplished. Both of these ideas, work *process* and *technology,* have a pervasive influence on work at all levels at which work is analyzed. The purpose of the following sections is to establish that the concepts of work *process* and *technology* rightfully belong to both units of the theory--*work environment* and *work task.* That is, the pervasiveness and importance of work *process* and *technology* justify their conceptual development at both the *work environment* and *work task* levels.

The next section examines work *process* as a conceptual component of both *work environment* and *work task.* The following section conceptualizes *technology* at both of these levels. Each section begins with a definition of the component derived from the literature.

Work process at the work environment and work task levels. Work *process* is a conceptual component of both *work environment* and *work task.* The concept of work *process* is pervasive enough in the workplace to apply to both levels, and it is central to current thinking about how work should be structured and improved. Two aspects of work *process* give it the breadth and importance necessary for it to be viewed as a dimension of the *work environment:* the cross-functional nature of processes in the workplace and the centrality of process improvement to total quality management (TQM).

In the "Review of the Literature" for this study, a work process is characterized as having identifiable inputs and outputs, as being of variable size and scope, and as composed of stages or component processes. Larger, more complex processes that span the boundaries between organizational units are called "cross-functional" processes because they typically require activities that draw on multiple functional areas. The idea that larger, complex processes flow through multiple functional units and interconnect components of organizations gives the concept of *process* the range and breadth it needs to be conceptualized as a component of the *work environment* (Davenport, 1993; Swanson, 1994). Indeed, processes such as providing customer service and developing new products are important and pervasive enough to require the attention of nearly all the major functional units of an organization. It is in this sense that work *process* should be viewed as a dimension of the *work environment.*

The centrality of work *process* to TQM also gives it importance and breadth and justifies work *process* as a conceptual component of *work environment.* Process improvement is a goal that is central to TQM. Furthermore, TQM is not simply a set of management practices; it is a philosophy of management that must be applied organization-wide to be successful. Thus, the centrality of work *process* to the TQM philosophy gives it highly

visible status in organizations and further justifies it as a conceptual dimension of *work environment.*

The concept of work *process* is equally applicable at the level of the *work task.* Schultz and Schroeder (1990) define a process as "a collection of cause factors which can be translated into a sequence of tasks, activities, or functions to produce a given output. The cause factors typically include people, machines, materials, methods, and environment. The translation of these cause factors leads to various stages of the process. Each of the stages could itself be considered a process" (p. 2). Schultz and Schroeder consider the people, machines, materials, methods, and environment as inputs to the process. They also recognize that a process can be composed of various stages, with each stage itself considered a process. This conception of *process* is more focused and task-specific than the idea that work *processes* flow cross-functionally through multiple departmental units and interconnect the components of an organization. For example, the process of preparing a restaurant meal involves inputs (the customer's order, unprepared food, and so on), a related set of food preparation processes (preparing and cooking the food), and outputs (the meal itself and the customer's check). Similarly, the process of loading a printing press with paper requires inputs (paper), a related set of processes (selecting, loading, and adjusting paper), and outputs (a press with paper that is ready for a pressrun). These examples of work at the task level demonstrate that work *process,* when it is defined in a limited way, fits well with the concept of *work task.*

Technology at the work environment and work task levels. Technology is also a factor that is important and pervasive enough in the workplace to justify its conceptual development at the *work environment* and *work task* levels. Technology is a means through which work is accomplished. Berniker embeds the concept of "technology" within the larger structure of "a technical system." Berniker (1987) defines a technical system as "a specific combination of machines, equipment, and methods used to produce some valued outcome . . . . Every technical system embodies a technology. It derives from a large body of knowledge which provides the basis for design decisions. Technology refers to a

body of knowledge about the means by which we work on the world, our arts and our methods" (p. 10).

Following Berniker's ideas, technology can be defined as knowledge within a technical system. The notion of technology residing in a technical system distinguishes the two constructs of "technology" and "technical system," and allows the choice of technology and the design of the technical system to be more explicit than with a unidimensional conception of technology. Viewing technology as knowledge within a technical system allows the design of technology to be a more explicit, public process. Rather than accepting technology as "a thing" with its attendant constraints and requirements [the *technological determinism* described by Davis and Taylor (1976)], technology is a flexible set of means for accomplishing work. Technology is a variable, not a given.

The influence of technology pervades all dimensions of the *work environment.* Technology as "knowledge within a technical system" can be used for many purposes including production, communication, and systems integration. Because production technology enables the creation of new products and services, and information technology can add value to existing products and services, new markets in the business environment supported by technical innovation are continuously being developed. The mission and goals of an organization should, in turn, reflect the markets to be served. As technology reshapes an organization's products and services, it also influences the relationships among workers throughout the environment. For example, Zuboff (1988) describes the effects of information technology in the international banking industry as both revolutionary and depersonalizing. The "informating" power of technology enables the creation of new customized banking products, on-line cash management, foreign exchange services, and electronic funds transfer that were only futuristic ideas a decade ago. On the other hand, information technology creates more distance between people, as in the case of large-scale business loans where the transactions can take place without the lender and client ever meeting face-to-face. Bank workers lament that developing the "gut feeling" for an investment opportunity or credit risk is being displaced by impersonal, on-line data that workers feel can be less reliable. Thus, international banking and other industries face opportunities and challenges as technology reshapes the work environment.

Technology's effects are just as profound at the level of the *work task.* For example, Giordano (1992) studied how technology is changing the work of engineers, drafters, and machinists in the computer industry. Giordano found that computerization has both skill upgrading and deskilling effects on machining tasks. The results of her research indicate a relationship that is complex and seemingly contradictory in that skill changes within machining work can shift simultaneously in both directions. As computerization automates the work traditionally performed by a machinist, two distinct types of machining expertise become apparent: the procedural skills that have historically defined this occupation, and the abstract, cognitive processes now needed by machinists to process computerized information. Although automation simplifies and, in effect, deskills parts of the machinist's job, the overall effects of computerization on machining increase the skills required of machinists who must now program and operate advanced machine tools. (Giordano also found that technology confronts decision makers with new choices regarding the selection and implementation of technical systems, and the distribution of authority. See the "Review of the Literature" for a discussion of Giordano's work). Because technology profoundly influences the outcomes of tasks and the means and skills needed to perform them, technology is rightfully a conceptual component of *work task.*

In summarizing the preceding discussion of work *process* and *technology* at the work environment and work task levels, work *process* and *technology* are considered important conceptual components of both units of the theory, *work environment* and *work task.* Given the five component ideas from which *work environment* was synthesized earlier, this unit of the theory is now amended to include the following conceptual components:

- organization structure;
- organization mission and goals;
- psychological/emotional atmosphere of the work environment;
- location and physical characteristics of the work environment;
- external environment of relevance to the organization;
- work process; and
- technology.

Similarly, given the five component ideas from Farina and Wheaton's conception of task from which *work task* was synthesized, this unit of the theory is also amended to include the following conceptual components:

- goal;
- input stimuli;
- procedures;
- responses;
- stimulus-response relationship;
- work process; and
- technology.

Units of the Theory: The Worker

The unit of the theory *worker* is based on the human capabilities required to do work. It is conceptually distinct from the work content (i.e., the *work task)* to which it is applied. That is, the person who performs the work is conceptually distinct from the work task to be performed. The component ideas from which the unit of the theory, *worker,* was synthesized derive from the human capabilities needed to perform work. These capabilities for work are the worker's ability, knowledge and skill, and motivation. In addition, because of growing evidence that the work team is gradually displacing the individual worker as the basic unit of work performance, it is argued that the concept of *worker* must be expanded to include the idea of "worker as team." Therefore, the following component ideas form the basis for the conceptual development of the unit of the theory, the *worker:*

- ability;
- knowledge and skill;
- motivation; and
- worker as team.

Each of these component ideas is briefly defined and discussed next. This section concludes with a summary description of the unit the theory, the *worker.*

Worker ability. Ability is a stable characteristic of workers that is, for the most part, unaffected by education and training (Campbell and Campbell, 1990). Ability is a general capacity of workers that supports the performance of a variety of related tasks. Traits such as proficiency in mathematics, linguistics, or spatial relationships appear to be, at least to some degree, abilities that are genetically determined. Ability persists over long periods of time, whereas the duration of task-related knowledge and skill is shorter and is more dependent on practice and learning. Individual differences in general verbal ability, upper body strength, and ease of social interaction make it possible for some people to learn and perform certain tasks more easily than others. Although ability is a relatively stable trait when compared with task-related knowledge and skill, there is ample evidence that ability can be influenced by motivation, education, and environmental influences (Naylor, Pritchard & Ilgen, 1980). Individual ability can exist in the cognitive domain (e.g., solving calculus problems), in the affective domain (e.g., demonstrating pride in one's family), and in the psychomotor domain (e.g., performing ballet). In the workplace, the best performers must demonstrate abilities in all three domains at one time or another.

Worker knowledge and skill. Knowledge and skill are task- and job-specific capabilities that can be learned over some finite period of time. In the context of performing a task, knowing what to do and how to do it requires the worker to use task-relevant information, procedures, and cognitive strategies in distinctive ways. Knowledge and skill are basic components of work expertise, yet the distinction between knowledge and skill as they apply to work performance is subtle. Differentiating knowledge from skill is more important for the cognitive psychologist who must, for example, specify the learning processes that best develop these attributes, but relatively less important for the human resource developer who is concerned with both learning processes and performance outcomes.

Gagne's (1985) "five categories of learned capabilities" is a taxonomy that describes the outcomes of instruction in terms of knowledge and skills. The taxonomy makes clear distinctions among the five learned capabilities, yet is organized in a hierarchy that shows how subtle the differences are between the levels of intellectual skills. The most

sophisticated intellectual processes at the top of the hierarchy are *cognitive strategies* which are the means by which we exercise control over our own thinking, learning, and remembering behavior. *Intellectual skills* and *verbal information* support cognitive strategies in Gagne's hierarchy, with the former providing procedural knowledge (i.e., knowing *how* to do something of an intellectual nature) and the latter providing declarative knowledge (i.e., knowing facts and information *about* something). *Motor skills* are physical capabilities used to accomplish purposeful activities. *Attitudes* are mental states that influence personal choices and courses of action. Although each of these five categories represents a distinctive learned capability, with the exception of *attitudes* each capability involves the use of both knowledge and skill.

Fleishman and Quaintance (1984) distinguish between ability and skill primarily on the basis of their specificity to task performance. Ability is the more general capacity of the individual to perform a variety of tasks. Individuals who perform well on task A also do well on tasks B and C, yet may not perform as well on tasks D, E, and F. Features common to the former three tasks that require certain human capabilities are presumably not present in the latter three tasks. Fleishman and Quaintance maintain that ability explains most of the inconsistency in performance from the former to the latter group of tasks. Abilities are general traits of people that can be inferred from consistencies in responses across a range of tasks. Worker skill, on the other hand, is defined as the level of proficiency with which a task or set of tasks is executed. Skill is more task-specific than ability, and is only partly determined by having certain relevant abilities. Although learning underlies both traits, skill development appears to rely more on learning than ability.

Worker motivation. Motivation drives the choice behavior of workers. Nearly all theories of motivation share the notion that some combination of intrinsic and extrinsic motivation compel workers to act in certain ways. Intrinsic motivation for work is based on the satisfaction of needs within the worker, such as the desire to perform work activities competently or the need to fully understand the process within which one is working. Extrinsic motivation arises from sources outside the worker, such as monetary rewards and occupational status, and also serves as an inducement to work performance. Intrinsic and

extrinsic motivational factors can operate independently of each other. A combination of intrinsic motivators (e.g., personal achievement and recognition from supervisors), extrinsic motivators (e.g., pay and adequacy of working conditions), or the perceived lack of these factors can simultaneously influence one's satisfaction and dissatisfaction with work. That is, one can be intrinsically motivated through the satisfaction of growth needs provided by inherently interesting work, and within the same job, be demotivated by working conditions perceived as inadequate (Herzberg, 1966).

Naylor, Pritchard and Ilgen (1980) point out that, at the most basic level, motivation allows people to invest only two resources in work: their *time* and *effort.* Time is a straightforward indicator of motivation--it is simply the amount of time devoted to a particular work activity. Effort, on the other hand, is more complex and represents some amount of energy invested in work behavior per unit of time. Naylor, Pritchard & Ilgen demonstrate the difference between expending high and low effort during the same period of time with a simple example. Concentrating exclusively on reading a chapter in a book reflects more effort than reading the chapter while also watching television. A third component of motivation has to do with the choice of behaviors in which a person decides to invest time and effort. While the choice of work behaviors is partially determined by the task to be performed, ultimately it is the individual who decides whether or not he or she will perform a particular work activity.

Campbell and Campbell (1990) link these three components of motivation into a concise sequence of choice behavior. As antecedents to performing a given set of work activities, a person exercises *choice to perform, level of effort,* and *persistence of effort.* The choice to perform determines whether or not a person will undertake a particular task. A capable, well trained worker who fully understands the task at hand may simply choose not to do it. The level of effort devoted to a task often determines the degree of success one achieves. Given the choice to perform a task, some may not work as hard at it as others. Finally, the persistence of effort expended by an individual over the long term explains successful performance when others, despite their initial best efforts, have since given up. Some people will direct their efforts to a task for however long it takes to achieve the goal.

Ability, knowledge and skill, and motivation have been most extensively studied as attributes of the individual. Yet, success in the workplace is becoming more reliant on the performance of teams as well as individuals. In the next section, the concept of *worker* is expanded to include the notion of "worker as team."

Worker as team. There is growing evidence that the work team is gradually displacing the individual worker as the basic unit of work performance. There are several reasons for this change. First, the Tayloristic notion of each worker being responsible for a single aspect of the work within narrowly defined jobs has given way to broader work responsibilities and relatively fewer functional specialists. More general responsibilities across related work tasks requires greater knowledge of what coworkers do and more interdependence among coworkers (National Center on Education and the Economy, 1990). Second, organizations are increasingly using teams to accomplish work as they shift to total quality management. The contributions of teamwork to quality improvement efforts has been widely studied (Cooke, 1992; Makjuka, 1991; Mawhinney, 1992; and Young, 1992). Third, several authors have recently emphasized the importance of the cross-functional flow of work through organizations as a way of improving organizational performance (Davenport, 1993; Hammer and Champy, 1993; Rummler and Brache, 1990). The cross-functional organization of work requires that workers possess a broad set of skills and be able to interact with each other to insure that multifunctional requirements are met.

Expanding the concept of *worker* to include work teams has important implications for "A Theory of Work Analysis." As will be demonstrated in the next section on the theory's *Laws of Interaction,* the notion of "worker as team" not only affects how workers relate to each other, it also leads to changes in the work environment and the redefinition of work tasks.

In summary, the *worker* is someone at any level of the organization from a top executive to an entry-level employee who can potentially or actually assume a work role and who has some degree of ability, knowledge and skill, and motivation to perform the work. The degree of ability, knowledge and skill, and motivation the worker possesses are

unspecified by this unit of the theory because workers assume work roles with various degrees of ability, knowledge and skill, and motivation to perform work. These characteristics of workers change over time and under various working conditions. The concept of *worker* is also expanded to include the idea of "worker as team."

The Work Analyst and "A Theory of Work Analysis"

The work analyst is responsible for determining the goals of work analysis, gathering and analyzing relevant work data, and documenting the analysis. The capabilities needed by work analysts are attention to detail, writing skill, and the interpersonal skills necessary for interviewing and relating effectively to others (McCormick, 1979). Although it is useful if work analysts also have some familiarity with the work to be analyzed, this is not necessary for effective work analysis because the relevant background information can be readily acquired during the process of analyzing the work. Subject matter experts, those who are recognized by peers and supervisors as possessing high levels of work-related knowledge, skill, and ability, are available as resources to provide this type of specific work information.

The role of the work analyst is not considered central to "A Theory of Work Analysis," and is not included as a unit of the theory for three reasons. First, work analysis is most often performed by those for whom work analysis is not their primary job responsibility. Indeed, outside of a few government agencies and very large corporations, positions for full-time work analysts are virtually non-existent. While work analysis is an important function, it does not enjoy the prevalence and status necessary to justify roles dedicated solely for this purpose (Gael, 1983). The author has trained hundreds of college undergraduate and graduate students to conduct work analysis, and less than a dozen of these students had ever previously analyzed work.

Second, a theory of work analysis need not specify all the concepts related to the theory as "units" of the theory, for the theorist is expected to make important judgments about those concepts that are central to the theory and those that are not. According to Dubin's (1978) methodology for theory building, status as "units" of the theory should be reserved only for the concepts felt to be most important to the theory's conceptual relationships (i.e.,

Dubin's *Laws of Interaction)* and conditions under which the theory is operative (i.e., Dubin's *System States).* The issue of specifying concepts as "units" of a theory is not one of relevance, but of relative importance. While the work analyst is important to the *practice* of work analysis, the work analyst concept is not central to a *theory* of work analysis.

Third, workers at all levels of the organization are far more capable of analyzing work, including their own jobs, than they are given credit for in the literature. The role of the work analyst is given very little attention in the literature on job and work analysis. Furthermore, the possibility that non-managers and blue-collar workers can analyze their own work is not explicitly acknowledged at all. The research on work analysis does not support the premise that only those at the management and professional levels are capable of analyzing work (Fleishman and Quaintance, 1984; Swanson, 1994). The author has trained job incumbents at all levels of the organization to conduct work analysis. It is important to acknowledge that workers with a variety of backgrounds are capable of analyzing work. Indeed, the notion of "worker as analyst" should be considered an important contribution of this theory to the knowledge of work analysis. The concept of *worker* is central to the theory (and is included as a unit of the theory); the concept of *work analyst* is not.

The Concept of Job and "A Theory of Work Analysis"

The concept of *job* has figured prominently as a starting point and anchor for existing methods of work analysis. A majority of the methods for analyzing work reviewed for this study use the job as a starting point for analysis, and then organize the techniques used to analyze and document work expertise around the notion of a job (Fine and Wiley, 1971; Gael, 1983; McCormick, 1979; U.S. Department of Labor, 1977). A major point of departure of "A Theory of Work Analysis" from current thinking about work analysis is based on the premise that a job in today's organizations is simply too fluid to be a meaningful starting point for the analysis of work. As jobs in organizations are being eliminated, combined, and reconfigured, it makes little sense to analyze and document work expertise organized around the concept of a job when the job may be here today and

gone tomorrow. For this reason, the concept of *job* is not considered central to "A Theory of Work Analysis," and is not included as a unit of the theory. The units of the theory *work environment, work task,* and *worker* are far more stable and meaningful as conceptual building blocks for "A Theory of Work Analysis" than the concept of a *job.*

Laws of Interaction

Laws of interaction specify the manner in which the units of a theory interact with each other. A law of interaction is a statement made by the theorist of the relationships between units that shows how the units of a theory are linked to each other. For example, Herzberg's theory of work motivation specifies two fundamental laws of interaction among the four units of the theory--extrinsic motivation factors, intrinsic motivation factors, satisfaction with work, and dissatisfaction with work. The first law of interaction is that there is an inverse relationship between an individual's dissatisfaction and the perceived adequacy of the extrinsic motivators in the work situation. The second law of interaction is that there is a positive relationship between an individual's satisfaction and the perceived adequacy of the intrinsic motivators in the work situation (Herzberg, 1966).

In this section, the laws of interaction of "A Theory of Work Analysis" are developed. The laws of interaction of "A Theory of Work Analysis" describe the interaction among three units of the theory: *work environment, work task,* and *worker.* The influence of changes in each of these units on the other two units are analyzed next. The laws of interaction of the theory are derived from the dynamic relationships among the three units of the theory, *work environment, work task,* and *worker.*

The Influence of Changes in the Work Environment

Change in the *work environment* necessarily affects the nature of *work tasks* and the capabilities needed by the *worker* to perform them. The work environment is becoming less hierarchical as organizations move to flatter, leaner structures (Nadler, Gerstein, and Shaw, 1992). There is a corresponding reduction in the ratio of managers and support

staff to front-line workers (National Center for Education and the Economy, 1990). Where work was once predominantly done within departments and important decisions were only made by those at the top who ran the departments, work in the present environment is increasingly cross-functional (Davenport, 1993). In the past, authority was concentrated in the hands of top managers who directed it widely, whereas today, authority is more distributed throughout the workforce and locally focused. Differences between roles used to be established to maintain stability, yet today, role differences are increasingly used to facilitate change (McLagan, 1989). The location of today's work environment is less stable than in the past. Communication technology has enabled work environments to exist virtually anywhere and has created the notion of an "organization without location" (Weick, 1990). For the individual, work can be conducted in one's office, home, and automobile; for the organization, business can be transacted locally as well as globally. The changing characteristics of the work environment are summarized in Figure 6.

WORK ENVIRONMENT

TRADITIONAL ELEMENTS	EMERGENT ELEMENTS
• Tall, Hierarchical Organization Structure	• Flat, Participatory Organization Structure
• High Manager-to-Employee Ratio	• Low Manager-to-Employee Ratio
• Work Occurs Within Functions	• Work Flows Across Functions
• Role Differences Established to Maintain Stability	• Role Differences Established to Facilitate Change
• Stable Location	• Changing Location

Figure 6. The Changing Nature of the Work Environment

Flatter organizational structures, a workforce with relatively fewer managers, more cross-functional work, and a work environment without location has changed the nature of work tasks. Flatter organizations and a leaner workforce mean that the decisions and business transactions that were taken care of higher in the organizational hierarchy are being pushed down to the level of the frontline worker. A broader range of more complex tasks is now being handled with less management supervision. Workers are given wider discretion for task accomplishment. Greater cross-functionality of work increases the heterogeneity of work tasks that must be accomplished in tandem to meet diverse customer needs. The tasks within the scope of a worker's responsibility are less likely to be limited to his or her department or specialty. As work location becomes more fluid, the tasks contain fewer physical cues to prompt performance and, although tasks are goal-directed, they take on increasingly novel forms to conform to the diverse settings in which they are performed. Business is transacted with customers by phone during flight, and production is simultaneously scheduled for international facilities via satellite.

