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Exploring Knowledge Processes for Technology Assimilation

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EXPLORING KNOWLEDGE PROCESSES

FOR TECHNOLOGY ASSIMILATION

by

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ABSTRACT

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In the emerging knowledge society, the ability to make the experience and expertise of those involved in and affected by new technology unconditionally available to all members of an organization is becoming increasingly important. One of the problems in developing such knowledge processes for technology assimilation is that current social structures do not easily accommodate unconditional participation. Since the implementation of modern information technology is changing the workplace and the nature of work itself, alternative social structures are needed. This research takes as given that deep questions concerning knowledge processes and social transformation are in principle undecidable; and, only questions which are in principle undecidable, we can decide. Since most scientific research deals with decidable questions, an alternative research approach has been designed to deal with these deeper questions. The central research question is: "how do (or might) organizational personnel contribute to a knowledge process that facilitates the assimilation of new technologies?"

As an alternative to traditional research hypotheses, the research approach developed here to address undecidable questions formulates propositions as statements which are false, but whose truth would be desirable. The research design then explores the desirability of these propositions rather than their truth. This exploration was

conducted at a major research university which was in the process of implementing new distance education technology.

The propositions are based in ideas that come from cybernetic inquiry and draw specifically from Heinz von Foerster's distinction between trivial and non-trivial machines. A theoretical framework extends the concept of the non-trivial machine by identifying three types. This typing augments and complements the non-linear dynamic theory of leadership of Margaret Wheatley (Leadership and the New Science), the spiral of knowledge of Ikujiro Nonaka and Hirotaka Takeuchi (The Knowledge-Creating Company), and the knowledge society of Peter Drucker (Post-Capitalist Society). The distinction between the 'closed world' and 'open development' paradigms of Peter Brödner proves valuable in explaining the results of the research. The primary conclusions of this research are: (1) members of current hierarchical organizations do not, for the most part, participate unconditionally in knowledge processes that affect their tasks, roles, and performance metrics; (2) many, if not most, organizational members recognize the significance, if not the necessity, of dialogue as an aspect of knowledge processes, although some are cynical about the possibility; and, (3) an hypothesis worth pursuing in future research is: organizational members participate in knowledge processes for technology assimilation when the propositions on cybernetics and social transformation are true. It is also suggested that other approaches to research on undecidable questions would be worth pursing.

DEDICATION

Dedicated to the members of my family with all of my love and appreciation.

Mother
Mrs. Georgia M. McReynolds-Young

Father
Mr. Roscoe C. Young Jr. (Deceased)

Brothers and Sisters
Roscoe III, Thiel Young-Carnes, Gregory, Simone

Nieces and Nephew
Tamala Young, Tory Young and Solomon Carnes

Great-Uncle
Henry "Doc" Montgomery

Gold there is, and rubies in abundance, but lips that speak knowledge are a rare jewel.
(Proverbs 20:15)

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This dissertation has required standing on the shoulders of a giant in cybernetics, Heinz von Foerster. I first met Heinz at a conference in Chicago at which time he embraced me with a kiss and said, "I am glad you are one of us." By so doing he recognized me as an observing system and invited me into his system of observing. Other giants in cybernetics, whose legacies are similarly tied to Heinz, were also instrumental in inspiring the ideas presented here—in particular, Herbert Brün and the late Gordon Pask.

Over the course of this research, interactions with many individuals served to mold the research approach and interpretation of the results. Of special note were Klaus Krippendorff, Susan Parenti and Frederick Steier. Other members of the university community who helped me in many ways included John Eck, Billie Reed, Ben Troutman and Anne Blanchette. Special thanks goes to the faculty and staff at Colorado Technical University who inspired me to continue my studies toward a doctorate—Bob Stein, LouEllen Crawford, Frank Prochaska, Mark Burroughs and David O'Donnell.