Flatter organizational structures, a workforce with relatively fewer managers, more cross-functional work, and a work environment without location has also affected the capabilities workers need to perform the work. Less structure and direction from superiors has required workers to exercise more discretion over how work is accomplished. Planning and evaluating work have been added to existing production responsibilities. Cross-functional responsibilities require workers to understand work operations as a whole, rather than what used to be their specific tasks within a process; knowledge of one's own job is no longer sufficient to insure the efficient flow of products and services to customers. Broader knowledge of work systems involves knowing not only what co-workers do, but how to work with them collaboratively to achieve common goals. Flexibility is also needed to adapt to continuously changing work conditions and locations. As environmental cues to performance become less stable due to changing work conditions and locations, workers must compensate by developing a deeper knowledge of the work system. Mental rather than physical representations of work are increasingly needed to guide performance. And finally, in environments where frequently changing technology and methods gradually lead to obsolescence of skills, workers need reassurance that the

uncertainty that permeates the workplace during periods of change is a function of the evolving nature of work, and not necessarily an indication of the worth of the worker.

In summary, the changing nature of the work environment is bringing about changes in work tasks and in the worker. The effects of the changing work environment on work tasks are:

- Work tasks are more heterogeneous;
- Work tasks provide fewer physical cues to prompt task performance;
- Work tasks include the need for more effective communication.

The effects of the changing work environment on the worker are:

- Worker needs the capacity for continuous learning;
- Worker needs the flexibility to adapt to changing work locations and conditions;
- Worker needs to be reassured that uncertainty is a function of the changing work environment, and not an indication of his/her declining worth as a worker.

The Influence of Changes in the Work Task

Change in the nature of *work tasks* necessarily affects the larger *work environment* and the capabilities needed by the *worker* to perform the work. Today's work tasks increasingly involve less direct physical interaction between the worker and work tools and materials, and there is less visible evidence of the link between actions and effects (Hirschorn and Mokray, 1992). As technology automates manufacturing, the tools to be used and the tasks to be performed change substantially. Hirschorn and Mokray analyzed metal fabrication processes and printed circuit board production at a computer manufacturer. Automation had transformed metal punch presses from manual operation to computer-controlled presses where information was downloaded electronically and tools and dies automatically appeared in the right sequence. For operators there is now more continuity between the raw materials and the tools for transforming them. Rather than the metalworker directly applying the tool to the metal and experiencing the physical tension of the metalworking process, the tool interacts continuously with the material in a computer-controlled system. The operator's task is to observe the consequences of this interaction and monitor the overall process. As tools and materials become integrated, operators cannot

get direct sensory feedback from the process but instead must rely on data from an interface such as a computer screen or data printout.

Automation also broadens the perspective of the task from focusing on the instantaneous interaction of tools and materials to the observation of a broader pattern of events. Hirschorn and Mokray observed the same transformation of tasks and tools in the automation of printed circuit board production from "through-hole" to "surface mounting" technologies. As the pasting, placing, and soldering of printed circuit board components was integrated, workers were removed from the actual component insertion process and relied on process interfaces--oven readings and post-assembly tests--for production data. They monitored the whole process rather than its parts. The complex and interactive systems of a nuclear power plant deprive operators of a sense that their performance directly affects plant conditions, especially during multiple system failures. Operators must trust that actions taken in response to indicators in the control room will have the desired effects somewhere out in the plant (Perrow, 1984). In the banking industry, a sizable loan can now be negotiated without the customer and loan officer ever meeting face-to-face (Zuboff, 1988). The stability and repetition of procedural manufacturing tasks and linear tasks in service-oriented work has been displaced by tasks that are constantly changing. Strongly influenced by technology that Weick (1990) characterizes as "stochastic, abstract, and continuous," the ever changing dynamics of today's work prevent workers from ever becoming comfortable with them. No sooner is a new technique integrated into a work system than a related method is revised that also requires additional learning. The changing characteristics of work tasks are summarized in Figure 7.

WORK TASKS

TRADITIONAL ELEMENTS	EMERGENT ELEMENTS
• Stable, Static	• Changing, Dynamic
• Predictable	• Stochastic
• Linear, Repetitious	• Interactive, Reciprocal
• Visible, Concrete	• Conceptual, Abstract
• Single Tools that Narrow the Worker's Focus	• Systems of Information & Tools that Broaden the Worker's Focus
• Discontinuity between Processes, Tools, and Materials	• Seamless Interaction of Processes, Tools, and Materials
• Sensory Feedback at Juncture of Information, Tools, and Materials	• Cognitive Feedback at Interface between Information, Tools, and Materials

Figure 7. The Changing Nature of Work Tasks

The increasing sophistication of work tasks has influenced the larger work environment in which they are performed. The reduced visibility among co-workers and customers in tasks that are now heavily technology-mediated (e.g., telecommunication services, banking and investment services) contribute to increased psychological distance between people and a more impersonal work environment. Working on tasks where the tools and materials are less visible and conditions frequently change creates a greater potential for miscommunication among workers. Because tasks are reciprocal and interact with each other, there is a need for greater interdependence among workers who rely on each other to coordinate resources among interrelated tasks. Less well understood procedures and systems contribute to an uneasiness and uncertainty in today's high-technology work environments. New technical systems have always been unpredictable when first introduced. New "flying machines" crashed and steam boilers blew up. But as Weick

(1990) observes, "the unique twist in new technologies is that the uncertainties are permanent rather than transient" (p. 8). The persistence of uncertainty about the operation of work systems pervades the work environment as attested to by workers in nuclear power production, air traffic control, banking, and computerized manufacturing environments (Perrow, 1984; Zuboff, 1988). Instant communication and computerized tasks have increased the pace of work activity and contributed to a feeling that there is less time to accomplish more work. Yet the challenge to workers afforded by dynamic and complex work also provides them greater opportunities to acquire broader knowledge about the systems they operate. The feelings of uncertainty and less control over events are a salient feature of today's work environment that can be addressed with greater depth of knowledge about work systems. This enables workers to exercise wider control over events and reduces the anxiety related to new technology.

The increasing sophistication and unpredictability of work tasks has also influenced the worker and the capabilities they need to perform the work. Performance in environments where events and outcomes are less predictable requires greater tolerance of uncertainty and change. Abstract, less visible work induces workers to impose some structure on the work to make it more concrete and to assure that unseen task components are not forgotten. A prominent feature of complex tasks is that there are fewer physical cues arising directly from the work to prompt behavior and provide feedback. Workers must be aware of the increased potential for the decoupling of mental representations of the work from the actual events themselves. Their mental model of a process as a simple chain of events may be quite different from how the process actually occurs. Consequently, workers need more feedback than arises directly from the task and must receive it through other relevant channels such as from co-workers, supervisors and indirect indicators of performance. And finally, the challenge created by work that is complex and ever-changing must be met by workers who have the capability for continuous learning.

In summary, the changing nature of work tasks is bringing about changes in the work environment and in the worker. The effects of the changing nature of work tasks on the work environment are:

- A sense of loss of control over work due to its unpredictability and changing nature;
- An opportunity to acquire knowledge about work (to regain control over work);
- Greater psychological distance among people and a sense of impersonalness;
- More potential for miscommunication;
- Greater need for interdependence among workers.

The effects of the changing nature of work tasks on the worker are that:

- The worker needs an awareness of the potential for the decoupling of his/her mental models and the actual events of work;
- The worker needs more frequent, task-specific feedback as work tasks become more abstract, stochastic, and complex.

The Influence of Changes in the Worker

Change in the *worker* necessarily affects the larger *work environment* and the nature of *work tasks* to be performed. Although some structure and direction from management is an essential feature of well designed work systems, today's workers want more autonomy and responsibility for their work (Hackman and Oldham, 1980; Hall, Goodale, Rabinowitz and Morgan, 1978). The team of two or more workers is gradually replacing the individual worker as the basic unit of work performance. In the office and on the shop floor, achieving work goals is increasingly a team effort involving group consensus (Cooke, 1992; Makjuka, 1991; Mawhinney, 1992). Today's worker is less likely to be a white male as women, minorities, and other nontraditional workers make up an increasing proportion of the workforce (National Center on Education and the Economy, 1990). The average worker today will change occupations five times during his or her working lifetime. Where the bulk of one's work skills was once acquired early in one's career, maintaining relevant skills today requires a commitment to continuous learning (Adler, 1992; MIT Commission on Industrial Productivity, 1988). These changing characteristics of the worker are summarized in Figure 8.

WORKER

TRADITIONAL ELEMENTS	EMERGENT ELEMENTS
• Worker as Individual	• Worker as Team
• Homogeneous Workers (Predominantly White Males)	• Diverse, Nontraditional Workers (Women and Minorities)
• Workers Hold Few Occupations During Careers	• Workers Change Occupations Frequently
• Learning Occurs Early in Career	• Learning Occurs Throughout Career
• Workers Receive More Direction and Close Supervision	• Workers Have More Responsibility and Autonomy for Work

Figure 8. The Changing Nature of the Worker

The reconception of the "worker" as a team means that work is more likely to be defined as a team project rather than an individual task. In addition to task knowledge, today's work requires the ability to interact and communicate effectively with co-workers. The fact that these co-workers are more likely to come from diverse backgrounds increases the challenge to today's worker. The parameters and specifications for how the work is accomplished should be developed by the team, rather than imposed from outside.

These changes in the needs and demographics of workers have stimulated important adaptations in the work environment. Because today's work is more likely to be performed by teams than individuals, the work environment should be continue to be reorganized to support team versus individual structures. This means that the flow of work and the procedures to accomplish it are brought into team structures rather than having work proceed serially from one work station to the next. Today's worker is also afforded relatively more autonomy in decision making and greater participation in defining the values

and goals of the organization. Workers with multiple careers bring broader experiences to organizations, but this, in turn, requires organizations to have more flexible human resource policies and be more tolerant of employee turnover. The increase in nontraditional workers also necessitates expanded personnel practices that accommodate diversity in gender, age, and ethnic background. Organizations have responded to requests that they be more flexible about when work is done by providing programs for job sharing and flexible work scheduling. And as before, organizations must continue to offer meaningful, fulfilling work by providing workers with opportunities for learning new skills and for advancement.

In summary, the changing nature of the worker is bringing about changes in work tasks and in the work environment. The effects of the changing worker on work tasks are:

- Work is defined as a team project rather than an individual task;
- Work requires interpersonal and communication skills as well as task-specific skills;
- Work parameters and specifications are developed by the team rather than imposed from outside the team.

The effects of the changing worker on the work environment are:

- The work environment is reorganized to support team versus individual structures;
- The work environment allows more autonomy and participation in defining the values and goals of the organization;
- The work environment provides more flexible human resource policies and practices.

Summary of the "Laws of Interaction"

A major conclusion to be drawn from the preceding discussion is that change in each unit of the theory necessarily brings about subsequent changes in both of the other units of the theory. The following Laws of Interaction are derived from these dynamic relationships among the three units of the theory.

1. Work analysis applied to one unit of the theory--*work environment, work task,* or *worker,* must account for the changes in both of the other units.
2. Changes in *work environments* (see Figure 6) are affecting the following changes in *work tasks* and in *workers.*

(a) As *work environments* become more cross-functional and participatory, *work tasks* become more heterogeneous and demand more effective communication skills.

(b) As organizations are restructured and jobs are reconfigured, *workers* need greater capacities for continuous learning and adaptability, and need more assurance of their inherent worth as workers.

3. Changes in *work tasks* (see Figure 7) are affecting the following changes in *work environments* and in *workers*.

(a) As *work tasks* become more dynamic and unpredictable, they create *work environments* that offer greater opportunities for learning and interdependence among workers.

(b) As *work tasks* become more conceptual and abstract, *workers* need more frequent feedback about their work and greater awareness of the consequences of performing complex tasks.

4. Changes in *workers* (see Figure 8) are affecting the following changes in *work tasks* and in *work environments.*

(a) As worker autonomy and teamwork become more prominent features of the workplace, *work tasks* are more likely to be team efforts that require effective interpersonal skills, rather than individual efforts.

(b) As *workers* come from more diverse backgrounds and demonstrate greater career mobility, *work environments* are being restructured to reflect more flexible human resource policies.

Boundaries of the Theory

The boundaries of a theory are established to set forth the domain within which the theory is expected to hold. Most theorists attempt to model a complex aspect of the empirical world. The boundaries of a theory establish those aspects of the world the theory is modeling by distinguishing the theoretical domain from other aspects of the world not addressed by the theory. For example, Herzberg's theory of work motivation has two

important boundaries which define the domain within which the theory is expected to hold. First, Herzberg's two-factor theory is limited to situations of employment in organizations. The theory does not hold, then, for motivation in social situations outside of organizations. Second, the theory does not apply to groups of individuals and is, therefore, not a theory of morale in organizations. Herzberg's theory is bounded by work organizations and applies to individual motivation, not the motivation of groups (Herzberg, 1966).

The boundaries of "A Theory of Work Analysis" are first defined by the distinction between work activities and leisure activities because the focus of analysis is on work. The activities one pursues for leisure fall outside the domain addressed by "A Theory of Work Analysis." Leisure is commonly defined as "the freedom provided by the cessation of activities, especially work duties and activities" (Merriam-Webster, 1970). Leisure activities can involve play, recreation, and whatever activities one wishes to pursue during leisure time. For the purpose of establishing the boundaries of the theory, all human activities are, therefore, considered to be either work or non-work (i.e., leisure and recreation) activities. Because the boundaries of "A Theory of Work Analysis" depend on the distinction that is drawn between work and leisure, the theory must specify who decides whether an activity is work or leisure, and describe how one might make this work-leisure distinction.

The worker is ultimately the only one who can distinguish work from leisure. Others, such as the worker's friends, family members, coworkers, and the work analyst may offer an opinion as to whether a given activity is work or not, but especially in cases that fall outside of traditional work activities and settings, the worker him or herself is the only one who can distinguish what is work from what is not. Two persons may consider the same activity to be different things depending on their perspectives. For example, watering one's lawn may be a leisure activity for a busy corporate manager, yet it may also be considered a work activity by someone who dislikes such domestic chores. Family activities such as child care, entertaining guests, and other duties and social interactions involving those one considers to be family, can be thought of as leisure, work, or some combination of these. Only the person engaged in the activity can decide whether the activity is work, leisure, or some combination.

A second boundary of "A Theory of Work Analysis" exists within the domain of work. Within the domain of work, "A Theory of Work Analysis" applies to the analysis of work. Work analysis can be used for several purposes which include defining work roles (McCormick, 1979), identifying the learning needs of workers (Rossett, 1987), and serving as the basis for improving work performance (Swanson, 1994). The nature and purpose of work analysis cannot be limited to a single outcome (e.g., documenting the distinctions between two jobs), and "A Theory of Work Analysis" must reflect the variety of roles served by work analysis. Because work analysis is used for many purposes, the boundary defining the application of the theory to the domain of work analysis must be an "open boundary" with the domain of work. Dubin (1978) specifies the use of an "open boundary" when there is exchange over the boundary between the domains through which the boundary extends. A "closed boundary," on the other hand, is used when exchange does not take place between the domains through which the boundary extends. Therefore, the boundary defining the application of the theory to the domains of work analysis and work is an "open boundary," whereas the boundary defining the application of the theory to the domains of work and non-work (i.e., recreation and leisure activities) is a "closed boundary." These boundaries of "A Theory of Work Analysis" are shown in Figure 9. The "open boundary" is represented by the dotted line, and the "closed boundary" is represented by the solid line.

There are no boundaries specified for the environmental context of work analysis because the theory addresses work analysis performed in any work-related environmental context. "A Theory of Work Analysis" supports work analysis applied to a broad range of work activities and work settings. Although a listing of environmental contexts for work analysis supported by the theory is necessarily incomplete, it gives a sense of the wide spectrum of contexts to which the theory applies. The boundaries of "A Theory of Work Analysis" encompass but are not limited to:

- work analysis for the purposes of defining, learning, and performing work;
- work performed by an individual, by a group, or by an organization;
- work in public or private organizations;
- work in organizations with or without financial profit-seeking goals;

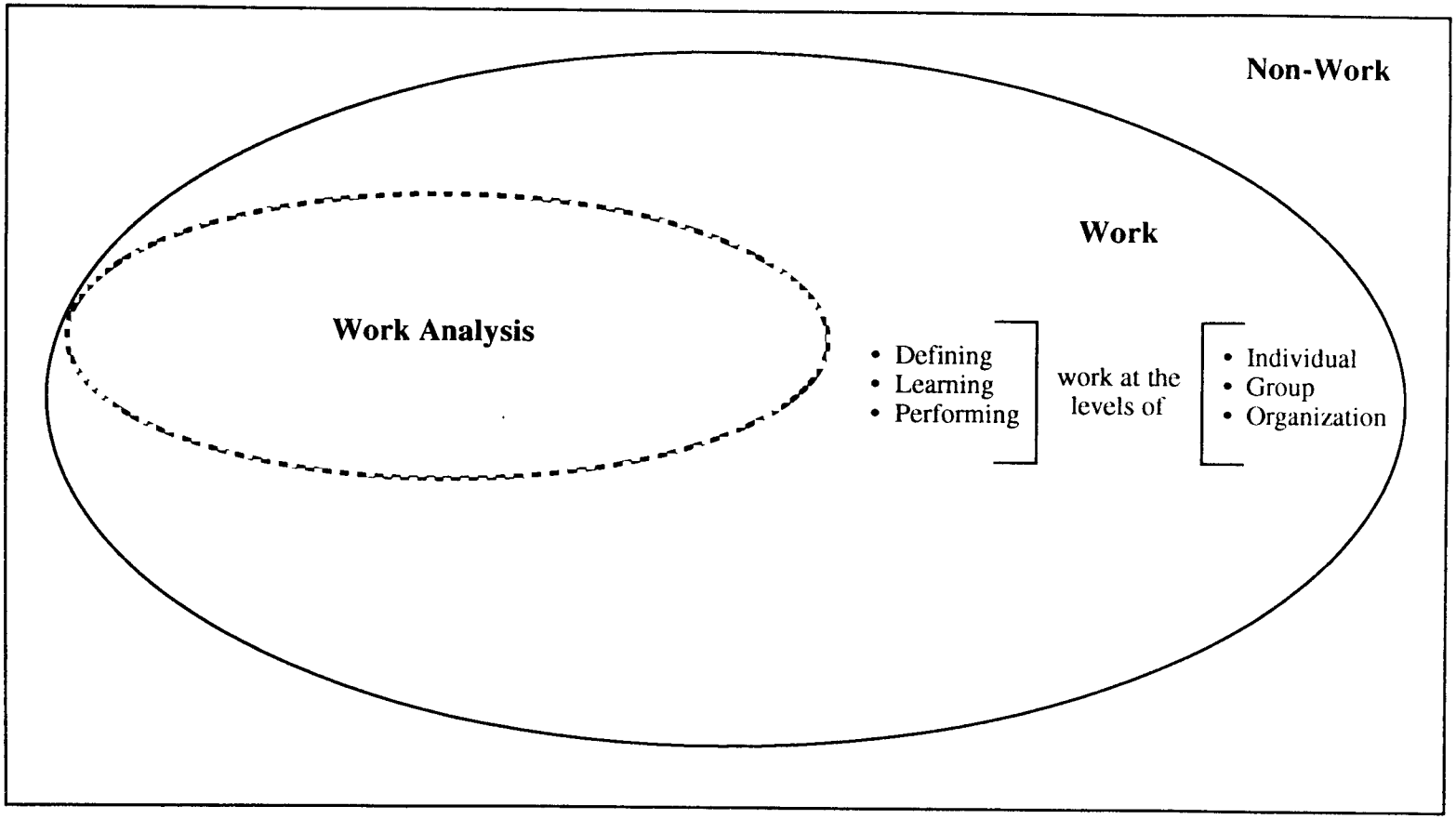


Figure 9. The Boundaries of the "Theory of Work Analysis"

- work conducted in the past, present, or future;
- work conducted in variable locations and conditions (e.g., in the office, field automobile, home, and other settings).

In summary, the domain within which "A Theory of Work Analysis" is expected to hold is the domain of work. The distinction between work and non-work activities separates the domain of the theory from non-work human activities not addressed by the theory. Only the person engaged in an activity can decide whether the activity is work, leisure, or some combination of these. Within the domain of work, the theory applies to the analysis of work. The boundary defining the application of the theory to the domains of work analysis and work is an "open boundary," whereas the boundary defining the application of the theory to the domains of work and non-work is a "closed boundary." Because the theory addresses work analysis performed in any context, there are no boundaries specified for the environmental contexts of "A Theory of Work Analysis." The theory applies to the analysis of work regardless of the contextual dimensions of person, organization, purpose, time, or conditions.

System States of the Theory

Having specified the units of "A Theory of Work Analysis," the laws by which the units interact, and the boundaries of the theory, the theorist using Dubin's methodology of theory building then sets forth the *system states* within which the theory is operative. The system represented by "A Theory of Work Analysis" is composed of the three units of the theory, *work environment, work task,* and *worker,* and the Laws of Interaction which govern the relationships among these units. The system boundaries are established to distinguish the work from the non-work domains because the system is not intended to hold outside the domain of work. There are various system states of the theory in which the units of the theory interact differently. A system state is a condition of the system being modeled in which the units of the system take on characteristic values and attributes. A system state represents a condition under which the theory is operative. For example, Herzberg's

theory of work motivation is operative in three system states. First, an individual can be characterized as being in a state of equal satisfaction and dissatisfaction with work when "motivational factors" are counterbalanced by "hygiene factors" that have not been addressed. Second, a system state can exist in which the level of satisfaction is much higher than the level of dissatisfaction with work. Third, the opposite system state can exist in which worker satisfaction is much higher than dissatisfaction. Thus, the three system states of the theory reflect different levels of satisfaction relative to dissatisfaction (Herzberg, 1966).

The system states of "A Theory of Work Analysis" are based on a central principle established in the theory's Laws of Interaction. This principle is that a change in any one of the units of the theory--*work environment, work task,* or *worker*-- necessarily affects change in both of the other units of the theory. This means that there cannot be change in any single unit of the theory without related changes occurring in the other two units of the theory. For example, with change in the *work task,* we should expect change in both the *worker* and in the *work environment.* Changes in the *worker* and the *work environment* are the result of, and directly influenced by change in the *work task.* There can be change in any one of the units of the theory--*work environment, work task,* or *worker*-- which would be expected to bring about subsequent change in the other two units of the theory.

This dynamic relationship among the units of the theory is called the "principle of three-way interaction." The system states within which "A Theory of Work Analysis" is operative are based in this principle. Figures 10, 11, and 12 show three acceptable system states for "A Theory of Work Analysis." Figures 10, 11, and 12 each show three-dimensional cubes with each facet of the cube representing one of the units of the theory--*work environment, work task,* and *worker.* The purpose of using these three-dimensional figures is to show that all three units of the theory are related in a dynamically interactive way. For example, the cube in Figure 10 shows the three units of the theory--*work environment, work task,* and *worker*-- and the component ideas from which each of these three units was synthesized. This figure represents the "principle of three-way interaction" in that a change in any one of the units of the theory necessarily affects change in both of the other units. For example, a change in any dimension of the *work environment* is

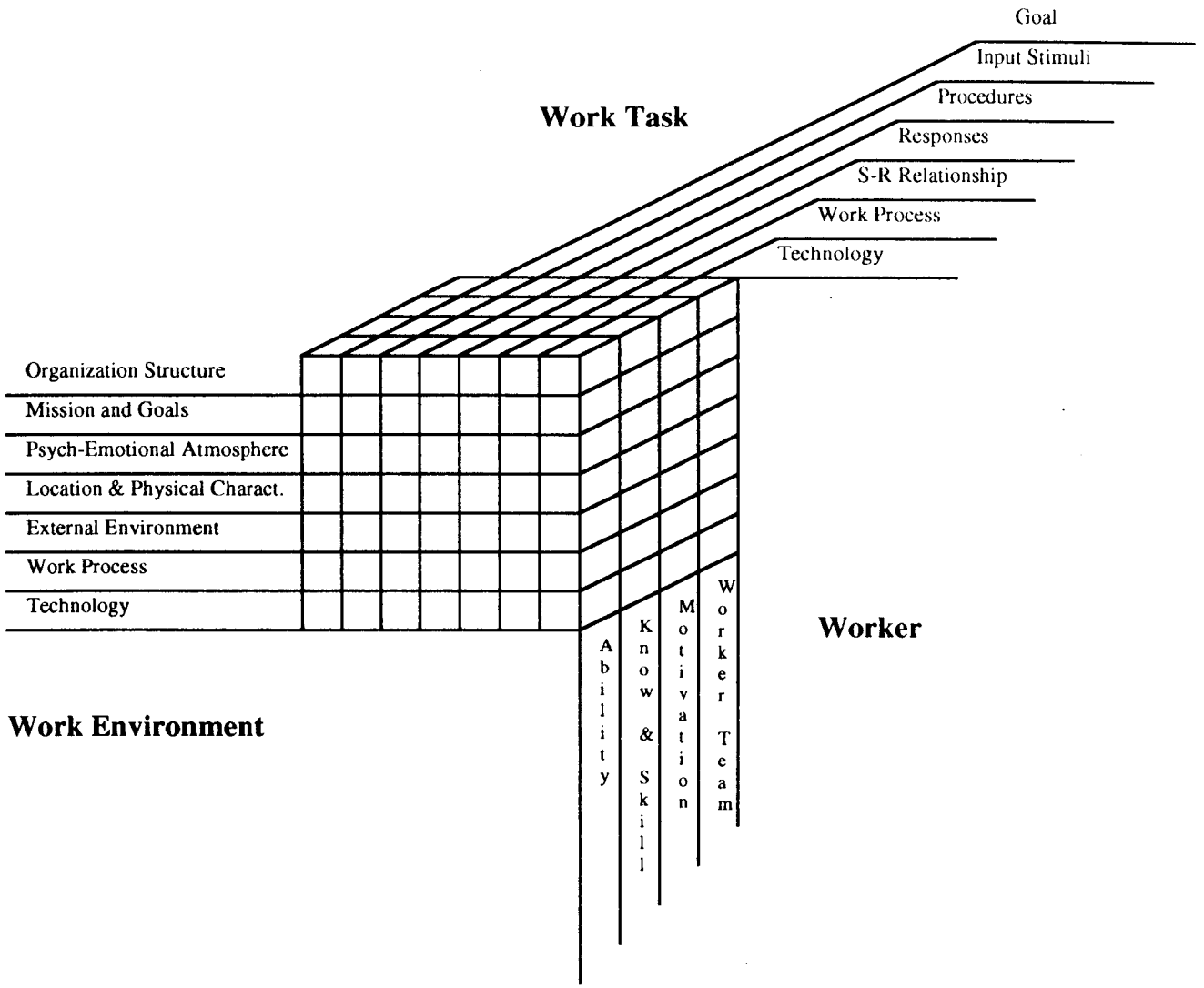


Figure 10. An Acceptable System State for the "Theory of Work Analysis"

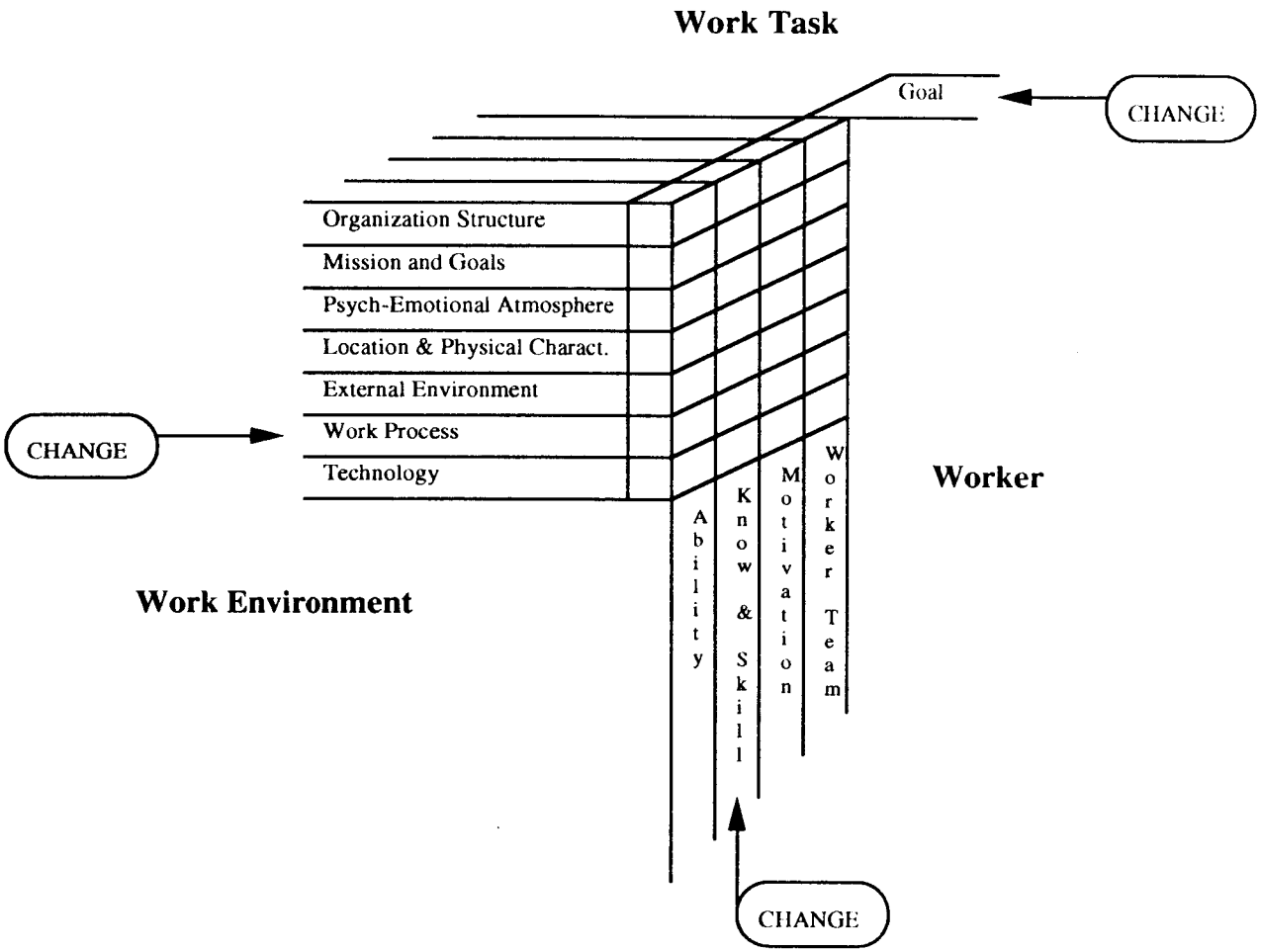


Figure 11. An Acceptable System State for the "Theory of Work Analysis"

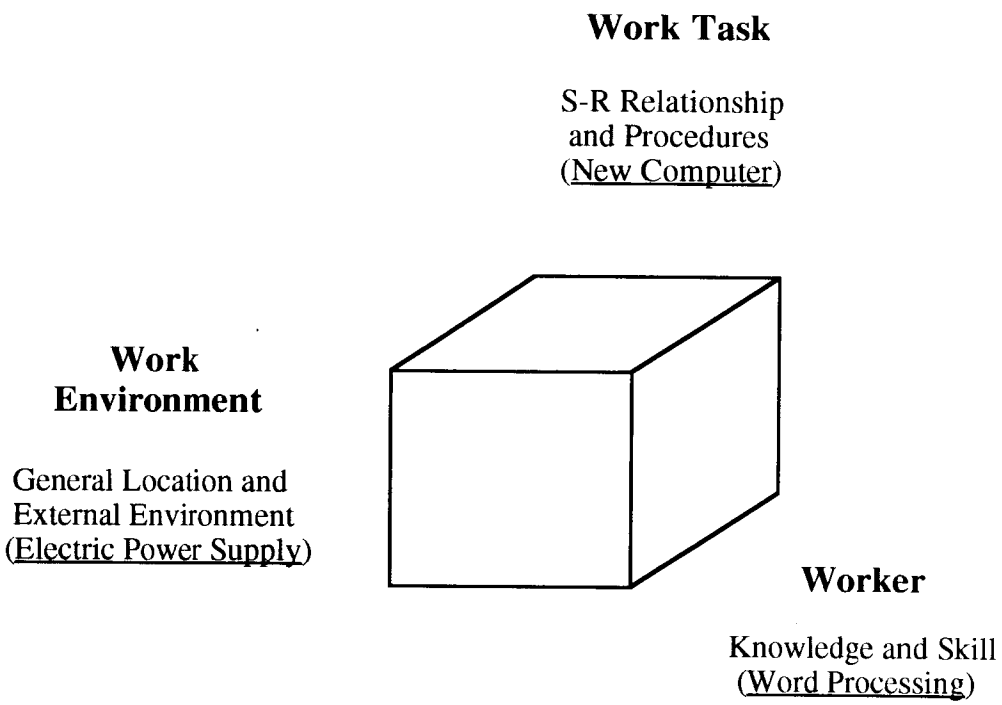


Figure 12. An Acceptable System State for the "Theory of Work Analysis"

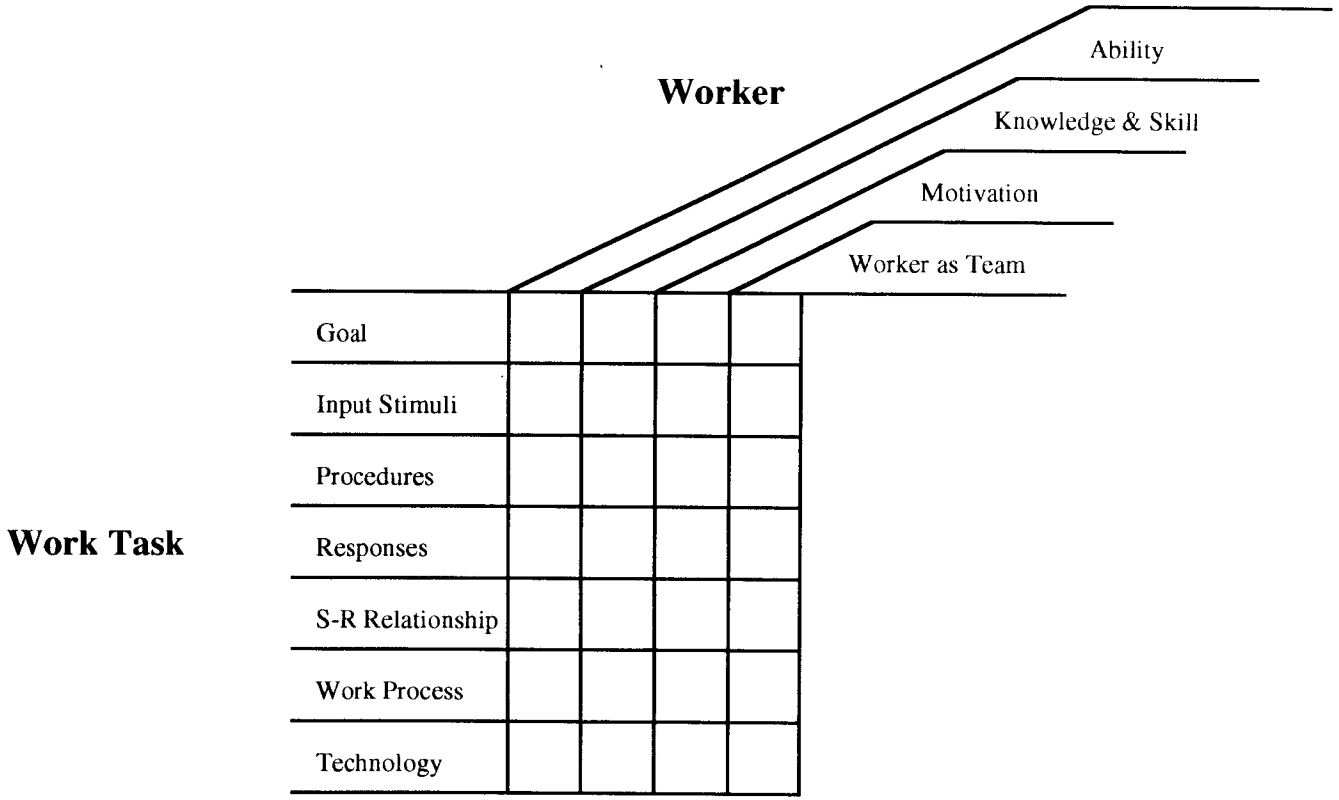


Figure 13. An Unacceptable System State for the "Theory of Work Analysis"

Work Environment

Organization Structure	
Mission and Goals	
Psych-Emotional Atmosphere	
Location & Physical Charact.	
External Environment	
Work Process	
Technology	

Figure 14. An Unacceptable System State for the "Theory of Work Analysis"

expected to affect related changes in both the *work task* and the *worker.* The cube in Figure 11 shows that, in some work situations, only a single dimension of a unit of the theory is the object of work analysis. The instance represented by the cube in Figure 11 is one in which change in one dimension of the *work task* is expected to bring about changes in the *work environment* and the *worker.* Figure 11 shows that change in a *work task* goal requires changes in the *worker,* which include acquiring new knowledge and skill, and changes in the *work environment,* which include modifications of the work process.

Figures 13 and 14 show two system states that are unacceptable for "A Theory of Work Analysis." Figure 13 shows a two-axis matrix that represents two of the three units of the theory--the *work task* and the *worker.* Figure 14 is a one-dimensional figure that represents only one of the three units of the theory--the *work environment.* Both Figure 13 and Figure 14 fail to represent acceptable system states for "A Theory of Work Analysis" because neither of the figures are three-dimensional. System states for "A Theory of Work Analysis" must be three-dimensional to accurately represent the "principle of three-way interaction" among the units of the theory.

Changes in the workplace that might affect the *work environment, work task,* and *worker* can sometimes be quite modest. For example, a new piece of equipment may be the only change in the workplace at a given time. This equipment will affect how a particular work task is accomplished. The "principle of three-way interaction" should apply even when change in one unit of the theory is limited to a single dimension of that unit, as in the case of a new piece of equipment changing how a particular work task is accomplished. It is apparent that new equipment will alter the *work task.* However, the "principle of three-way interaction" maintains that this new equipment will also affect the *work environment* and the *worker.* The cube in Figure 12 represents this situation. Imagine that the new piece of equipment is a computer used for word processing, and that the worker is a freelance writer who, prior to the arrival of the new computer, wrote everything using the basic writing tools of paper and pencil. This new computer not only affects change in the *work task*-- from writing thoughts down on paper to expressing them through electronic means, it also requires changes in the *work environment* and in the *worker.* At a minimum, the writer's environment must change to accommodate a computer

(i.e., an electrical power supply is now necessary) and the writer must acquire new skills (i.e., basic proficiency in word processing). Thus, even change in a single dimension of one unit of the theory is expected to influence both of the other units of the theory.

Propositions of the Theory

Propositions are truth statements about a theory. Propositions of a theory are true because they are logical statements about the theoretical system. It is important to note that these statements are not necessarily truth statements about aspects of the real world that the theory represents. To address the problem of matching the theory with the real world the theory is intended to model, it is necessary to convert the propositional statements into hypotheses, and then test the hypotheses through research. (The sequence of steps for taking propositions through Dubin's theory building process to the final stage of research is presented in Figure 1.) Propositional statements from the theory must be true if they are logically derived from the theory. Propositions can be made from any theory that has had its units, laws of interaction, boundaries, and system states specified.

For example, three propositions can be logically derived from Herzberg's theory of work motivation. First, an individual's motivation toward work is the sum of the level of satisfaction and the level of dissatisfaction. Second, an individual may be genuinely indifferent toward work. That is, an individual may feel no satisfaction and no dissatisfaction about an organizational work situation. Third, the levels of satisfaction and dissatisfaction felt by an individual toward work are independent of each other.

The following propositions are logically derived from "A Theory of Work Analysis":

1a. The content of work analysis is derived from all three units of "A Theory of Work Analysis"--*work environment, work task,* and *worker.*

1b. The units of the theory--*work environment, work task,* and *worker* --are interdependent. Change in one unit brings about change in both of the other units. Therefore, work analysis applied to one unit must account for change in the other two units.

2. Given frequent change in the units of the theory--*work environment, work task,* and *worker,* the purpose of work analysis should be the *synthesis* of change among the units to represent the *intent* of work, rather than the *analysis* of static work structures to represent the present *content* of work.

3a. The worker can analyze his or her own work. That is, the worker and the work analyst can be the same person.

3b. If the "worker" is a team of two or more people, and if the worker can be the work analyst (Proposition 3a.), then work analysis can be conducted by a team of workers.

CHAPTER 7

THE IMPLICATIONS OF "A THEORY OF WORK ANALYSIS"

This chapter describes how traditional work analysis methods would change if "A Theory of Work Analysis" was adopted. Traditional work analysis methods are compared with what work analysis methods would be like if the proposed theory was adopted. To illustrate how work analysis methods would change, work analysis is discussed in two ways. First, traditional methods of work analysis that are not based on "A Theory of Work Analysis" are applied to a situation in which work is analyzed as the basis for work redesign. Then, this situation is described using work analysis methods that reflect the adoption of the proposed theory. This discussion demonstrates the value of using work analysis methods informed by "A Theory of Work Analysis."

Work Analysis Using Traditional Methods

Traditional methods for analyzing work use the job as the starting point of work analysis. Most work analysis projects involve more than one job, and even when related jobs are analyzed, the focus of the analysis and documentation techniques is on each job. Using traditional methods, the job is first described in general terms, and then it is broken down into more specific statements that describe the ability requirements of the job and the characteristics of individual tasks. Because different methods place emphasis on different aspects of work analysis, one method may stress the ability requirements of the job, whereas another method may focus on the task characteristics, and so on. However, all methods of work analysis are intended to provide a basic description of the current content of individual jobs and the tasks that make up the jobs.

Traditional methods of work analysis generally limit those who conduct the analysis to management-level employees who have special training in work analysis. Given the

objectives of a work analysis project, these analysts begin the process by collecting data on each job to be analyzed using some combination of interviews, questionnaires, observation, and by reviewing records. The major tangible outcome of a work analysis project is documentation that accurately reflects the current content of each individual job and the tasks that make up the job.