Someday, I'd like to present the world with the cybernetics of Larry Richards, my mentor, confidant and dear friend. His constant presence and encouragement continued to fuel my enthusiasm for this research and the dialogic process proposed by it. His vision of propositions for a Knowledge Society served as the foundation for this research.

All my love goes out to my sisters in Christ—Beverlee Hart and Vivian Martin. The distance may separate us, but the love keeps us together. Thank you always for praying for me—*"May the God of peace, who through the blood of the eternal covenant brought back from the dead our Lord Jesus, that great Shepherd of the sheep, equip you with everything good for doing his will and may he work in us what is pleasing to him, through Jesus Christ, to whom be glory for ever and ever. Amen."* (Hebrews 13:20-21)

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CHAPTER 1

INTRODUCTION

This study was motivated by a desire to understand how cybernetic inquiry could play a role in establishing knowledge processes to facilitate the assimilation of new technology into an organization's operational and social structure. The research deals with questions which are in principle undecidable, distinguishing it from traditional research which attempts to answer decidable questions. The undecidable question represents "a movement toward holism, toward understanding the system as a system and giving primary value to the relationships that exist among seemingly discrete parts." (Wheatley 1992, 9) As an alternative to traditional research hypotheses, this research formulates a set of propositions presented in the form of statements that are currently false, and which, if true, would be desirable as a basis for a knowledge society. These propositions concern the domains of cybernetics and social transformation, and suggest that the concept of knowledge processes offers an avenue for connecting these two domains. Heinz von Foerster's (1991) distinction between trivial and non-trivial machines serves as our gateway to that avenue.

Background

The global objective of the research reported here is to explore processes by which the experience and expertise of those involved in and affected by the transfer of technology are made unconditionally available to all members and aspects of the organization. The implied premise suggests that once a mechanism for the unconditional dissemination of information is available, the free and open creation of

knowledge will flourish. One goal of these knowledge processes is to capture the issues embedded in "actual decisions, behaviors and privately expressed attitudes toward technology." (Rubinstein 1994, 338)

How an organization embraces the transfer of technology depends on how knowledge is represented and distributed within the social system of the organization. Sutton and Sutton identify three relationships that affect organizational dynamics within the social domain of the organization:

- Changes in technology alter the nature of tasks and vice versa;
- Changes in the tasks to be done affect the people and vice versa;
- Changes in people change the organization and vice versa. (Sutton and Sutton 1990, 123)

This research assumes that understanding these relationships is central to developing knowledge processes, as well as to understanding current organizational dynamics and the need for social transformation.

Technology is defined here as the "application of scientific and engineering knowledge to the solution of problems." (Werther, et al. 1994, 20) Top management regards new technology as a necessity for solving organizational problems and sustaining strategic competitiveness. Simpson notes that new technology promises to "achieve an end, and to do so quickly and efficiently" by saving time and space. (Simpson 1995, 3) To the rest of the organization, new technology means changes in the tasks to be done, the way they are done, and the way performance is evaluated.

Shockley-Zalabak and Morley characterize the social structure of organizations as a university of 'shared realities' "which contribute to a uniqueness of behavior expectations." (Shockley-Zalabak and Morley 1989, 484) They also state that this social

structure provides "value systems that help organizational members understand what the organization holds as important and how the unique sense of the place should influence their personal decision making and behavior." (Shockley-Zalabak and Morley 1989, 484) One role of a knowledge system, therefore, is to continuously "teach organizational members about what they should expect from others and what is likely to be expected from them." (Shockley-Zalabak and Morley 1989, 484) Sustaining a shared belief system requires the dissemination of information.