The focus of work analysis has recently shifted toward increasing the efficiency of work and improving contemporary measures of performance such as quality, cost, and service. Work is more frequently analyzed today for the purpose of redesigning how work processes and tasks should be accomplished to meet effectiveness and efficiency goals. Processes are often streamlined through the elimination or integration of separate tasks to minimize the errors, delays, and rework associated with having different people do different parts of the same process. The most dramatic of these approaches to redesigning work is called "reengineering." The pursuit of work efficiency underlying reengineering is reminiscent of "scientific management," including the objectives of determining the best and quickest way to complete a task and eliminating all unnecessary steps and resources from the process, including workers who have been displaced by efficiency cutbacks. Principles of industrial engineering and cost accounting take precedence over job enrichment and employee satisfaction in an environment where the work is restructured to meet cost and efficiency goals, not the needs of people.

Methods of work analysis used for these purposes ignore the ideas represented by the unit of the theory, the *worker*. They focus on restructuring the organization and the flow of work within the organization to achieve performance improvements measured in terms of effectiveness, efficiency, and cost. Work analysis and redesign is concerned primarily with aligning structural changes at the level of the *work environment* with those at the level of the *work task*. While decision makers involved in process reengineering will generally acknowledge the importance of restructuring the organization in such a way as to create the most benefit for the most people, once these same decision makers are involved in a specific work analysis project, they focus on productivity and financial goals and ignore the human implications of the restructuring effort. The consequences to workers displaced by

process reengineering is an afterthought that is handed off to someone else in the organization for disposition.

Adoption of "A Theory of Work Analysis" as the basis of work analysis allows decision makers to move beyond short-sighted decisions to achieve near-term financial goals without sacrificing the long-term economic viability of their organizations. This is possible because work that is analyzed with respect to all three units of the theory allows for the continued development of the organization and its members. The importance of basing the analysis of work on "A Theory of Work Analysis" is illustrated next.

Work Analysis Based on "A Theory of Work Analysis"

If "A Theory of Work Analysis" was adopted, traditional methods for analyzing work would change in several ways. First, the job would not be the starting point of work analysis. The work process, production method, work task, or a structure that is more stable for organizing work than a job would be used as the starting point and anchor of work analysis. Even if work analysis was limited to a few jobs or work tasks, which narrows the scope of an analysis project, the core work systems and methods that are the most critical to the organization's success should be the focus of analysis, rather than a job that may be here today and gone tomorrow. For example, if work related to marketing was the object of analysis, "methods of determining new product applications" or another central marketing function would likely be a more stable basis for analyzing this work than starting with how the current job of Sales and Marketing Representative is defined. Even mechanisms for classifying jobs and work roles, such as the *Dictionary of Occupational Titles,* would be more meaningful if they were organized by work functions or processes rather than job titles (e.g., metal joining and cartographing versus welder and map maker). The point is that there is more stability in the inherent function served by the work than in a job title, which may be based on tradition and arbitrarily established.

The second major change in work analysis methods based on adoption of "A Theory of Work Analysis" is that work analysis would not stop at achieving effectiveness, efficiency,

and cost goals, but would assure that people whose jobs were reconfigured or eliminated through the analysis and redesign of work would still have opportunities to contribute to the organization. Redesigning work to achieve effectiveness, efficiency, and cost goals is a challenging undertaking; achieving these same efficiencies without eliminating human resources is even more challenging. Reliable tools have been developed to make the workplace more efficient and cost-effective (Hammer and Champy, 1992; Nadler, Gerstein, and Shaw, 1992; Rummler and Brache, 1990). Flow charts and other graphic techniques allow work analysts to diagram the flow of work within and across departments at several levels of complexity as a way of proceeding from current work flows, which are presumably inefficient, to desired work flows, which reflect more streamlined processes. Redesigning work to increase efficiency and reduce costs is technically demanding work that requires integrating new technology with existing work systems, and aligning the flows of information and material with newly-designed work patterns. Yet, the tools for redesigning work in this way have been refined to a high level of reliability and have been frequently used to achieve cost and efficiency goals. "A Theory of Work Analysis" requires using these tools without sacrificing human resources in the process.

This is done by integrating human resource planning with the analysis and redesign of work. Grounded in all three units of the theory, the goals of work analysis are set to achieve financial objectives *(work environment)*, task efficiency *(work task)*, and human resource needs *(worker)* so that the constraints of not decreasing employment or devaluing jobs are honored during the work restructuring process. Adding constraints reflecting the unit of the theory, the *worker,* to existing cost and efficiency goals increases both the challenges and benefits of adopting "A Theory of Work Analysis." Holding other factors constant, in the short term, it is clearly more difficult to reduce costs and increase efficiency while also maintaining optimal employment levels. However, in the long term, adopting policies that reflect investments in human resources has been shown to benefit both the organization and its employees (Adler, 1992; Commission of the Skills of the American Workforce, 1990).

Accepting the challenge of analyzing and designing work in a way that is grounded in all three units of the theory requires decisions that are made from a long-term, systems

perspective. Indeed, very few present methods of work analysis can be said to have conceptual roots in all three of the units of the theory. The only work analysis methods reviewed for this study that are based on the *work environment,* the *work task,* and the *worker* are those of Rummler and Brache (1990), Davenport (1993), and Swanson (1994). As emphasized in all three works, work analysis and design that does not reflect the changes in all three units of the theory will quickly become outdated.

A final way in which work analysis methods would change if "A Theory of Work Analysis" was to be adopted is that analysis would reflect the present content of work as well as its future direction. A major premise of this study is that change affects all three units of the theory-- *work environment, work task,* and the *worker*-- and that change among these units is interactive. Contemporary work in most fields is simply too dynamic to be captured by present methods of work analysis that only describe the current contents of jobs. In addition to documenting current job contents, work analysis should identify emerging features of the work environment, work tasks, and workers. This is done by collecting existing data to answer the following questions:

- What new methods for accomplishing work tasks are currently being developed?
- What abilities, knowledge, and skills will these emerging work methods require of workers?
- How will new work systems be aligned with the work environment?

Each of these questions is grounded in a unit of "A Theory of Work Analysis." Analysis techniques either already exist or can be readily devised to answer these three questions. Sources of information on the future direction that work is taking exist in every industry. Without augmenting work analysis with an orientation toward the future, the present situation will continue to perpetuate itself: work analysis will be left behind as the work itself continues to evolve.

The Need for "A Theory of Work Analysis"

This study has established that work is changing, and that this change is based on the interaction of factors in the *work environment,* the *work task,* and the *worker.* These three concepts are the foundation of "A Theory of Work Analysis." Because work will continue to change, work analysis methods that are dynamic will be needed to assure that work performance is linked to a clear, accurate understanding of the work itself. Adoption of "A Theory of Work Analysis" as the basis for work analysis methods will assure that this vital linkage is maintained.

Directions for Future Research

This study has established the need for a theory of work analysis and has developed such a theory based on three major concepts and their interrelationships. Propositions derived from the interaction of the *work environment,* the *work task,* and the *worker* have been offered in hopes of stimulating a reconception of why and how work analysis is conducted. If this or any theory is to have lasting value, it must be taken into the real world and tested to see if it models the phenomena it is intended to characterize. This is done through the process of research.

Research which follows Dubin's (1978) methodology for theory building and is intended to match the theory with the real world begins by converting the propositions of the theory into hypotheses that can be tested through research. This is done by operationally defining key concepts of the theory with enough precision that each concept can be measured. The specification of procedures for measuring keys concepts produces what Dubin calls "empirical indicators." These are translations of a theory's propositions into measurable statements. Hypotheses are parallel statements that predict what will be true in the real world if the phenomena of interest behave according to the theory. Hypotheses drive the research process which is ultimately intended to produce data that either support the theory or disconfirm it.

Future research on "A Theory of Work Analysis" should begin with any of the five propositions of the theory (see the section "Propositions of the Theory" in Chapter 6). For example, the proposition which states that the content of work analysis is derived from all three units of the theory should be tested through empirical research. Research could focus on applying this proposition to selected methods for analyzing work to assess whether or not analysis content is derived from all three units of the theory. Research could also examine the proposition which states that the worker and the work analyst can be the same person and that work analysis can be conducted by a team of workers as well as individuals. Ultimately, each of the theory's propositions should be translated into empirical indicators, stated as hypotheses, and tested through research. Only theories that have been subjected to the rigors of empirical testing have any hope of significantly influencing the thinking of scholars and practitioners. Through a continuous process of research, "A Theory of Work Analysis" should be refined to the point where it provides the lasting theoretical support for work analysis methods it is intended to provide.

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APPENDIX A

Focus Group to Critique

"A Theory of Work Analysis"

- The focus group to critique "A Theory of Work Analysis" will be held on July 7, 1994. (See the *Reminder* notice attached).

- In preparation for the focus group, a copy of "A Theory of Work Analysis" is enclosed for your review. The document is the latest revision of my dissertation. "A Theory of Work Analysis" is at the end of the document and has been printed on colored paper to make it easier to identify.

- The focus group will be conducted according to Krueger's (1988) guidelines and should take approximately one hour to complete. The focus group will address accepted criteria for evaluating theory and any criticisms and comments about the theory that you wish to make.

- Thank you in advance for helping me with this project.

Krueger, R. A. (1988). *Focus groups: A practical guide for applied research.* Newbury Park, CA: Sage Publications.

APPENDIX B

FIRST DRAFT OF

"A THEORY OF WORK ANALYSIS"

FIRST DRAFT OF
"A THEORY OF WORK ANALYSIS"

A theory of work analysis is needed to support a broader conception of work analysis. Present approaches to work analysis are deficient in the following ways:

- The notion of a *job* is central to current methods of analyzing work and is the starting point for several methods of work analysis. Yet in today's organizations where jobs are being eliminated, combined, and reconfigured, the *job* is simply too fluid to be a meaningful starting point for the analysis of work.
- The work team is displacing the individual worker as the basic unit of work performance. Yet, current methods of analyzing human capabilities for work are primarily focused on the individual, not the team.
- Although the flow of work in today's organizations is increasingly cross-functional, data collection in current methods of work analysis generally occurs within a single department or function of the organization.
- Current methods of work analysis reflect the assumption that work locations are stable. Yet, advances in communication technology increasingly give rise to "work organizations without location."

Traditional, atheoretical methods of work analysis have been designed for static work environments where organizational structures and the nature of work itself were stable by comparison to today's work environment. The dynamic, continuously evolving workplace of today requires work analysis based on theory that is constant and can support specific work analysis methods as they are updated and revised. As work changes, work analysis methods must change. A stable, conceptually sound theory of work analysis is needed to guide and support this change.

Overview of "A Theory of Work Analysis"

"A Theory of Work Analysis" is structured according to Dubin's methodology for theory building. The first five elements of Dubin's methodology are shown in Figure 3. Each of these five elements represents a necessary phase of theory building that must be systematically addressed according to Dubin's methodology. No single phase, nor any partial combination of the five phases completely captures the "Theory of Work Analysis." All five phases taken as a whole constitute the "Theory of Work Analysis."

Consequently, this chapter of the study which presents the "Theory of Work Analysis" is organized according to the five phases of Dubin's methodology shown in Figure 3. Each of the sections of this chapter addresses a phase of Dubin's methodology beginning with *Units of the Theory* and ending with *Propositions.* Dubin's methodology requires that key concepts of the theory are identified (Dubin refers to key concepts as "units" of the theory), and that the units are conceptually developed and related to one another. The initial conceptual development of the units is presented in the section entitled *Units of the Theory,* and the units are related to each other in the section entitled *Laws of Interaction.* Because the conceptual development needed for theory building is extensive, the first two sections of this chapter are relatively lengthy. Indeed, the sections *Units of the Theory* and *Laws of Interaction* represent approximately seventy-five percent of the total volume of work in this chapter.

Units of the Theory

The units of a theory are the elements or variables that constitute the subject matter addressed by the theory. The units interact with each other in ways specified by the theory. According to Dubin (1978), the specification of the units of a theory and the laws by which the units interact constitutes the major potential contribution to knowledge generated by a theory.

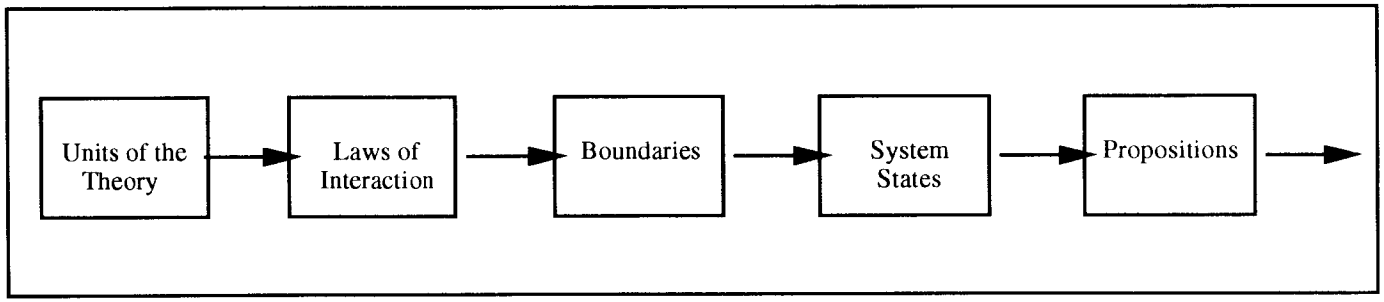

Figure 3. The First Five Phases of Dubin's Methodology for Theory Building

Herzberg's (1966) two-factor theory of work motivation provides an example of a theory that accurately reflects the first five phases of Dubin's theory building methodology. It will be used as an example as each of the five phases of theory building is discussed in this chapter. Indeed, Dubin (1976) has used Herzberg's theory to illustrate his own theory building methodology. Herzberg's theory has four variables or "units of the theory:" (1) extrinsic motivation factors; (2) intrinsic motivation factors; (3) satisfaction with work; and, (4) dissatisfaction with work. Extrinsic motivation factors, such as pay, company policies and procedure, and working conditions, arise from outside the worker (Herzberg called these "hygiene factors"), and intrinsic motivation factors, such as achievement, recognition, and advancement, arise in response to needs that exist within the worker (Herzberg called these "motivational factors"). Worker satisfaction and dissatisfaction are reactions to work situations that give rise to such feelings in the worker. Herzberg's theory suggests that worker satisfaction is optimized when addressing "motivational factors" produces satisfaction and addressing "hygiene factors" prevents dissatisfaction. Thus, the four units of Herzberg's theory are extrinsic motivators, intrinsic motivators, worker satisfaction, and worker dissatisfaction. The interrelationships among these four units (the Laws of Interaction discussed in the next section) constitute the majority of Herzberg's contribution to our knowledge of work motivation.

The units of "A Theory of Work Analysis" are the *work environment,* the *work task,* and the *worker.* A major distinction among the units of the theory *work environment, work task,* and *worker* is the conceptual scope of these units. The unit of the theory with the broadest conceptual scope is *work environment.* Within the work environment exist the units, *work task* and *worker.* Each of these units of "A Theory of Work Analysis" is a synthesis of ideas that the author feels best contribute to a conceptually sound unit that interrelates in a meaningful way with other units of the theory. Each of these unit of "A Theory of Work Analysis" and the component ideas from which each unit was synthesized are described next.

Units of the Theory: The Work Environment

A conception of *work environment* that is suitable for a theory of work analysis should capture a number of dimensions of the environment in which work is accomplished. These dimensions should include salient features of the organization in which work is being accomplished and the external environment that is relevant to the organization. *Work environment* should also represent the physical and emotional environment in which work is being performed. The unit of the theory, *work environment,* is therefore, a synthesis of several component ideas that are represented in every work environment regardless its size or the number of workers who function within it. The component ideas selected by the author from which the unit, *work environment,* was synthesized are:

- organization structure;
- organization mission and goals;
- psychological/emotional atmosphere of the work environment;
- general location of work; and
- external environment of relevance to the organization.

Each of these five components of the unit *work environment* is briefly described in the following sections and supported by constructs developed by leading authors who have written about work environments. (Four works from which constructs are taken are discussed in the *Review of Literature* section of this study. These works are Nadler, Gerstein and Shaw, 1992; Rummler and Brache, 1990; Hackman and Oldham, 1980; McLagan, 1989; and Zuboff, 1988).

Organization structure is the overall design of the organization that provides a framework within which the functions and resources of the organization interact. Nadler, Gerstein and Shaw (1992) use the architecture metaphor for discussing the subject of organization structure. They take a systemic view of the structure of organizations and the ways in which organizational structure is changed. The authors start from the premise that those interested in changing the organization's structure, the organizational designers, effect change to improve organizational effectiveness. The authors maintain that if design change is to have this effect, organizational designers must attend to design change within three

major dimensions of the organization--the *formal organization,* the *informal organization,* and the *design of senior management.*

The organization mission and goals identify the markets and customers the organization wishes to serve, and state the expectations the organization has related to these markets and customers. Rummler and Brache (1990) maintain that organizational performance is enhanced when the organization's mission and goals have been derived from an analysis of external threats and opportunities and internal strengths and weaknesses. The mission and goals should reflect the philosophy and values of the organization, and should be based on critical success factors in the industry in which the organization wishes to succeed. Once formulated, the organization's mission and goals should be articulated and clearly communicated to the organization's key constituencies.

The psychological and emotional atmosphere of the work environment reflects the quality of the inter-group and intra-group relationships in the work environment. According to Hackman and Oldham (1980), the psychological and emotional atmosphere of the work environment is increasingly perceived as positive as those who are working in the environment achieve a sense of common purpose. Hackman and Oldham's model of work group effectiveness identifies three criteria that indicate whether or not the desired psychological atmosphere has been achieved. The desired state is achieved when: (a) members' needs are more satisfied than frustrated by a work experience; (b) the capacity of members to work together on subsequent projects is maintained or enhanced; and (c) output of the group meets or exceeds organizational standards of quality and quantity. Hackman and Oldham offer prescriptions for designing the work experiences of groups which they maintain enhance morale and productivity in the work environment.

The general location of work represents a seemingly straightforward dimension of the work environment. The immediate physical environment of work can be the factory floor, the home, or any other location that supports the performance of work. When work goals require that the immediate work environment varies over time, the general environment of work can include a sales territory or a geographic region

Yet, the location of today's work environment is less stable than in the past. Communication technology has enabled work environments to exist virtually anywhere and

has created the notion of an "organization without location" (Weick, 1990). Weick describes technology's influence on work as esoteric, uncertain, and complex due to characteristics of new technologies that include its ability to link together previously inaccessible functions and locations. Weick's notion of an organization without location reflects communication technology's capacity to "knit separate actors, transactions, and locations together into a continuous process" (p. 12). For the individual, work can be conducted in one's office, home, and automobile; for the organization, business can be transacted locally as well as globally.

The external environment of relevance to the organization includes all of the forces external to the organization that influence its mission and goals, and shape the ways it uses its resources to achieve its goals. The external environment can include local forces in the community, forces in the organization's industry, and broader forces in society and the global economy. McLagan (1989) takes an open system view of organizations that reflects an organization's need to undergo constant change if it is to remain responsive to outside influences. McLagan offers a tiered view of systems with the organization and its subsystems at the center of a model that shows systems becoming increasingly larger as one proceeds from organization to industry, from industry to socio-economic political system, and finally, from socio-economic political system to ecological system.

As indicated by the last two components of the unit of the theory *work environment,* "general location of work" and "external environment," *work environment* is a construct that extends beyond the environment that exists within the organization itself.

Although no single description of a work environment is best suited as an example of this concept, Zuboff's (1988) work best captures the meaning of "work environment" in the sense that it is used as a unit of the "Theory of Work Analysis." Her research on how information technology has fundamentally changed the ways in which organizations accomplish work brings together analyses of technical and social phenomena both internal and external to the organizations she studied. Zuboff describes work environments in which complex networks of information technology link organizations and revolutionize work through their "informating" and "automating" powers. Her work also features the personal narratives of workers from all organizational levels, and suggests that traditional

notions of managerial authority and structure restrict the sharing of knowledge needed by all workers if organizations are to make the most of "informated" work environments. Zuboff's conception of work environment is not limited to a single organization, for she has carefully shown how political, cultural, and economic forces external to organizations as diverse as insurance companies and paper mills have influenced their internal policies and practices and external relationships. Although she does not reduce the notion of work environment to a concise definition, her comprehensive study of eight organizations in several industries develops a rich sense of the meaning of *work environment.*

The *work task* is the next unit of the theory to be examined and is fully developed as a concept in the next section. A work task consists of a discrete set of activities that is normally accomplished by a worker or a group of workers within the context the work environment. The unit of the theory *work task* is conceptualized as existing within the unit of the theory *work environment.* The unit *work task* exists "within" the *work environment* in the sense that a work task is accomplished within some organizational or environmental structure to achieve work goals. Whether the environment is a small family business or a multinational corporation, work tasks are conceived as essential components or building blocks of the work environment.

For example, in the work environment of the insurance industry, work tasks involve the development of actuarial data and the assessment of insurance risks. In the work environment of overnight delivery services, work tasks involve sorting and routing freight according to precise delivery routes and schedules. As these examples illustrate, a major distinction between the units of the theory *work environment* and *work task* is one of conceptual scope. The *work task* is conceptualized as an essential component or building block of the *work environment.* The *work environment* is a broader notion that embraces environments that are internal and external to the organization and that, from a conceptual perspective, include the notion of *work tasks.*

Units of the Theory: The Work Task

The unit, *work task,* exists independent of who performs it (the worker). The work task consists of the activities to be performed to achieve work outcomes. The tasks of

assembling a product or making a decision exist apart from who performs the assembly or makes the decision. Farina and Wheaton (1973), who have studied work tasks and task components extensively, defined a task as "a complex situation capable of eliciting goal-directed performance from an operator" (p.26). They conceived of tasks as having five task components, each of which possessed certain salient characteristics. The task components identified by Farina and Wheaton are an explicit goal, input stimuli, procedures, responses, and stimulus-response relationships. The relationship among the task, task components and task characteristics is shown in Figure 4.

TASK	TASK COMPONENTS	TASK CHARACTERISTICS
Task	Goal	• Number of output units • Duration for which an output unit is maintained • Number of elements per output unit • Work load imposed by task goal • Difficulty of goal attainment
	Input Stimuli	• Variability • Duration • Regularity of stimulus occurrence
	Procedures	• Number of steps • Dependency among procedural steps • Adherence to procedures • Procedural complexity
	Responses	• Precision • Rate • Simultaneity of responses • Amount of muscular effort involved
	Stimulus-Response Relationship	• Degree of operator control • Reaction time/feedback lag relationship • Decision making

Figure 4. Relationship among Task, Components, and Characteristics

Farina and Wheaton's conception of work *task* was selected as the basis for conceptualizing this unit of the theory because it captures the essence of the immediate work situation rather than the capabilities workers need to perform tasks. Each of the nineteen task characteristics listed in Figure 4 was derived from "task characteristic rating scales" developed by the authors in which subjects rated a wide variety of actual work tasks on these nineteen characteristics. Some examples of the tasks that were rated include:

- Performing an aircraft preflight evaluation;
- Solving trigonometric problems;
- Replacing the mainspring of a wristwatch;
- Balancing equations for basic chemical reactions;
- Firing an automatic rifle.

As Fleishman and Quaintance (1984) observe, the approach to describing tasks that has been most extensively developed is the "ability requirements" approach, which describes tasks in terms of the capabilities of the worker required to perform them effectively.

Farina and Wheaton's notion of task is quite different, however, in that it conceptualizes a work task as a situation distinct from the worker's abilities, skills, and motivation to perform the task. Farina and Wheaton's notion of task reflects the procedures, techniques, and variables of the task itself, rather than focusing on the abilities required to perform it. This conception of *work task* is important to the "Theory of Work Analysis" because of the existence of the unit of the theory, *worker,* which represents ideas that are similar to the "ability requirements" approach to task description. Choosing an "ability requirements" approach as the basis for conceptualizing the notion of task would result in the units of the theory work *task* and *worker* being too similar to each for conceptual clarity. Farina and Wheaton's conception of *task* best captures the essence of the immediate work situation and keeps the concepts *work task* and *worker* conceptually distinct from each other.

The Concepts of Work *Process* and *Technology*

Two ideas that are central to the nature of contemporary work and how it is analyzed are work *process* and *technology.* The concepts of *process* and *technology* represent distinctly different influences on work. Work *process* is primarily a design construct that

communicates how work is organized. *Technology* has a more intrinsic influence on work. Technology shapes the substance of work and embodies the knowledge and means by which work is accomplished. Both of these ideas, work *process* and *technology*, have a pervasive influence on work at all levels at which work is analyzed. The purpose of the following sections is to establish that the concepts of work *process* and *technology* rightfully belong to both units of the theory--*work environment* and *work task*. That is, the pervasiveness and importance of work *process* and *technology* justify their conceptual development at both the *work environment* and *work task* levels.

The next section examines work *process* as a conceptual component of both *work environment* and *work task*. The following section conceptualizes *technology* at both of these levels. Each section begins with a definition of the component derived from the literature.

Work Process at the *Work Environment* and *Work Task* Levels

Work *process* is a conceptual component of both *work environment* and *work task*. The concept of work *process* is pervasive enough in the workplace to apply to both levels, and it is central to current thinking about how work should be structured and improved. Two aspects of work *process* give it the breadth and importance necessary for it to be viewed as a dimension of the *work environment:* the cross-functional nature of processes in the workplace and the centrality of process improvement to TQM.

In the *Review of Literature* for this study, a work process is characterized as having identifiable inputs and outputs, as being of variable size and scope, and as composed of stages or component processes. Larger, more complex processes that span the boundaries between organizational units are called "cross-functional" processes because they typically require activities that draw on multiple functional areas. The idea that larger, complex processes flow through multiple functional units and interconnect components of organizations gives the concept of *process* the range and breadth it needs to be conceptualized as a component of the *work environment.* Indeed, processes such as providing customer service and developing new products are important and pervasive enough to require the attention of nearly all the major functional units of an organization. It

is in this sense that work *process* should be viewed as a dimension of the *work environment.*

The centrality of work *process* to TQM also gives it importance and breadth, and justifies work *process* as a conceptual component of *work environment.* Process improvement is a goal that is central to TQM. Furthermore, TQM is not simply a set of management practices; it is a philosophy of management that must be applied organization-wide to be successful. Thus, the centrality of work *process* to the TQM philosophy gives it highly visible status in organizations and further justifies it as a conceptual dimension of *work environment.*

The concept of work *process* is equally applicable at the level of the *work task.* Schultz and Schroeder (1990) define a process as "a collection of cause factors which can be translated into a sequence of tasks, activities, or functions to produce a given output. The cause factors typically include people, machines, materials, methods, and environment. The translation of these cause factors leads to various stages of the process. Each of the stages could itself be considered a process" (p. 2). Schultz and Schroeder consider the people, machines, materials, methods, and environment as inputs to the process. They also recognize that a process can be composed of various stages, with each stage itself considered a process. This conception of *process* is more focused and task-specific than the idea that work *processes* flow cross-functionally through multiple departmental units and interconnect the components of an organization. For example, the process of preparing a restaurant meal involves inputs (the customer's order, unprepared food, and so on), a related set of food preparation processes (preparing and cooking the food), and outputs (the meal itself and the customer's check). Similarly, the process of loading a printing press with paper requires inputs (paper), a related set of processes (selecting, loading, and adjusting paper), and outputs (a press with paper that is ready for a pressrun). These examples of work at the task level demonstrate that work *process,* when it is defined in a limited way, fits well with the concept of *work task.*

Technology at the *Work Environment* and *Work Task* Levels

Technology is also a factor that is important and pervasive enough in the workplace to justify its conceptual development at the *work environment* and *work task* levels. Technology is a means through which work is accomplished. Berniker embeds the concept of "technology" within the larger structure of "a technical system." Berniker (1987) defines a technical system as "a specific combination of machines, equipment, and methods used to produce some valued outcome . . . . Every technical system embodies a technology. It derives from a large body of knowledge which provides the basis for design decisions. Technology refers to a body of knowledge about the means by which we work on the world, our arts and our methods" (p. 10).

Following Berniker's ideas, technology can be defined as knowledge within a technical system. The notion of technology residing in the technical system distinguishes the two constructs of "technology" and "technical system," and allows the choice of technology and the design of the technical system to be more explicit than with a unidimensional conception of technology. Viewing technology as knowledge within a technical system allows the design of technology to be a more explicit, public process. Rather than accepting technology as "a thing" with its attendant constraints and requirements (the *technological determinism* of Davis and Taylor), technology is a flexible set of means for accomplishing work. Technology is a variable, not a given.

The influence of technology pervades all dimensions of the *work environment.* Technology as "knowledge within a technical system" can be used for many purposes including production, communication, and systems integration. Because production technology enables the creation of new products and services, and information technology can add value to existing products and services, new markets in the business environment supported by technical innovation are continuously being developed. The mission and goals of an organization should, in turn, reflect the markets to be served. As technology reshapes an organization's products and services, it also influences the relationships among workers throughout the environment. For example, Zuboff (1988) describes the effects of information technology in the international banking industry as both revolutionary and depersonalizing. The "informating" power of technology enables the creation of new

customized banking products, on-line cash management, foreign exchange services, and electronic funds transfer that were only futuristic ideas a decade ago. On the other hand, information technology creates more distance between people, as in the case of large-scale business loans where the transactions can take place without the lender and client ever meeting face-to-face. Bank workers lament that developing the "gut feeling" for an investment opportunity or credit risk is being displaced by impersonal, on-line data that workers feel can be less reliable. Thus, international banking and many other industries face both opportunities and challenges as technology fundamentally reshapes the work environment.

Technology's effects are just as profound at the level of the *work task.* For example, Giordano (1992) studied how technology is changing the work of engineers, drafters, and machinists in the computer industry. Giordano found that computerization has both skill upgrading and deskilling effects on machining tasks. The results of her research indicate a relationship that is complex and seemingly contradictory in that skill changes within machining work can shift simultaneously in both directions. As computerization automates the work traditionally performed by a machinist, two distinct types of machining expertise become apparent: the procedural skills that have historically defined this occupation, and the abstract, cognitive processes now needed by machinists to process computerized information. Although automation simplifies and, in effect, deskills parts of the machinist's job, the overall effects of computerization on machining increase the skills required of machinists who must now program and operate advanced machine tools. (Giordano also found that technology confronts decision makers with new choices regarding the selection and implementation of technical systems, and the distribution of authority. See the "Review of Literature" for a discussion of Giordano's work). Because technology profoundly influences the outcomes of work tasks and the means and skills needed to perform them, technology is rightfully a conceptual component of *work task.*

In summarizing the preceding discussion of work *process* and *technology* at the work environment and work task levels, work *process* and *technology* are considered important conceptual components of both units of the theory, *work environment* and *work task.* Given the five component ideas from which *work environment* was synthesized earlier,

this unit of the theory is now amended to include the following conceptual components:

- organization structure;
- organization mission and goals;
- psychological/emotional atmosphere of the work environment;
- general location of work;
- external environment of relevance to the organization;
- work process; and
- technology.

Similarly, given the five component ideas from Farina and Wheaton's conception of task from which *work task* was synthesized, this unit of the theory is also amended to include the following conceptual components:

- goal;
- input stimuli;
- procedures;
- responses;
- stimulus-response relationship;
- work process; and
- technology.

Units of the Theory: The Worker

The unit of the theory *worker* is based on the human capabilities required to do work. It is conceptually distinct from the work content (i.e., the *work task)* to which it is applied. That is, the person who performs the work is conceptually distinct from the work task to be performed. The component ideas from which the unit of the theory, *worker,* was synthesized derive from the human capabilities needed to perform work. These capabilities for work are the worker's ability, knowledge and skill, and motivation. In addition, because of growing evidence that the work team is gradually displacing the individual worker as the basic unit of work performance, it is argued that the concept of *worker* must be expanded to include the idea of "worker as team." Therefore, the following component ideas form the basis for the conceptual development of the unit of the theory *worker:*

- ability;
- knowledge and skill;
- motivation; and
- worker as team.

Each of these component ideas is briefly defined and discussed next. This section concludes with a summary description of the unit the theory, *worker*.

Worker Ability. Ability is a stable characteristic of workers that is, for the most part, unaffected by education and training. Ability is a general capacity of workers that supports the performance of a variety of related tasks. Traits such as proficiency in mathematics, linguistics, or spatial relationships appear to be, at least to some degree, abilities that are genetically determined. Ability persists over long periods of time, whereas the duration of task-related knowledge and skill is shorter and is more dependent on practice and learning. Individual differences in general verbal ability, upper body strength, and ease of social interaction make it possible for some people to learn and perform certain tasks more easily than others. Individual ability can exist in the cognitive domain (e.g., solving calculus problems), in the affective domain (e.g., demonstrating pride in one's family), and in the psychomotor domain (e.g., performing ballet). In the workplace, the best performers must demonstrate abilities in all three domains at one time or another.

Worker Knowledge and Skill. Knowledge and skill are task- and job-specific capabilities that can be learned over some finite period of time. In the context of performing a task, knowing what to do and how to do it requires the worker to use task-relevant information, procedures, and cognitive strategies in distinctive ways. Knowledge and skill are basic components of work expertise, yet the distinction between knowledge and skill as they apply to work performance is subtle. Differentiating knowledge from skill is more important for the cognitive psychologist who must, for example, specify the learning processes that best develop these attributes, but relatively less important for the human resource developer who is concerned with both learning processes and performance outcomes.

Gagne's (1985) "five categories of learned capabilities" is a taxonomy that describes the outcomes of instruction in terms of knowledge and skills. It makes clear distinctions among the five learned capabilities, yet is organized in a hierarchy that shows how subtle the differences are between the levels of intellectual skills. The most sophisticated intellectual processes at the top of the hierarchy are *cognitive strategies* which are the means by which we exercise control over our own thinking, learning, and remembering behavior. *Intellectual skills* and *verbal information* support cognitive strategies in Gagne's hierarchy, with the former providing procedural knowledge (i.e., knowing *how* to do something of an intellectual nature) and the latter providing declarative knowledge (i.e., knowing facts and information *about* something). *Motor skills* are physical capabilities used to accomplish purposeful activities. *Attitudes* are mental states that influence personal choices and courses of action. Although each of these five categories represents a distinctive learned capability, with the exception of *attitudes* each capability involves the use of both knowledge and skill.

Fleishman and Quaintance (1984) distinguish between ability and skill primarily on the basis of their specificity to task performance. Ability is the more general capacity of the individual to perform a variety of tasks. Individuals who perform well on task A also do well on tasks B and C, yet may not perform as well on tasks D, E, and F. Features common to the former three tasks that require certain human capabilities are presumably not present in the latter three tasks. Fleishman and Quaintance maintain that ability explains most of the inconsistency in performance from the former to the latter group of tasks. Abilities are general traits of people that can be inferred from consistencies in responses across a range of tasks. Worker skill, on the other hand, is defined as the level of proficiency with which a task or set of tasks is executed. Skill is more task-specific than ability, and is only partly determined by having certain relevant abilities. Although learning underlies both traits, skill development appears to rely more on learning than ability.

Worker Motivation. Motivation drives the choice behavior of workers. Nearly all theories of motivation share the notion that some combination of intrinsic and extrinsic motivation compel workers to act in certain ways. Intrinsic motivation for work is based

on the satisfaction of needs within the worker, such as the desire to perform work activities competently or the need to fully understand the process within which one is working. Extrinsic motivation arises from sources outside the worker, such as monetary rewards and occupational status, and also serves as an inducement to work performance. Intrinsic and extrinsic motivational factors can operate independently of each other. A combination of intrinsic motivators (e.g., personal achievement and recognition from supervisors), extrinsic motivators (e.g., pay and adequacy of working conditions), or the perceived lack of these factors can simultaneously influence one's satisfaction and dissatisfaction with work. That is, one can be intrinsically motivated through the satisfaction of growth needs provided by inherently interesting work, and within the same job, be demotivated by working conditions perceived as inadequate (Herzberg, 1966).

Naylor, Pritchard and Ilgen (1980) point out that, at the most basic level, motivation allows people to invest only two resources in work: their *time* and *effort.* Time is a straightforward indicator of motivation--it is simply the amount of time devoted to a particular work activity. Effort, on the other hand, is more complex and represents some amount of energy invested in work behavior per unit of time. Naylor, Pritchard and Ilgen demonstrate the difference between expending high and low effort during the same period of time with a simple example. Concentrating exclusively on reading a chapter in a book reflects more effort than reading the chapter while also watching television. A third component of motivation has to do with the choice of behaviors in which a person decides to invest time and effort. While the choice of work behaviors is partially determined by the task to be performed, ultimately it is the individual who decides whether or not he or she will perform a particular work activity.

Campbell and Campbell (1990) link these three components of motivation into a concise sequence of choice behavior. As antecedents to performing a given set of work activities, a person exercises *choice to perform, level of effort,* and *persistence of effort.* The choice to perform determines whether or not a person will undertake a particular task. A capable, well trained worker who fully understands the task at hand may simply choose not to do it. The level of effort devoted to a task often determines the degree of success one achieves. Given the choice to perform a task, some may not work as hard at it as others. Finally, the

persistence of effort expended by an individual over the long term explains successful performance when others, despite their initial best efforts, have since given up. Some people will direct their efforts to a task for however long it takes to achieve the goal.

Ability, knowledge and skill, and motivation have been most extensively studied as attributes of the individual. Yet, success in the workplace is becoming more reliant on the performance of teams as well as individuals. In the next section, the concept of *worker* is expanded to include the notion of "worker as team."

Worker as Team. There is growing evidence that the work team is gradually displacing the individual worker as the basic unit of work performance. There are several reasons for this change. First, the Tayloristic notion of each worker being responsible for a single aspect of the work within narrowly defined jobs has given way to broader work responsibilities and relatively fewer functional specialists. More general responsibilities across related work tasks requires greater knowledge of what coworkers do and more interdependence among coworkers (National Center on Education and the Economy, 1990). Second, organizations are increasingly using teams to accomplish work as they shift to total quality management. The contributions of teamwork to quality improvement efforts has been widely studied (Cooke, 1992; Mawhinney, 1992; Makjuka, 1991; Young, 1992). Third, several authors have recently emphasized the importance of the cross-functional flow of work through organizations as a way of improving organizational performance (Davenport, 1993; Hammer & Champy, 1993; Rummler & Brache, 1990). The cross-functional organization of work requires that workers possess a broad set of skills and be able to interface with each other to insure that multifunctional requirements are met.

Expanding the concept of *worker* to include work teams has important implications for the "Theory of Work Analysis." As will be demonstrated in the next section on the theory's *Laws of Interaction,* the notion of "worker as team" not only affects how workers relate to each other, it also leads to changes in the work environment and the redefinition of work tasks.

In summary, the *worker* is someone at any level of the organization from a top executive to an entry-level employee who can potentially or actually assume a work role and who has some degree of ability, knowledge and skill, and motivation to perform the work. The degree of ability, knowledge and skill, and motivation the worker possesses are unspecified by this unit of the theory because workers assume work roles with various degrees of ability, knowledge and skill, and motivation to perform work. These characteristics of workers change over time and under various working conditions. The concept of *worker* is also expanded to include the idea of "worker as team."

The Work Analyst and "A Theory of Work Analysis"

The work analyst is responsible for determining the goals of work analysis, gathering and analyzing relevant work data, and documenting the analysis. The capabilities needed by work analysts are attention to detail, writing skill, and the interpersonal skills necessary for interviewing and relating effectively to others (McCormick, 1979). Although it is useful if work analysts also have some familiarity with the work to be analyzed, this is not necessary for effective work analysis because the relevant background information can be readily acquired during the process of analyzing the work. Subject matter experts, those who are recognized by peers and supervisors as possessing high levels of work-related knowledge, skill, and ability, are available as resources to provide this type of specific work information.

The role of the work analyst is not considered central to the "Theory of Work Analysis," and is not included as a unit of the theory for three reasons. First, work analysis is most often performed by those for whom work analysis is not their primary job responsibility. Indeed, outside of a few government agencies and very large corporations, positions for full-time work analysts are virtually non-existent. While work analysis is an important function, it does not enjoy the prevalence and status necessary to justify roles dedicated solely for this purpose (Gael, 1983). The author has trained hundreds of college undergraduate and graduate students to conduct work analysis, and less than a dozen of these students had ever previously analyzed work.

Second, a theory of work analysis need not specify all the concepts related to the theory as "units" of the theory, for the theorists is expected to make important judgments about those concepts that are central to the theory and those that are not. According to Dubin's (1978) methodology for theory building, status as "units" of the theory should be reserved only for the concepts felt to be most important to the theory's conceptual relationships (i.e., Dubin's *Laws of Interaction)* and conditions under which the theory is operative (i.e., Dubin's *System States).* The issue of specifying concepts as "units" of a theory is not one of relevance, but of relative importance. While the work analyst is important to the *practice* of work analysis, the work analyst concept is not central to a *theory* of work analysis.

Third, workers at all levels of the organization are far more capable of analyzing work, including their own jobs, than they are given credit for in the literature. The role of the work analyst is given very little attention in the literature on job and work analysis. However, the possibility that non-managers and blue-collar workers can analyze their own work is not explicitly acknowledged at all. The research on work analysis does not support the premise that only those at the management and professional levels are capable of analyzing work (Fleishman & Quaintance, 1984; Swanson, 1994). The author has trained job incumbents at all levels of the organization to conduct work analysis. It is important to acknowledge that workers with a variety of backgrounds are capable of analyzing work. Indeed, the notion of "worker as analyst" should be considered an important contribution of this theory to the knowledge of work analysis. The concept of *worker* is central to the theory (and is included as a unit of the theory); the concept of *work analyst* is not.

The Concept of *Job* and "A Theory of Work Analysis"

The concept of *job* has figured prominently as a starting point and anchor for existing methods of work analysis. A majority of the methods for analyzing work reviewed for this study use the job as a starting point for analysis, and then organize the techniques used to analyze and document work expertise around the notion of a job (Gael, 1983; Fine & Wiley, 1971; McCormick, 1979; Swanson, 1994). A major point of departure of the "Theory of Work Analysis" from current thinking about work analysis is based on the

premise that a job in today's organizations is simply too fluid to be a meaningful starting point for the analysis of work. As jobs in organizations are being eliminated, combined, and reconfigured, it makes little sense to analyze and document work expertise organized around the concept of a job when the job may be here today and gone tomorrow. For this reason, the concept of *job* is not considered central to the "Theory of Work Analysis," and is not included as a unit of the theory. The units of the theory *work environment, work task,* and *worker* are far more stable and meaningful as conceptual building blocks for the "Theory of Work Analysis" than the concept of a *job.*

Laws of Interaction

Laws of interaction specify the manner in which the units of a theory interact with each other. A law of interaction is a statement of the relationships between units that shows how the units of a theory are linked to each other. For example, Herzberg's theory of work motivation specifies two fundamental laws of interaction among the four units of the theory--extrinsic motivation factors, intrinsic motivation factors, satisfaction with work, and dissatisfaction with work. The first law of interaction is that there is an inverse relationship between an individual's dissatisfaction and the perceived adequacy of the extrinsic motivators in the work situation. The second law of interaction is that there is a positive relationship between an individual's satisfaction and the perceived adequacy of the intrinsic motivators in the work situation (Herzberg, 1966).