Linear explanations describe how information is disseminated in an organization in terms of the power of those providing the information and the power of the type of information being provided. Krippendorff states that "with a commitment to linear explanations, power is seen as flowing one-way, from its source to its destination, where it is pitched against a measure of resistance to change." (Krippendorff 1991, 181) According to Stolzenberg, a consequence of this way of thinking about the process of informing in the scientific community is the evolution of constraints that obstruct the free and open creation of knowledge:

> ...[first, in] being taken in (a) by certain uses of information that have the appearance, but only that, of being meaningful; and (b) by certain modes of [scientific] reasoning that have the appearance, but only that, of being self-evidently correct; second, in being locked in as a result of the psychological act, or process, of accepting these appearances as being "really so." Somehow, by a process that may be quite complex, they become so thoroughly woven into the very fabric of what we take to be our web of reality that it no longer seems possible to adopt a standpoint from which the question of their correctness may be entertained seriously as a "mere" hypothesis. What were originally assumptions have now become givens and the idea of calling them into question is no longer intelligible. (Stolzenberg 1984, 260-261)

This research assumes that a similar process currently dominates most western organizations.

New technology in the organization affects the types of tasks to be done and the people who have to do them. According to Kipnis, problems caused by new technology often result in "routinized jobs, alienation of workers, and the use of bureaucratic and hierarchical controls to maintain satisfactory levels of employee performance." (1990, 135) He also states that the transfer of technology "tends to create work that isolates people from each other and from the community, and encourages passive modes of adaptation," and "isolated and passive individuals tend to be powerless and less able to resist unwelcome attempts to influence them." (Kipnis 1990, 134-135)

In this type of organizational environment, "concepts about science, work and people are always presumed to be shared and failures in relationships between individuals are often blamed on poor communications or on something that can be fixed by the next reorganization." (Hainer 1968, 7-8) This mentality creates a culture that tends to place individuals in set roles. These 'set' roles have a strong influence on how information is shared or exchanged in the organization. Individuals within the organization tend to be "dependent upon and submissive to their superiors, where they experience a very short time perspective and low feelings of responsibility about their work." (Argyris 1971, B-276)

The role, or perceived role of the superior is described as "basically hierarchical in nature with well defined areas of responsibility and accountability, where this structure emphasizes well delineated lines of authority expressed in superior and

subordinate relationships and structured channels of control, with regular patterned information flow." (Preston 1986, 524) This type of hierarchical structure ensures "purposive and rational, goal directed behavior that promotes consistency and the coordination of various functional subsystems within the organization." (Preston 1986, 524) The drawback to this type of structure is that it "requires executives to manage an intended rational world, to direct, control, reward and penalize others, and to suppress their own and others' emotionality." (Argyris 1971, B-276)

The roles of individuals in the organization, coupled with linear explanation in the scientific tradition as the dominant form of information, promote the reluctance of both players (supervisor and employee) to test or express those thoughts, feelings or experiences that may contradict the official information and interfere with the exchange of that same information.

Problem Identification

The problem addressed by this research is presented here as a set of assumptions and statements of desire that are shared by the researcher and others in the academic community interested in engineering management and organizational development. These assumptions and desires are directed at the current situation as formulated in the previous section.

In order for organizations to adapt to technological innovations, management must recognize that changes in technology alter organizational dynamics. Changes in organizational dynamics affect the roles and tasks of the people in the organization. Also affected by new technologies is organization culture, which includes the

socialization of change among organizational components. The internalization of new technologies within the social domain of the organization is defined here as 'assimilation.' Knowledge processes are needed to facilitate this internalization.

Technology Assimilation

Technology assimilation can be viewed as continuous education about a technology's strategic contribution at all levels of the organization. Vertically, "information flows are needed to ensure that executives, who are not technically oriented, make informed decisions about the technological needs demanded by production and marketing personnel. Horizontally, consensus about needed technologies must span intra-organizational boundaries." (Werther, et al. 1994, 26) This is accomplished by the "development of effective social structures that embrace new technologies." (Werther, et al. 1994, 23-24)

Developing a social structure for the assimilation of new technologies presents a challenge for the organization. The effectiveness of continuous education, both vertically and horizontally, is determined by how well new technologies can be internalized, understood and discussed within the organizational social structure. The development of this structure must be undertaken with an appreciation that the assimilation of new technologies demands unprecedented commitments from all members of the organization.