The laws of interaction of the "Theory of Work Analysis" describe the interaction among three units of the theory: *work environment, work task,* and *worker.* The influence of changes in each of these units on the other two units are analyzed next. The laws of interaction of the theory are derived from the dynamic relationships among the three units of the theory *work environment, work task,* and *worker.*

The Influence of Changes in the Work Environment

Change in the *work environment* necessarily affects the nature of *work tasks* and the capabilities needed by the worker to perform them. The work environment is becoming less hierarchical as organizations move to flatter, leaner structures (Nadler, Gerstein & Shaw, 1992). There is a corresponding reduction in the ratio of managers and support staff to front-line workers (National Center for Education and the Economy, 1990). Where work was once predominantly done within departments and important decisions were only made by those at the top who ran the departments, work in the present environment is increasingly cross-functional (Davenport, 1993; Rummler & Brache, 1990). In the past, authority was concentrated in the hands of top managers who directed it widely, whereas today, authority is more distributed throughout the workforce and locally focused. Differences between roles used to be established to maintain stability, yet today, role differences are increasingly used to facilitate change (McLagan, 1989). The location of today's work environment is less stable than in the past. Communication technology has enabled work environments to exist virtually anywhere and has created the notion of an "organization without location" (Weick, 1990). For the individual, work can be conducted in one's office, home, and automobile; for the organization, business can be transacted locally as well as globally. The changing characteristics of the work environment are summarized in Figure 5.

WORK ENVIRONMENT

TRADITIONAL ELEMENTS	EMERGENT ELEMENTS
• Tall, Hierarchical Organization Structure	• Flat, Participatory Organization Structure
• High Manager-to-Employee Ratio	• Low Manager-to-Employee Ratio
• Work Occurs Within Functions	• Work Flows Across Functions
• Role Differences Established to Maintain Stability	• Role Differences Established to Facilitate Change
• Stable Location	• Changing Location

Figure 5. The Changing Nature of the Work Environment

Flatter organizational structures, a workforce with relatively fewer managers, more cross-functional work, and a work environment without location has changed the nature of work tasks. Flatter organizations and a leaner workforce mean that the decisions and business transactions that were taken care of higher in the organizational hierarchy are being pushed down to the level of the frontline worker. A broader range of more complex tasks is now being handled with less management supervision. Workers are given wider discretion for task accomplishment. Greater cross-functionality of work increases the heterogeneity of work tasks that must be accomplished in tandem to meet diverse customer needs. The tasks within the scope of a worker's responsibility are less likely to be limited to his or her department or specialty. As work location becomes more fluid, the tasks contain fewer physical cues to prompt performance and, although tasks are goal-directed, they take on increasingly novel forms to conform to the diverse settings in which they are performed. Business is transacted with customers by phone during flight, and production is simultaneously scheduled for international facilities via satellite.

Flatter organizational structures, a workforce with relatively fewer managers, more cross-functional work, and a work environment without location has also affected the capabilities workers need to perform the work. Less structure and direction from superiors has required workers to exercise more discretion over how work is accomplished. Planning and evaluating work have been added to existing production responsibilities. Cross-functional responsibilities require workers to understand work operations as a whole, rather than what used to be their specific tasks within a process; knowledge of one's own job is no longer sufficient to insure the efficient flow of products and services to customers. Broader knowledge of work systems involves knowing not only what co-workers do, but how to work with them collaboratively to achieve common goals. Flexibility is also needed to adapt to continuously changing work conditions and locations. As environmental cues to performance become less stable due to changing work conditions and locations, workers must compensate by developing a deeper knowledge of the work system. Mental rather than physical representations of work are increasingly needed to guide performance. And finally, in environments where frequently changing technology and methods gradually lead to obsolescence of skills, workers need reassurance that the uncertainty that permeates the workplace during periods of change is a function of the evolving nature of work, and not necessarily an indication of the worth of the worker.

In summary, the changing nature of the work environment is bringing about changes in work tasks and in the worker. The effects of the changing work environment on work tasks are:

- Work tasks are more heterogeneous;
- Work tasks provide fewer physical cues to prompt task performance;
- Work tasks include the need for more effective communication.

The effects of the changing work environment on the worker are:

- Worker needs the capacity for continuous learning;
- Worker needs the flexibility to adapt to changing work locations and conditions;
- Worker needs to be reassured that uncertainty is a function of the changing work environment, and not an indication of his/her declining worth as a worker.

The Influence of Changes in the Work Task

Change in the nature of *work tasks* necessarily affects the larger *work environment* and the capabilities needed by the worker to perform the work. Today's work tasks increasingly involve less direct physical interaction between the worker and work tools and materials, and there is less visible evidence of the link between actions and effects (Hirschorn & Mokray, 1992). As technology automates manufacturing, the tools to be used and the tasks to be performed change substantially. Hirschorn and Mokray analyzed metal fabrication processes and printed circuit board production at a computer manufacturer. Automation had transformed metal punch presses from manual operation to computer-controlled presses where information was downloaded electronically and tools and dies automatically appeared in the right sequence. For operators there is now more continuity between the raw materials and the tools for transforming them. Rather than the metalworker directly applying the tool to the metal and experiencing the physical tension of the metalworking process, the tool interacts continuously with the material in a computer-controlled system. The operator's task is to observe the consequences of this interaction and monitor the overall process. As tools and materials become integrated, operators cannot get direct sensory feedback from the process but instead must rely on data from an interface such as a computer screen or data printout.

Automation also broadens the perspective of the task from focusing on the instantaneous interaction of tools and materials to the observation of a broader pattern of events. Hirschorn and Mokray observed the same transformation of tasks and tools in the automation of printed circuit board production from "through-hole" to "surface mounting" technologies. As the pasting, placing, and soldering of printed circuit board components was integrated, workers were removed from the actual component insertion process and relied on process interfaces--oven readings and post-assembly tests--for production data. They monitored the whole process rather than its parts. The complex and interactive systems of a nuclear power plant deprive operators of a sense that their performance directly affects plant conditions, especially during multiple system failures. Operators must trust that actions taken in response to indicators in the control room will have the desired effects somewhere out in the plant (Perrow, 1984). In the banking industry, a sizable loan

can now be negotiated without the customer and loan officer ever meeting face-to-face (Zuboff, 1988). The stability and repetition of procedural manufacturing tasks and linear tasks in service-oriented work has been displaced by tasks that are constantly changing. Strongly influenced by technology that Weick (1990) characterizes as "stochastic, abstract, and continuous," the ever changing dynamics of today's work prevent workers from ever becoming comfortable with them. No sooner is a new technique integrated into a work system than a related method is revised that also requires additional learning.

The changing characteristics of work tasks are summarized in Figure 6.

WORK TASKS

TRADITIONAL ELEMENTS	EMERGENT ELEMENTS
• Stable, Static	• Changing, Dynamic
• Predictable	• Stochastic
• Linear, Repetitious	• Interactive, Reciprocal
• Visible, Concrete	• Conceptual, Abstract
• Single Tools that Narrow the Worker's Focus	• Systems of Information & Tools that Broaden the Worker's Focus
• Discontinuity between Processes, Tools, and Materials	• Seamless Interaction of Processes, Tools, and Materials
• Sensory Feedback at Juncture of Information, Tools, and Materials	• Cognitive Feedback at Interface between Information, Tools, and Materials

Figure 6. The Changing Nature of Work Tasks

The increasing sophistication of work tasks has influenced the larger work environment in which they are performed. The reduced visibility among co-workers and customers in tasks that are now heavily technology-mediated (e.g., telecommunication services, banking and investment services) contribute to increased psychological distance between people and a more impersonal work environment. Working on tasks where the tools and materials are less visible and conditions frequently change creates a greater potential for miscommunication among workers. Because tasks are reciprocal and interact with each other, there is a need for greater interdependence among workers who rely on each other to coordinate resources among interrelated tasks. Less well understood procedures and systems contribute to an uneasiness and uncertainty in today's high- technology work environments. New technical systems have always been unpredictable when first introduced. New "flying machines" crashed and steam boilers blew up. But as Weick (1990) observes, "the unique twist in new technologies is that the uncertainties are permanent rather than transient" (p. 8). The persistence of uncertainty about the operation of work systems pervades the work environment as attested to by workers in nuclear power production, air traffic control, banking, and computerized manufacturing environments (Perrow, 1984; Zuboff, 1988). Instant communication and computerized tasks have increased the pace of work activity and contributed to a feeling that there is less time to accomplish more work. Yet the challenge to workers afforded by dynamic and complex work also provides them greater opportunities to acquire broader knowledge about the systems they operate. The feelings of uncertainty and less control over events are a salient feature of today's work environment that can be addressed with greater depth of knowledge about work systems. This enables workers to exercise wider control over events and reduces the anxiety related to new technology.

The increasing sophistication and unpredictability of work tasks has also influenced the worker and the capabilities they need to perform the work. Performance in environments where events and outcomes are less predictable requires greater tolerance of uncertainty and change. Abstract, less visible work induces workers to impose some structure on the work to make it more concrete and to assure that unseen task components are not forgotten. A prominent feature of complex tasks is that there are fewer physical cues arising directly

from the work to prompt behavior and provide feedback. Workers must be aware of the increased potential for the decoupling of mental representations of the work from the actual events themselves. Their mental model of a process as a simple chain of events may be quite different from how the process actually occurs. Consequently, workers need more feedback than arises directly from the task and must receive it through other relevant channels such as from co-workers, supervisors and indirect indicators of performance. And finally, the challenge created by work that is complex and ever-changing must be met by workers who have the capability for continuous learning.

In summary, the changing nature of work tasks is bringing about changes in the work environment and in the worker. The effects of the changing nature of work tasks on the work environment are:

- A sense of loss of control over work due to its unpredictability and changing nature;
- An opportunity to acquire knowledge about work (to regain control over work);
- Greater psychological distance among people and a sense of impersonalness;
- More potential for miscommunication;
- Greater need for interdependence among workers.

The effects of the changing nature of work tasks on the worker are that:

- The worker needs an awareness of the potential for the decoupling of his/her mental models and the actual events of work;
- The worker needs more frequent, task-specific feedback as work tasks become more abstract, stochastic, and complex.

The Influence of Changes in the Worker

Change in the *worker* necessarily affects the larger *work environment* and the nature of *work tasks* to be performed. Although some structure and direction from management is an essential feature of well designed work systems, today's workers want more autonomy and responsibility for their work (Hackman and Oldham, 1980; Hall, Goodale, Rabinowitz, and Morgan, 1978). The team of two or more workers is gradually replacing the individual worker as the basic unit of work performance. In the office and on the shop floor, achieving work goals is increasingly a team effort involving group consensus

(Cooke, 1992; Mawhinney, 1992; Makjuka, 1991). Today's worker is less likely to be a white male as women, minorities, and other nontraditional workers make up an increasing proportion of the workforce (National Center on Education and the Economy, 1990). The average worker today will change occupations five times during his or her working lifetime. Where the bulk of one's work skills was once acquired early in one's career, maintaining relevant skills today requires a commitment to continuous learning (Adler, 1992; MIT Commission on Industrial Productivity, 1988). These changing characteristics of the worker are summarized in Figure 7.

WORKER

TRADITIONAL ELEMENTS	EMERGENT ELEMENTS
• Worker as Individual	• Worker as Team
• Homogeneous Workers (Predominantly White Males)	• Diverse, Nontraditional Workers (Women and Minorities)
• Workers Hold Few Occupations During Careers	• Workers Change Occupations Frequently
• Learning Occurs Early in Career	• Learning Occurs Throughout Career
• Workers Receive More Direction and Close Supervision	• Workers Have More Responsibility and Autonomy for Work

Figure 7. The Changing Nature of the Worker

The reconception of the "worker" as a team means that work is more likely to be defined as a team project rather than an individual task. In addition to task knowledge, today's work requires the ability to interact and communicate effectively with co-workers. The fact

that these co-workers are more likely to come from diverse backgrounds increases the challenge to today's worker. The parameters and specifications for how the work is accomplished should be developed by the team, rather than imposed from outside.

These changes in the needs and demographics of workers have stimulated important adaptations in the work environment. Because today's work is more likely to be performed by teams than individuals, the work environment should be continue to be reorganized to support team versus individual structures. This means that the flow of work and the procedures to accomplish it are brought into team structures rather than having work proceed serially from one work station to the next. Today's worker is also afforded relatively more autonomy in decision making and greater participation in defining the values and goals of the organization. Workers with multiple careers bring broader experiences to organizations, but this, in turn, requires organizations to have more flexible human resource policies and be more tolerant of employee turnover. The increase in nontraditional workers also necessitates expanded personnel practices that accommodate diversity in gender, age, and ethnic background. Organizations have responded to requests that they be more flexible about when work is done by providing programs for job sharing and flexible work scheduling. And as before, organizations must continue to offer meaningful, fulfilling work by providing workers with opportunities for learning new skills and for advancement.

In summary, the changing nature of the worker is bringing about changes in work tasks and in the work environment. The effects of the changing worker on work tasks are:

- Work is defined as a team project rather than an individual task;
- Work requires interpersonal and communication skills as well as task-specific skills;
- Work parameters and specifications are developed by the team rather than imposed from outside the team.

The effects of the changing worker on the work environment are:

- The work environment is reorganized to support team versus individual structures;
- The work environment allows more autonomy and participation in defining the values and goals of the organization;
- The work environment provides more flexible human resource policies and practices.

Summary of the "Laws of Interaction"

A major conclusion to be drawn from the preceding discussion is that change in each unit of the theory necessarily brings about subsequent changes in both of the other units of the theory. The following Laws of Interaction are derived from these dynamic relationships among the three units of the theory.

1. Work analysis applied to one unit of the theory--*work environment, work task,* or *worker,* must account for the changes in both of the other units.
2. Changes in *work environments* (see Figure 6) are affecting the following changes in *work tasks* and in *workers.*
   (a) As *work environments* become more cross-functional and participatory, *work tasks* become more heterogeneous and demand more effective communication skills.
   (b) As organizations are restructured and jobs are reconfigured, *workers* need greater capacities for continuous learning and adaptability, and need more assurance of their inherent worth as workers.
3. Changes in *work tasks* (see Figure 7) are affecting the following changes in *work environments* and in *workers.*
   (a) As *work tasks* become more dynamic and unpredictable, they create *work environments* that offer greater opportunities for learning and interdependence among workers.
   (b) As *work tasks* become more conceptual and abstract, *workers* need more frequent feedback about their work and greater awareness of the consequences of performing complex tasks.
4. Changes in *workers* (see Figure 8) are affecting the following changes in *work tasks* and in *work environments.*
   (a) As worker autonomy and teamwork become more prominent features of the workplace, *work tasks* are more likely to be team efforts that require effective interpersonal skills, rather than individual efforts.
   (b) As *workers* come from more diverse backgrounds and demonstrate greater career mobility, *work environments* are being restructured to reflect more flexible human resource policies.

Boundaries of the Theory

The boundaries of a theory are established to set forth the domain within which the theory is expected to hold. Most theorists attempt to model a complex aspect of the empirical world. The boundaries of a theory establish those aspects of the world the theory is modeling by distinguishing the theoretical domain from other aspects of the world not addressed by the theory. For example, Herzberg's theory of work motivation has two important boundaries which define the domain within which the theory is expected to hold. First, Herzberg's two-factor theory is limited to situations of employment in organizations. The theory does not hold, then, for motivation in social situations outside of organizations. Second, the theory does not apply to groups of individuals and is, therefore, not a theory of morale in organizations. Herzberg's theory is bounded by work organizations and applies to individual motivation, not the motivation of groups (Herzberg, 1966).

The boundaries of the "Theory of Work Analysis" are first defined by the distinction between work activities and leisure activities because the focus of analysis is on work. The activities one pursues for leisure fall outside the domain addressed by the "Theory of Work Analysis." Leisure is commonly defined as "the freedom provided by the cessation of activities, especially work duties and activities" (Merriam-Webster, 1970). Leisure activities can involve play, recreation, and whatever activities one wishes to pursue during leisure time. For the purpose of establishing the boundaries of the theory, all human activities are, therefore, considered to be either work or non-work (i.e., leisure and recreation) activities. Because the boundaries of the "Theory of Work Analysis" depend on the distinction that is drawn between work and leisure, the theory must specify who decides whether an activity is work or leisure, and describe how one might make this work-leisure distinction.

The worker is ultimately the only one who can distinguish work from leisure. Others, such as the worker's friends, family members, coworkers, and the work analyst may offer an opinion as to whether a given activity is work or not, but especially in cases that fall outside of traditional work activities and settings, the worker him or herself is the only one who can distinguish what is work from what is not. Two persons may consider the same

activity to be different things depending on their perspectives. For example, watering one's lawn may be a leisure activity for a busy corporate manager, yet it may also be considered a work activity by someone who dislikes such domestic chores. Family activities such as child care, entertaining guests, and other duties and social interactions involving those one considers to be family, can be thought of as leisure, work, or some combination of these. Only the person engaged in the activity can decide whether the activity is work, leisure, or some combination.

A second boundary of the "Theory of Work Analysis" exists within the domain of work. Within the domain of work, the "Theory of Work Analysis" applies to the analysis of work. Work analysis can be used for several purposes which include defining work roles (McCormick, 1979), identifying the learning needs of workers (Rossett, 1987), and serving as the basis for improving work performance (Swanson, 1994). The nature and purpose of work analysis cannot be limited to a single outcome (e.g., documenting the distinctions between two jobs), and the "Theory of Work Analysis" must reflect the variety of roles served by work analysis. Because work analysis is used for many purposes, the boundary defining the application of the theory to the domain of work analysis must be an "open boundary" with the domain of work. Dubin (1978) specifies the use of an "open boundary" when there is exchange over the boundary between the domains through which the boundary extends. A "closed boundary," on the other hand, is used when exchange does not take place between the domains through which the boundary extends. Therefore, the boundary defining the application of the theory to the domains of work analysis and work is an "open boundary," whereas the boundary defining the application of the theory to the domains of work and non-work (i.e., recreation and leisure activities) is a "closed boundary." These boundaries of the "Theory of Work Analysis" are shown in Figure 8. The "open boundary" is represented by the dotted line, and the "closed boundary" is represented by the solid line.

There are no boundaries specified for the environmental context of work analysis because the theory addresses work analysis performed in any work-related environmental context. The "Theory of Work Analysis" supports work analysis applied to a broad range of work activities and work settings. Although a listing of environmental contexts for

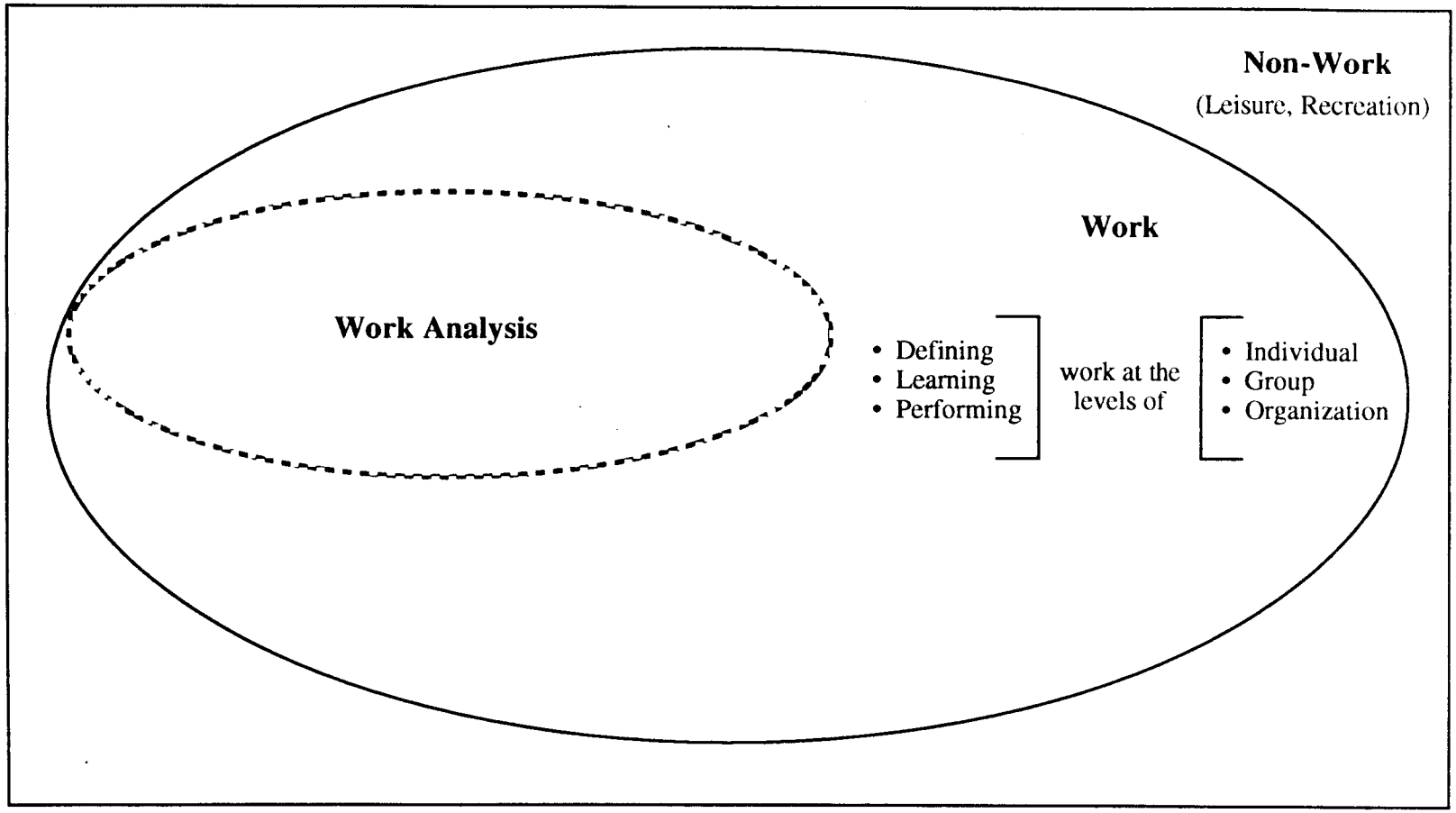

Figure 8. The Boundaries of the "Theory of Work Analysis"

work analysis supported by the theory is necessarily incomplete, it gives a sense of the wide spectrum of contexts to which the theory applies. The boundaries of the "Theory of Work Analysis" encompass but are not limited to:

- work analysis for the purposes of defining, learning, and performing work;
- work performed by an individual, by a group, or by an organization;
- work in public or private organizations;
- work in organizations with or without financial profit seeking goals;
- work conducted in the past, present, or future;
- work conducted in variable locations and conditions (e.g., in the office, field automobile, home, and other settings).

In summary, the domain within which "A Theory of Work Analysis" is expected to hold is the domain of work. The distinction between work and non-work activities separates the domain of the theory from non-work human activities not addressed by the theory. Only the person engaged in an activity can decide whether the activity is work, leisure, or some combination of these. Within the domain of work, the theory applies to the analysis of work. The boundary defining the application of the theory to the domains of work analysis and work is an "open boundary," whereas the boundary defining the application of the theory to the domains of work and non-work is a "closed boundary." Because the theory addresses work analysis performed in any context, there are no boundaries specified for the environmental contexts of the "Theory of Work Analysis." The theory of work analysis applies to the analysis of work regardless of the contextual dimensions of person, organization, purpose, time, or conditions.

System States of the Theory

Having specified the units of "A Theory of Work Analysis," the laws by which the units interact, and the boundaries of the theory, the theorist using Dubin's methodology of theory building then sets forth the *system states* within which the theory is operative. The system represented by "A Theory of Work Analysis" is composed of the three units of the theory,

work environment, work task, and *worker,* and the Laws of Interaction which govern the relationships among these units. The system boundaries are established to distinguish the work from the non-work domains because the system is not intended to hold outside the domain of work. There are various system states of the theory in which the units of the theory interact differently. A system state is a condition of the system being modeled in which the units of the system take on characteristic values and attributes. A system state represents a condition under which the theory is operative. For example, Herzberg's theory of work motivation is operative in three system states. First, an individual can be characterized as being in a state of equal satisfaction and dissatisfaction with work when "motivational factors" are counterbalanced by "hygiene factors" that have not been addressed. Second, a system state can exist in which the level of satisfaction is much higher than the level of dissatisfaction with work. Third, the opposite system state can exist in which worker satisfaction is much higher than dissatisfaction. Thus, the three system states of the theory reflect different levels of satisfaction relative to dissatisfaction (Herzberg, 1966).

The system states of "A Theory of Work Analysis" are based on a central principle established in the theory's Laws of Interaction. This principle is that a change in any one of the units of the theory--*work environment, work task,* or *worker*-- necessarily affects change in both of the other units of the theory. This means that there cannot be change in any single unit of the theory without related changes occurring in the other two units of the theory. For example, with change in the *work task,* we should expect change in both the *worker* and in the *work environment.* Changes in the *worker* and the *work environment* are the result of, and directly influenced by change in the *work task.* There can be change in any one of the units of the theory--*work environment, work task,* or *worker*-- which would be expected to bring about subsequent change in the other two units of the theory.

This dynamic relationship among the units of the theory is called the "principle of three-way interaction." The system states within which the "Theory of Work Analysis" is operative is based in this principle. Figures 9, 10, and 11 show three acceptable system states for the "Theory of Work Analysis." Figures 9, 10, and 11 each show three-dimensional cubes with each facet of the cube representing one of the units of the theory--

work environment, work task, and *worker.* The purpose of using these three-dimensional figures is to show that all three units of the theory are related in a dynamically interactive way. For example, the cube in Figure 9 shows the three units of the theory--*work environment, work task,* and *worker*-- and the component ideas from which each of these three units was synthesized. This figure represents the "principle of three-way interaction" in that a change in any one of the units of the theory necessarily affects change in both of the other units. For example, a change in any dimension of the *work environment* is expected to affect related changes in both the *work task* and the *worker.* The cube in Figure 10 shows that, in some work situations, only a single dimension of a unit of the theory is the object of work analysis. The instance represented by the cube in Figure 10 is one in which change in one dimension of the *work task* is expected to bring about changes in the *work environment* and the *worker.* Figure 10 shows that change in a *work task* goal requires changes in the *worker,* which include acquiring new knowledge and skill, and changes in the *work environment,* which include modifications of the work process.

Figures 12 and 13 show two system states that are unacceptable for the "Theory of Work Analysis." Figure 12 shows a two-axis matrix that represents two of the three units of the theory--the *work task* and the *worker.* Figure 13 is a one-dimensional figure that represents only one of the three units of the theory--the *work environment.* Both Figure 12 and Figure 13 fail to represent acceptable system states for the "Theory of Work Analysis" because neither of the figures are three-dimensional. System states for the "Theory of Work Analysis" must be three-dimensional to accurately represent the "principle of three-way interaction" among the units of the theory.

Changes in the workplace that might affect the *work environment, work task,* and *worker* can sometimes be quite modest. For example, a new piece of equipment may be the only change in the workplace at a given time. This equipment will affect how a particular work task is accomplished. The "principle of three-way interaction" should apply even when change in one unit of the theory is limited to a single dimension of that unit, as in the case of a new piece of equipment changing how a particular work task is accomplished. It is apparent that new equipment will alter the *work task.* However, the "principle of three-way interaction" maintains that this new equipment will also affect the

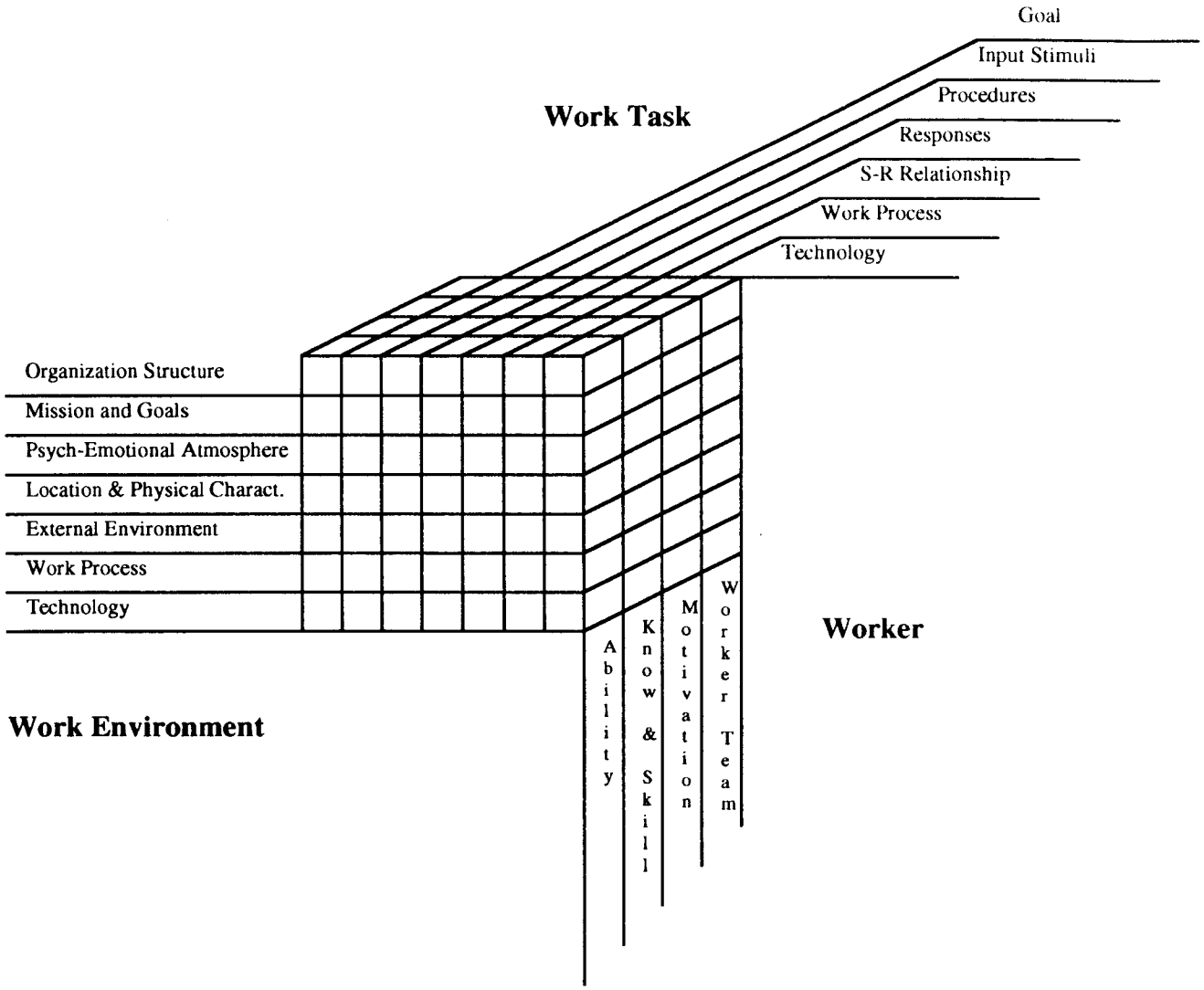

Figure 9. An Acceptable System State for the "Theory of Work Analysis"

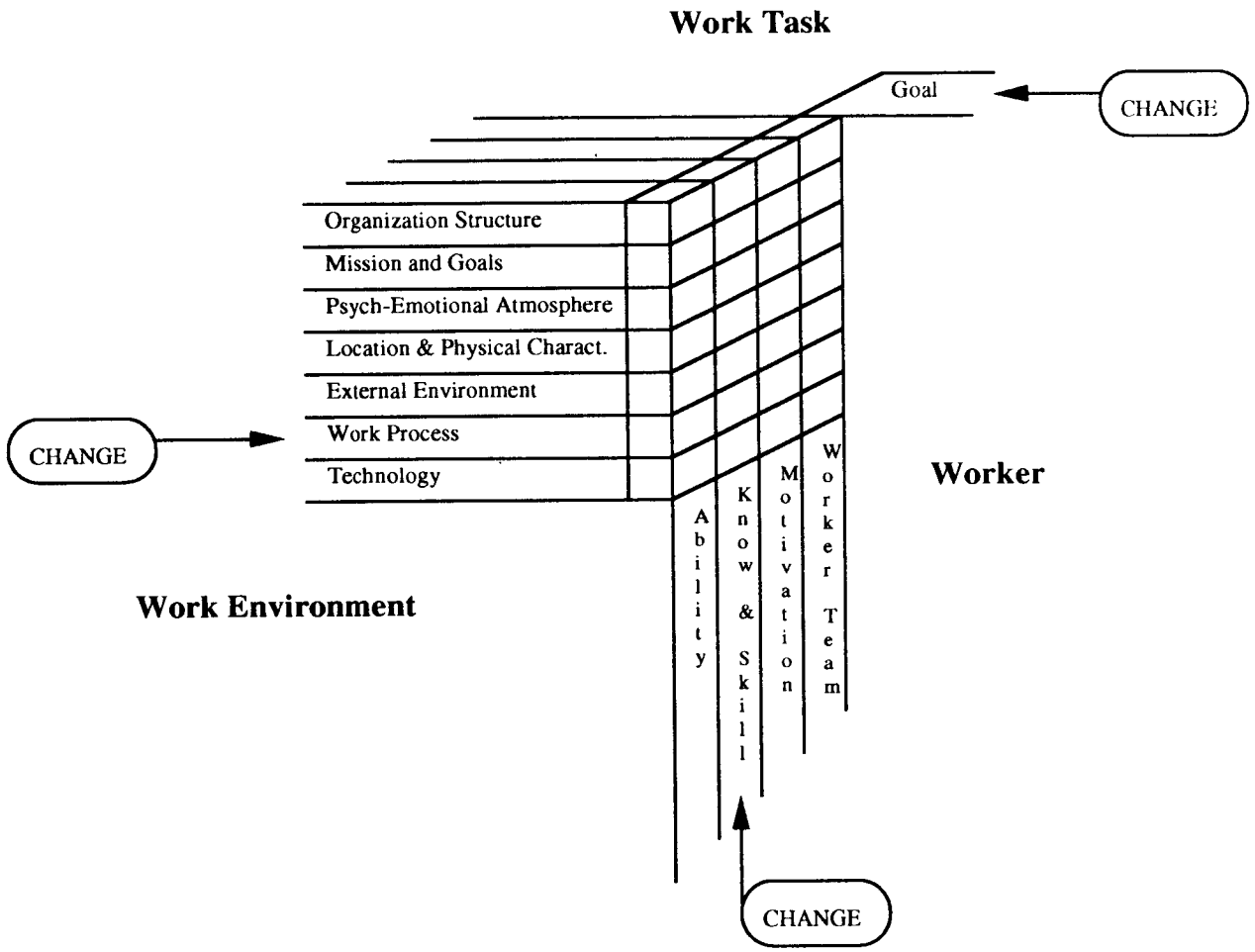

Figure 10. An Acceptable System State for the "Theory of Work Analysis"

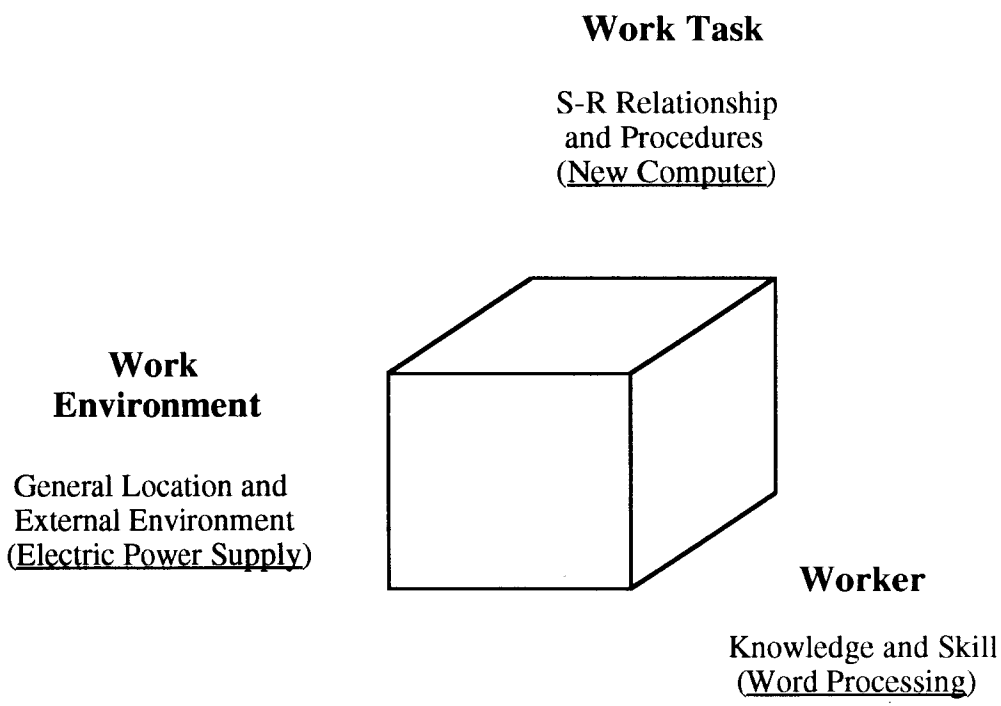

Figure 11. An Acceptable System State for the "Theory of Work Analysis"

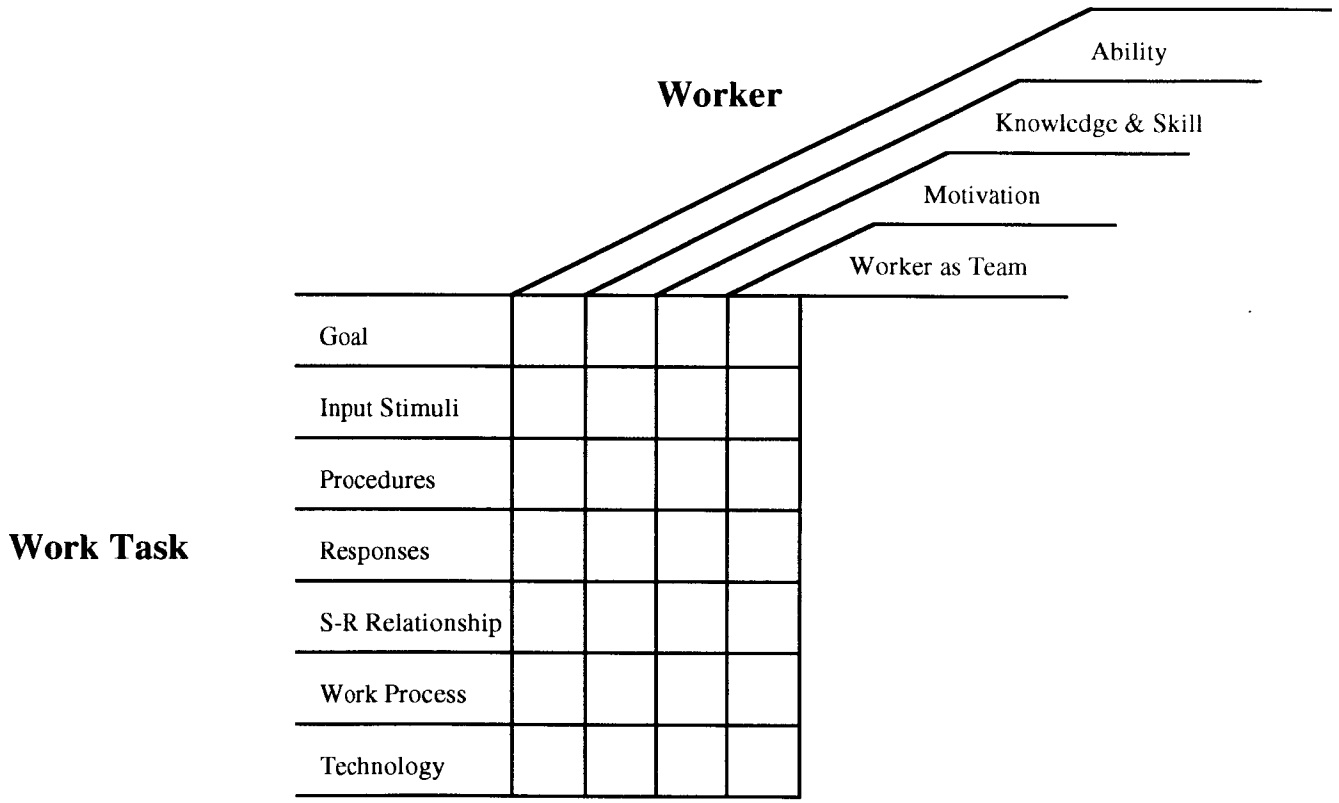

Figure 12. An Unacceptable System State for the "Theory of Work Analysis"

Work Environment

Organization Structure	
Mission and Goals	
Psych-Emotional Atmosphere	
Location & Physical Charact.	
External Environment	
Work Process	
Technology	

Figure 13. An Unacceptable System State for the "Theory of Work Analysis"

work environment and the *worker*. The cube in Figure 11 represents this situation. Imagine that the new piece of equipment is a computer used for word processing, and that the worker is a freelance writer who, prior to the arrival of the new computer, wrote everything using the basic writing tools of paper and pencil. This new computer not only affects change in the *work task*-- from writing thoughts down on paper to expressing them through electronic means, it also requires changes in the *work environment* and in the *worker*. At a minimum, the writer's environment must change to accommodate a computer (i.e., an electrical power supply is now necessary) and the writer must acquire new skills (i.e., basic proficiency in word processing). Thus, even change in single dimension of one unit of the theory is expected to influence both of the other units of the theory.

Propositions of the Theory

Propositions are truth statements about a theory. Propositions of a theory are true because they are logical statements about the theoretical system. It is important to note that these statements are not necessarily truth statements about aspects of the real world that the theory represents. To address the problem of matching the theory with the real world the theory is intended to model, it is necessary to convert the propositional statements into hypotheses, and then test the hypotheses through research. (The sequence of steps for taking propositions through Dubin's theory building process to the final stage of research is presented in Figure 1.) Propositional statements from the theory must be true if they are logically derived from the theory. Propositions can be made from any theory that has had its units, laws of interaction, boundaries, and system states specified.