Issues of continuous education, organization-wide commitment and social structure development must be addressed if the goal for introducing new technologies, i.e., sustaining a competitive advantage, is to be realized. The social dynamics of the

organization must be considered in a process which defines and evaluates continuous education, commitment and new social structures. This research explores knowledge processes for this purpose.

Knowledge Processes

The utilization of knowledge processes to address challenges in the organizational social structure is vital for organizational survival in an era of emerging information technology and continuous technological innovation. This research assumes that a knowledge process can be used to mediate organizational dilemmas and facilitate technology assimilation. The consequences of such a process could be a means for continuously revising the organizational social structure when the introduction of new technologies is imminent. While that possibility is outside of this research, it provides one of the motivations for pursing it.

Introducing knowledge processes to assimilate new technologies helps to prepare and encourage personnel within an organizational social structure "to assume the planning, control and decision making tasks." (Knight and Wall 1989, 31) The underlying premise of such a system allows for the creation of new action patterns where "everyone talks with, works with, everyone else, unimpeded." (Peters 1992, 81) The creation of new action patterns also lends itself to 'dialogue,' which is a, perhaps the, key aspect in a knowledge process. By opening channels for an ongoing dialogic process, knowledge development can proceed. It is probably safe to say that people are apprehensive about their participation in such a process, in part due to the perceived and real constraints placed on their participation by "objective" organizational policies, their roles in the organization, performance expectations, and/or the interrelationships

among these factors. Exploring the effects of new technologies in the context of these constraints, in particular those constraints embedded in current beliefs and behaviors resulting from experiences with technology assimilation, is an objective of this research.

Research Questions

Exploring knowledge processes for the assimilation of technology requires an action research methodology. This research approach aims to "contribute knowledge that will help people understand the nature of a problem so that human beings can more effectively control their environment." (Patton 1990, 153) This type of research approach was necessary to "encourage joint collaboration within a mutually acceptable ethical framework to solve organizational or community problems" and to allow members at various levels of the organization to participate in the research process, sharing in the creation, dissemination and representation of knowledge. (Patton 1990, 129) The focus of the research is implied by the following central question:

> **How do (or might) organizational personnel contribute to a knowledge process that facilitates the assimilation of new technologies?**

To further define the research, the central question was approached by addressing four supporting research questions:

1. **How are (or might) organizational personnel (be) affected by new technologies?**
2. **How has (or might) knowledge sharing with respect to the assimilation of new technologies been (be) defined in the organization?**
3. **How do (or might) organizational personnel participate in this process?**

4. How do (or might) organizational personnel perceive the utilization of a knowledge process resulting from the sharing of experience as a contribution towards sustaining the organization's competitive advantage?

These research questions were designed to address what "might be" with respect to participation. For the purposes of the research, three components of participation are identified: a Values/Time component, a Roles/Identity component and a Process component. Questions of "what might be" with respect to participation in knowledge processes for technology assimilation are "undecidable" questions, and "only questions which are in principle undecidable, we can decide." (von Foerster 1995, 2) Traditional scientific research addresses decidable questions by testing the truth or falsity of hypotheses. For undecidable questions, an alternative approach is needed that explores the "desirability" of propositions, rather than their truth or falsity.

Overview

The field site for this study is a large state-supported university. The focus of the research is knowledge processes in support of the assimilation of technology, specifically, distance learning technology. The levels of knowledge processes are (1) the level of the individual teacher and student, where the prevailing technology impacts teaching and learning styles; (2) the level of the university, where the prevailing policies impact the acceptance and mode of use of the technology; and, (3) the level of societal education, where the prevailing thinking and rhetoric on education impact the policies of the university.

The research instruments used include a variety of forms of interview and questionnaire. The research is designed to mirror or mimic a knowledge system that

bridges different levels of knowledge processes. A newsletter is used as a technology to facilitate a dialogic process. The desire of the researcher has been to provoke thinking on knowledge processes within the university and the educational community and to promote participation in the assimilation of distance learning technologies.

This dissertation is organized into nine chapters. Chapter 2 provides a cybernetic perspective that uses the distinction between trivial and non-trivial machines as a basis for describing and explaining sociocybernetic processes. Chapter 3 provides a theoretical framework for the research that is based on the role of the "observing system" in knowledge processes. Chapter 4 provides a set of propositions in the form of false statements that serve as alternatives to traditional research hypotheses for exploring "undecidable" questions concerning conditions governing the knowledge society. Chapter 5 outlines a research design and methodology that address the research questions developed in this Introduction. Chapter 6 presents results from the analysis of the data. Chapter 7 offers some interpretations of the results. Chapter 8 discusses implications of the research. And, Chapter 9 presents the contributions of the research, suggestions for redesigning the methodology and issues for further research.

CHAPTER 2

A CYBERNETIC PERSPECTIVE

The global objective of this research is to explore processes by which the experience and expertise of those involved in and affected by the transfer of technology is made unconditionally available to all members and aspects of the organization. Experience and expertise from organizational members can provide insights on the relationships affected by changes in tasks, people and the organization. Developing a process which includes these relationships, as well as information on "actual decisions, behaviors and privately expressed attitudes toward technology" (Rubinstein 1994, 338), requires a perspective grounded in a systems approach. Cybernetics offers an alternative to traditional perspectives on organizational social structures and organizational change.

This chapter uses cybernetic inquiry to explore several approaches to social transformation through the distinction between trivial and non-trivial machines. These distinctions help explain the "continuous emergence of new levels of organized complexity within society, at which new behavior can be demonstrated and new interactions with the environment become possible." (Geyer 1994, 1) The aspect of cybernetic inquiry employed here is in "the results of input-output transformation processes that may be explained by the structure of the system." (Geyer 1994, 2) This exploration provides a basis for understanding the dynamics of knowledge processes.

The Trivial Machine

The trivial machine is used to denote a system for which a set of inputs produces an analytically determinable, even if probabilistic, set of outputs. Analyzing something as trivial is to render its behavior (the output) predictable from the conditions that impinge upon it (the input). Analytical determinism is a consequence of "the degree to which input-output relations are non-random and linear." (Krippendorff 1992, 5) and the extent to which an input renders a predictable and reliable behavioral output. The concept of 'analytically determinable' describes input-output relationships that are inferred from observations. This concept of system assumes "that every ordinary machine can be acted on by various conditions, and thereby made to change its behavior" (Ashby 1956, 42) in order to reach and/or maintain a stable state.

There are several attributes associated with the Trivial Machine. These attributes not only provide this type of system a means to maintain itself in its environment, but also permit for its survival in view of environmental changes.

1. **System boundaries.** One can mentally and arbitrarily carve out any part of the universe and call it a system. The way system boundaries are drawn is observer dependent, time dependent and problem dependent.

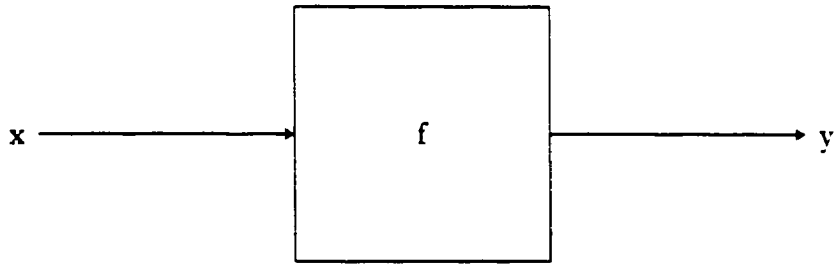
2. **Systems, subsystems and suprasystems.** Since one can arbitrarily draw the boundaries of a system, one can decide not only how one wants to define the system under consideration, but also how one wants to define the subsystems--i.e., component parts that should be especially looked at—and the suprasystem(s) of which it forms a part.