For example, three propositions can be logically derived from Herzberg's theory of work motivation. First, an individual's motivation toward work is the sum of the level of satisfaction and the level of dissatisfaction. Second, an individual may be genuinely indifferent toward work. That is, an individual may feel no satisfaction and no dissatisfaction about an organizational work situation. Third, the levels of satisfaction and dissatisfaction felt by an individual toward work are independent of each other.

The following propositions are logically derived from "A Theory of Work Analysis":

1a. The content of work analysis is derived from all three units of "A Theory of Work Analysis"--*work environment, work task,* and *worker.*

1b. The units of the theory--*work environment, work task,* and *worker* --are interdependent. Change in one unit brings about change in both of the other units. Therefore, work analysis applied to one unit must account for change in the other two units.

2. Given frequent change in the units of the theory--*work environment, work task,* and *worker,* the purpose of work analysis should be the *synthesis* of change among the units to represent the *intent* of work, rather than the *analysis* of static work structures to represent the present *content* of work.

3a. The worker can analyze his or her own work. That is, the worker and the work analyst can be the same person.

3b. If the "worker" is a team of two or more people, and if the worker can be the work analyst (Proposition 3a.), then work analysis can be conducted by a team of workers.

APPENDIX C

GUIDELINES FOR CRITIQUE OF THE "THEORY OF WORK ANALYSIS"

- Please read the "Theory of Work Analysis" section of the enclosed document. The "Theory of Work Analysis" is at the end of the document and has been printed on colored paper to make it easier to identify. I encourage you to read as much of the rest of the study as you wish for a meaningful and frank critique.

- Attached are six questions intended to serve as guidelines for your critique of the "Theory of Work Analysis." Please answer each of the six questions. You may word process your responses on separate paper, write your responses on the attached sheets, or use another means which is convenient for you to provide written responses. Each of the six questions addresses one of the following aspects of the "Theory of Work Analysis":
    - Importance;
    - Preciseness and clarity;
    - Parsimony or simplicity;
    - Potential to yield predictions that can be tested;
    - Practicality; and
    - Any other comments you wish to offer.

- Please mail or fax your responses back to me by Thursday, July 7, 1994. I have enclosed a stamped, self-addressed envelope for this purpose. If you wish to fax your responses to me, my telephone and fax number is (612) 379-2211.

- If you wish to write comments directly on the "Theory of Work Analysis" document, I have also enclosed a large self-addressed envelope and extra stamps so you can mail the document back to me.

- All of your critique will be reviewed and serve as the basis for revising the "Theory of Work Analysis. After final revisions are made, I will send you a copy of the "Theory of Work Analysis" which will reflect your critique. Please call me collect, (612) 379-2211, if you have questions about any aspect of this critique.

APPENDIX D

Questions for Critique of the "Theory of Work Analysis"

1. Please comment on the importance of the "Theory of Work Analysis." How important in terms of significance and relevance is the theory to your theoretical knowledge and/or practice?

2. Please comment on the preciseness and clarity of the "Theory of Work Analysis." How understandable and internally consistent is the theory?

3. Please comment on the parsimony or simplicity of the "Theory of Work Analysis." How straightforward and to-the-point is the manner in which the theory is written?

4. Please comment on the theory's potential to yield hypotheses or predictions that can be tested. What is the capacity of the theory to lead to the development of new knowledge?

5. Please comment on the practicality of the "Theory of Work Analysis." How useful and functional is the theory to your theoretical knowledge and/or practice?

6. Please comment on any other aspects of the "Theory of Work Analysis" you wish to address.

APPENDIX E

CRITIQUE OF "A THEORY OF WORK ANALYSIS" FROM PRACTITIONER EXPERTS

1. Gary R. Sisson
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   Littleton, CO 80120

2. Barry-Craig P. Johansen, Ph.D.
   Director of Quality
   River Region Health Services
   1407 West Fourth Street
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3. Roger F. Miller
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   Minnesota Department of Employee Relations
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Gary R. Sisson
President
Paradigm Corporation
1979 West Littleton Boulevard
Littleton, Colorado 80120
(303) 797-2415

Mr. Rich Torraco
618 Fifth St. S.E.
Minneapolis, MN 55414

7/2/94

Dear Rich:

Here are my thoughts about your Doctoral Thesis. It's an impressive piece of work and like any such effort at presenting what you think (my own included) there are ideas which can be challenged. I hope you find a couple of these below!

In addition to this fax, I am sending you an original in the mail, thinking that you may need to make a copies and a "real" original is better for that purpose.

I have tried to follow the format you suggested. Here goes:

1. IMPORTANCE:

A. To me, the single most important idea in this theory is the notion that work should be analyzed as an *interactive system* comprised of the Worker, the task and the environment. And to me, this is a *very important* idea. Did I already know it? At some level I probably did, but having it articulated this way is useful for my way of looking at work.

In my type of practice it is all too easy to focus on the task, alone and neglect to analyze the other two potentially important factors making up the whole system. And it is also easy to focus on each separately without ever looking for relationships between the three factors that might yield interesting insights into requirements for performance improvement.

At the same time I recognize the importance of this way of thinking, I must also express caution lest I get caught up in a whirlwind of change. Is the world of work according to Torraco so fluid as to undermine the value of the very system he advocates (*ie* work analysis)? Does every change of personnel (*ie* the Worker) change the relationships among the variables, so as to alter the work system and negate the value of yesterday's analysis? If I read Proposition 2b (p. 124) correctly I might logically reach that conclusion. This being the case, I think it could be wise to somehow characterize the nature of change in a way that would still make the point but allow practitioners some hope of avoiding a possible analytical black hole!

B. I totally agree that the Worker can analyze his/her own work and that this is a very important and usually overlooked idea. I can tell you that in my practice I would rather have the Worker help me than anyone else. The name of the Worker appears next to mine (first actually) as the Author of all my analytical documentation!

2. USEFULNESS:

When I think about *usefulness* in relation to a theory or a "tool," I have to start by thinking about the purpose(s) for which it might be employed. It seems to me that there are at least two reasons for bothering to do work analysis. The first is simply to *describe* work. The second is to *derive* conclusions from the information gathered through the process of analysis. Thus, it is problematic to assert that *"... the purpose of work analysis should be the synthesis of change among the units to represent the intent of work, rather than the analysis of static work structures to represent the present content of work."* To me this is only part of the story.

Unless we are playing a semantic game having to do with the difference between *analysis* and *description*, it seems to me that a "real world" Work Analyst has little choice but to deal with the content of work as it exists at some given point in time. To put it bluntly: one of the reasons clients pay me money is to *document* work. Why? Here are a few reasons: ISO 9001, standardization of methods, it looks good to their customers, it reveals areas for improvement, it provides a record they need in order to transfer technology.

As a responsible practitioner (I hope) I really can't say that these reasons are wrong. In fact, I can say that I have personally experienced at least one situation in which every single one of the reasons I listed has resulted in analytical work that affected the bottom line performance of a client. And unless I'm missing something, I understand *documentation* to result from *"analysis of static work structures to represent the present content of work."* Let's not "throw out the baby with the bath water" by getting dogmatic!

As a practitioner, I think a "useful" theory is one that I can apply in my work. Unless my concern (expressed above) is based on misunderstanding, I would have a difficult time reconciling a great deal of time and effort spent on descriptions of work with the "counter-effort" required to maintain consistency with this theory.

To me, emphasis on the *synthesis of change* to the exclusion of other possible reasons for work analysis is a fallacy in this theory. Why must work analysis be a single purpose system? Why couldn't this theory of work analysis recognize the legitimacy of uses other than the synthesis of change?

3. NEW KNOWLEDGE POTENTIAL:

Given the number of assertions made in the theory, I would expect that it holds great potential for the generation of new knowledge.

There are certainly ways to observe and record the interdependence of the three variables. Doing so would likely reveal trends in the behavior of two variables when the third is manipulated. This could be very interesting indeed.

I think we have a lot to learn about the Worker as Analyst. While this notion isn't thoroughly explored in the theory, just pointing out the possibility may be an important contribution to the generation of new knowledge.

The notion of "Worker as team" also presents some interesting possibilities for further study.

While I personally have problems with the concept as presented in the theory, I certainly recognize that it could be fertile ground for research and the generation of new knowledge.

4. CLARITY/CONSISTENCY:

The theory is clearly a well thought out, well articulated, and well written piece of work. The only obscurity I see is the juxtaposition between *analysis* and *synthesis* in Proposition 3 (p. 125). "Getting it" took some thought! I guess the question for me would be is it more important to be clever or clear?

From my reading I found no internal inconsistencies in the theory at all. It seems consistent throughout. One example stands out in my mind, and this could have been a pitfall. You state that the Worker is separate from the work. This makes eminent good sense! Later on you use essentially the same argument to avoid a tempting side trip into the role of the Analyst: The analysis is one thing ... the Analyst is another.

5. CONCISENESS:

It is concise enough.

6. OTHER ASPECTS:

I want to offer a couple of thoughts in reaction to the initial reasons for the theory (p. 89).

A. The *Worker as team* concept is overstated, in my opinion. While there is no question as to the current direction of organizations toward the development of work teams, the basic unit of the team (and hence the work, itself) is and will remain the Worker. I base this assertion on a lot of direct observation in organizations ranging from Ben & Jerry's (on the left) to GM (on the right).

First and foremost you have to look at what teams are doing in the field. Here's a generalization: Teams are primarily responsible for coordination, communication and decision making having to do with their work. If this has a familiar ring, it might be because these are the traditional functions of a Supervisor. In fact, what I see is that Workers (*ie* Team Members) are assuming parts of the Supervisory role *in addition* to their normal functions. If you were to remove these from most work teams, you would see a group of Workers doing what they always did. There is little, if any substantive change in their work due to the presence of teams. (Technology is another matter altogether.) So to me *team as Supervisor* is more accurate than *Worker as team.*

B. The concept of *organizations without location* also is overstated. While it is true that advances in technology have allowed many organizations to become far less dependent on a single location as the locus of work, I have yet to see the day when my friend, Jack Poot will operate his Leblond CNC machining center from home! I think you're making too big a deal out of this! If you extend the concept of work without location to its logical conclusion (given that the work environment is one of three central variables in work) you could wind up with an infinitely variable environment that defies analysis. What's the point of this?

Rather than apply the notion of organization without location as a major reason for the theory, why not simply treat the separation of work from a single location in much the same way as you separate the Worker from the work? I'm just urging temperance.

C. Finally just one comment on the relationship of *process* and *technology*.

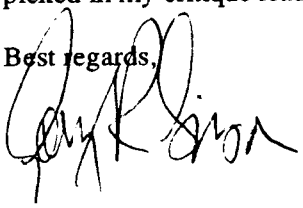
When I read the excellent discussion of process and technology (pp. 97 - 101) I am faced with the thought that something is just a little off-base here. I think I may know why.

It seems to me that work process is an *outflow* of technology. That is, I think in most cases process is subordinate to (or dependent upon) technology. The structure of the writing in this section would lead one to believe that the two are co-equal or perhaps even that process is more important. I find this discordant and would suggest you reassess the way the section is written or organized.

Finally, finally I just want you to know I'm honored that you would seek my thoughts about your work. I think what you've done here is done well. You have said something important ... something that needs to be said.

When I finish reading most publications in our field I usually just shake my head and wonder why I bothered! I feel like I wasted my time reading something that essentially leads nowhere. Your thesis is different than that. There *is* a need for a theory to underpin the practice of work analysis and I, for one, think your work represents a real contribution. Please don't let the "nits" I picked in my critique lead you to believe otherwise.

Best regards,



BARRY-CRAIG P. JOHANSEN, PH.D.
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RED WING, MINNESOTA 55066
612/388-0867

July 6, 1994

Rich,

Thanks for the opportunity to critique your work. I take it as a great compliment that you included me in an august and sagacious group! Attached find my comments for your consideration with one or two additions. Please feel free to give me a call if you need further clarification or have comments or feedback for me. Best wishes for the successful completion of this phase of the dissertation!

In you letter you provide a list of five important criteria to be used in evaluating the theory of work analysis. I would like to add an additional consideration that I believe is central to evaluating a theory; especially if the theory is the outgrowth of an already established body of work. It does not matter if the previous work is well grounded, poorly grounded, or based solely on practice. I don't believe there is a term for this criteria - let me refer to it as "dimension." That is, does the theory add another dimension to the established theory or body of work? By adding another dimension a theory will allow us to discover relationships that were heretofore hidden, unseen because previous theories were limited in what they could conceptualize. A theory of higher dimension is elegant in that it illuminates order in what was thought to be chaos. A theory of higher dimension will, by it's very nature, encompass the seemingly disparate theories that went before it and unify them by demonstrating that they were all manifestations of a greater underlying structure.

So, having waxed philosophic, let me finally answer your questions.

ON THE IMPORTANCE OF THE THEORY OF WORK ANALYSIS.

I believe the work is of significant importance as it presents an updated framework which better fits the realities of the current workplace. Your criticisms of current conceptions of work analysis (job no longer as relevant, focus on the individual, cross functional nature of work, centralized location of work, etc.) are, in my experience quite valid. I expect the theory of work analysis will be pioneering in that it will meet with a lot of resistance as it causes major changes in how work is conceptualized. This reconceptualization will be difficult as it calls for the development of new tools, methods, and means of evaluating performance. Indeed, I'm not sure if this is truly a theory of work analysis or a theory on the nature of work itself.

ON THE USEFULNESS OF THE THEORY OF WORK ANALYSIS

The theory is useful as a starting point for additional research. It is yet to be established, accepted, and tested.

ON THE POTENTIAL TO YIELD HYPOTHESIS THAT CAN BE TESTED.

The theory offers a wealth of opportunities for the development of hypothesis and continued research. The units of theory can be validated not only through empirical methods, but also by a meta-analysis of other theoretical work, much as you have done in your review of the literature. The laws of interaction could be tested both quantitatively and qualitatively. For example, one could test the basic precepts of the laws of interaction through relatively simple descriptive methods. For example, a survey to determine if tasks are in fact becoming more heterogeneous and abstract. Another study might focus on the communications skills of workers as they relate to success in various work environments and tasks. You could also test the role of feedback and systems understanding on worker satisfaction, performance, and organizational success.

It seems to me, however, that many of these relationships may have already been tested or established under the guise of different models or even disciplines. Therefore the challenge will be to develop studies that are unique to the theory of work analysis. Of course all the propositions of the theory, starting on 124, can be tested.

ON THE CLARITY OF THE THEORY OF WORK ANALYSIS.

I do not feel the theory would be clear to those without an academic grounding in HRD, TQM, work analysis, management science, or one of the other disciplines who have addressed the analysis of work. To a practitioner I believe it would be too abstract to be of use. Examples, case studies, and tools are needed to make it clear to practitioners.

I like to consider myself somewhat grounded in the discipline and did have difficulty understanding the importance and role of some of the central concepts. There are a number of relationships or assertions that, while in harmony with my experience, seem to arise without warning. For example, on page 95 you describe the "work task." It is unclear to me how a collection of work tasks are different from the old notion of a "job." Is not a "job" a fluid collection of work tasks?

On page 98 you support the importance of the concept of work process with the cross-functional nature of process in the workplace and the centrality of process improvement to TQM. What I didn't follow is the justification of TQM as being so important. Perhaps it is covered more fully earlier in the document, but I didn't follow the logic. Yes, process is important to TQM, but how important is TQM to work? I don't know that this link was established.

On page 99 Schroeder (1990) is cited and process is defined as " a collection of cause factors which can be translated into a sequence of tasks.....to produce a given output." Lower on the page "technical system" is defined a la Berniker (1987) as "combination of machines, equipment.... used to produce some valued outcome." My question then is: Is a process a technical system?

I have a great deal of difficulty with your definition or characterization of "worker ability." You state, without references, that it is unaffected by education and training and may be genetically determined. Is not ability a function of knowledge and skill born or environment, education, practice, and reinforcement? Do you really mean that some people are genetically predisposed to be better workers? If so, references are required. If this were true, why not use genetics to select the best worker? If an ability is stable and unaffected by education and training, then it makes little sense to waste time and effort trying to train the person? Are males really better at math and spatial relationships because of some genetic coding or is it an effect of how they are socialized, rewarded, and trained? Personally, I reject this definition of ability as I find it unfounded. Logical extensions of this type of view have been used as the justification for discrimination of all types including race, gender, and sexual orientation. I strongly object to this definition of ability. The ability to learn a task may vary from person to person as they present themselves in the work environment but I would argue that these differences in ability are the product of education, environment, motivation, and life experience rather than genetic determination.

On page 103 you define ability as relatively stable, on the bottom of page 105 you state that the characteristics of workers (including ability) change over time. Is this not a contradictory statement?

On pages 110 and 111 you write about the "worth" of a worker. On 110 you state that workers need reassurance that the uncertainty that permeates the workplace "is a function of the evolving nature of work...not necessarily and indication of the worth of the worker." What do you mean by "worth?" Is it the same as the value of the worker to the company? Or are we talking about the worth (value) of the person as a human being? If a person is unable to keep up with the rate of technological change in an organization, is not the value (worth) of that employee less than someone who can keep up with the changes? On 111 you state that uncertainty is not an indication of his/her declining worth as a worker. I'm not at all sure this statement is true.

ON THE PARSIMONY OF THE THEORY OF WORK ANALYSIS

I find the theory quite concise. Indeed, so much so that I believe it needs a bit more explanation to improve the clarity of the theory.

ON THE "DIMENSIONAL" ASPECT OF THE THEORY OF WORK ANALYSIS

I suspect that, as the theory is well grounded in the literature, it will allow the discovery of new relationships between the units of theory, interactions, and explain the various propositions contained within. It may also offer a framework for the evaluation of other theories and approaches to work analysis. As yet it does not offer such insights, but it does offer the opportunity for such exploration.

Other comments

It's too late in the game, but let me give you another reference. Alvin Toffler's book The Third Wave discusses many of the changes in the work environment, the nature of work, the technology, and the human impact of these changes. I think you would find that it fits well with the body of your work and details many of the relationships you call out in some of the charts in the dissertation. It has been a major influence on my thinking about work and technology and a very useful model and reference.

Best Wishes

Bo

Rich, Here (finally) are my responses to your Theory of Work Analysis. Thanks for your patience!

Roger Miller

I have adopted a simple scale of "High--Medium--Low" in responding to each dimension you inquire about. Also, I have tried to identify strengths and weaknesses for each dimension of the theory.

My perspective is that of both practitioner and scholar.

1. Importance

How important in terms of significance and relevance to my theoretical and practical knowledge?

High. Units and components of the theory are very relevant to my work and research. In many ways the changing dimensions of work addressed by the theory are the driving forces behind my work and research. For example, the critique of "job" as a unit of analysis, and the shifts from individual to team responsibilities are both very relevant to my work because they require change in performance measures and management practices.

Another reason for rating importance "high" is that we need a stronger base of theory within the field of HRD in to advance both theory and practice.

2. Usefulness

How useful and functional to my theoretical and practical knowledge?

Meduim-high. The theory in its present state is useful in helping me conceptualize and plan both research and practice. I see the potential usefiulness increasing as hypotheses and empirical results are generated.

3. Potential to yield testable hypotheses or predictions

What is the capacity of the theory to lead to the development of new knowledge?

High. For me, this overlaps with usefulness. I see potential in the distinction between task and worker (an advance from the "ability requirements" approach). Your theory will allow investigation of relationships between demand characteristics of the task and KSAs of the worker. Presently these are blurred.

4. Clarity
How understandable and internally consistent is the theory?

Medium--high. Generally the theory is clear and understandable. My greatest challenge is understanding the task components and characteristics. My difficulty here lies partially in my familiarity with the "ability requirements" approach, which is specifically not applied here. By not using this approach, you add internal consistency (ability is addressed in the "worker" unit), but the theory becomes more challenging to apply. Definition of "task" as a demand situation which elicits performance is appealing to me. It makes sense to clearly distinguish task from worker. How to apply this is not as clear to me. I need a good example.

Part of my confusion also lies in the specific task components and characteristics you have chosen. I have no problem with what you have on p. 96, but they appear most relevant for person-thing interactions, and less useful for describing person-system and especially person-person work. Also, they seem to assume more information is available about the task than may be the case. For example, an increasingly common demand situation for success as a manager is to identify and address unique, unstructured problem situations. How would this task be analyzed?

In reading through Figure 4 (p. 96), I wrote in the following:

goal	*clarity of outputs (e.g., unstructured problems)* *variety of output units (how broad a task?)*
procedures	*predictability of procedural results* *(probability that procedure will yield desired output)*
responses	*amount of cognitive effort involved*

I can probably think of others, but these illustrate my point.

What task components would address dimensions of "emotional work"? For example, the constant need for empathy with customers when performing many customer service tasks. This seems to me to be an increasingly important dimension of service work. Your definition of task is well-grounded in behavioral theory. How do you accommodate cognitive and affective dimensions of the task?

5. Conciseness

How straightforward and to-the-point is the manner in which the theory is written?

High. You have kept the units to a minimum. All variables appear important.

6. Any other aspect

I think you may slight the physical characteristics of the work environment. For example, I am currently working with a group involved in forest fire suppression. Your include a task characteristic of "amount of muscular effort involved", but I don't see anything in the work environment unit that would capture important characteristics of this work--heat, cold, danger, sustained effort over long period (endurance vs. strength).

One increasingly important purpose of work analysis (Ch1, p. 1) is compensation. Within the public sector, especially here in Minnesota, there is a more specific compensation issue of pay equity.

It seems to me that another important characteristic of the task and work environment is their stability or rate of change. How is this addressed within the theory?