3. **Circular causality.** The increased awareness of ubiquitous circular processes, in technology, nature and society, supports the notion that something *can* cause itself. The circular casual cycle may be short—like A causes B and B causes A—or it may be a long cycle through the entire alphabet or more, in which case it will be harder to discover.

4. **Positive and negative feedback loops.** Both positive and negative feedback loops are examples of circular causality. They can occur spontaneously, in nature as well as in society, or they can be engineered. Negative feedback loops steer systems by keeping them on a certain course, rather than having them change direction, i.e., letting them fluctuate within a specified margin around an equilibrium. Positive feedback loops are deviation amplifying rather than deviation counteracting.

5. **Simulation.** The obvious advantage of simulations is that one can investigate the effects of changing some of the model variables without actually changing them in reality. (Geyer 1994, 4-7)

Under the concept of a trivial machine, a social transformation would be explained by a shift from one mode of control to another in order to maintain system stability. According to Krippendorff, the construction of people as trivial machines "equates them with technical devices and the social use of knowledge renders them as instrumental components of a technologically comprehended society." (Krippendorff 1992, 23) Organizational information systems have traditionally been designed with such a concept in mind. (See Argyris 1971, B-275 - B-276.) Figure 1 is a diagram of the trivial machine.



History independent
Analytically determinable
Predictable

Figure 1. The Trivial Machine (von Foerster 1991, 69)

The Non-Trivial Machine

Heinz von Foerster describes the non-trivial machine as "unanalyzable, hence unpredictable: an output once observed for a given input will most likely not be the same for the same input given later". (von Foerster 1991, 69). The primary difference between the trivial and non-trivial machine is that the latter "generally deals with living systems and not with the developing control systems for inanimate technical devices and it explicitly includes the observer(s) in the systems." (Geyer 1994, 6) According to Geyer these differences also have important consequences:

> Living systems, no matter how primitive, have a 'will' of their own. They exhibit what Maturana and Varela have termed autopoiesis or self-production: they not only reproduce, but also produce their own 'spare parts' whenever necessary, generally utilizing elements from their environment. Living systems thus are organizationally closed, but informationally open. This results in the difficulty to *control* the living systems' interactions with their environment. Thus, the system—whether an individual or a group—is defined as having the ability to reflect on its own operations on the environment, and even on itself. These operations generate variety in the environment, or in itself, which can reflexively be recognized as being due to systemic variation: observations can be observed, communications can be communicated, etc. (Geyer 1994, 6-7)

These attributes of the non-trivial machine provide the substance with respect to autonomous entities and their interactions with their environment and are further defined by self-organization, self-reference and autopoiesis:

1. **Self-organization.** According to Ashby, self-organization refers to the "system that starts with its parts separate (so that the behavior of each is independent of the others' states) and whose parts then act so that they can change towards forming connections of some type. Such a system changes from *parts separated* to *parts joined.*" (Ashby 1962, 260) Ceruti further defines this phenomena as being "characterized by a long search for appropriate ordering strategies of hierarchies, relationships, and possible problems." (Ceruti 1994, 73) In short, these systems "coupling with the environment ... give meaning to their interactions on the basis of their own history, rather than on the basis of manipulating the environment." (Geyer 1994, 12)

2. **Self-reference.** "The system, whether an individual or social system, collects information about its own functioning, which in turn can influence that functioning; minimal requirements in this case are self-observation, self-reflection and some degree of freedom of action. This means not only that the knowledge accumulated by the system about itself in turn affects both the structure and the operation of that system,

but it also implies that in these [types] of systems, feedback loops exists between parts of external reality on one hand, and models and theories about these parts on the other hand." (Geyer 1994, 13)

3. **Autopoiesis.** "The characteristic of living systems to continuously renew themselves and to regulate the process in such a way that the integrity of their structure[1] is maintained." (Wheatley 1992, 18) Furthermore, autopoiesis illuminates "an important paradox: Each structure has a unique identity, a clear boundary, yet it is merged with its environment. At any point in its evolution, the structure is noticeable as a separate event, yet its history is tied to the history of the larger environment and to other autopoietic structures." (Wheatley 1992, 18)

These consequences and attributes are useful for providing understanding and guidance for social transformation with respect to the non-trivial machine Types I, II, and III.

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[1] It is important here to make a distinction between structure and organization. Ceruti has made this distinction by defining the organization of a system as "a particular set of relationships, whether static or dynamic, and between components which constitute a composite unity as a unity in the real sense of the word. That is to say, the organization of a system is given by those relationships between its components which have to remain invariant so that the identity of the system itself may remain. If these relationships change, either the system *dies* or it becomes something else.

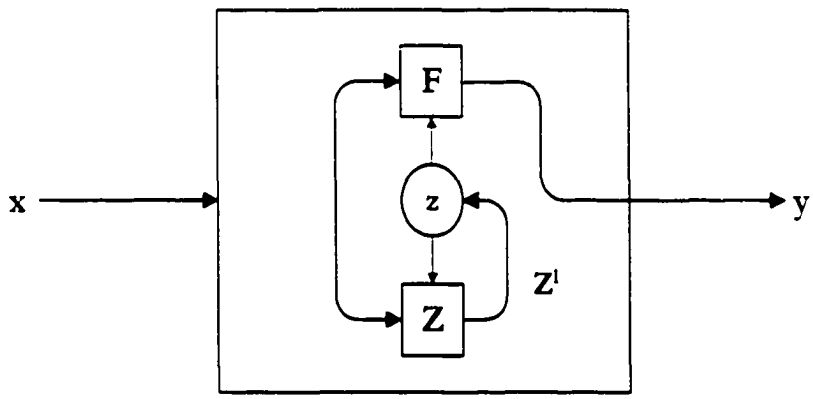
The structure of a system is instead defined as the set of current concrete components and relationships through which the origination of the system manifests itself in particular surroundings as a particular spatio-temporal entity. Structure refers to the process of construction, to the components, and to the actual relationships which constitute a particular unity through the realization of its organization. In order for a system to belong to a specific class, the organization which defines it must remain invariant, while its structures can undergo changes. Therefore, the *same* organization can realize or manifest itself through *different* structures." (Ceruti 1994, 91-92)

Type I: Incompletely Observable System

When the internal states affect themselves, the variety of possible outputs for a given set of inputs can grow to an unmanageable number. It is this magnitude of the possible internal states that renders a system incompletely observable and its output unpredictable. Observing a history of input/output interactions may permit an explanation of behavior that constrains the possible states and /or outputs, offering a type of predictability, hence a history dependence. The homeostat is an example of a Type I non-trivial machine. If we were to call the trivial machine a trivial, trivial machine, indicating a choice to describe it and explain its behavior as history independent and state determined, the Type I non-trivial machine could be called a non-trivial, trivial machine, indicating that, while we continue to describe it as state determined, we can no longer explain its behavior without observing its history. The assumption of the state determined system is that the limiting aspect in understanding a system and its behavior is information. Hence, the description of the system is developed in terms of its inputs, outputs and states. With enough information, we could fully explain and predict a system's behavior in terms of its current state and inputs—the trivial machine. When the amount of information required to do that is too large to acquire, a reliance on a history of behaviors may serve to constrain the set of possible behaviors sufficiently to permit an understanding adequate for the purposes of the observer—the Type I non-trivial machine.

The concept of self-reference coupled with analytically indeterminable behavior explains the nature of the Type I, non-trivial machine. Krippendorff states that this type of system assumes that "members of a class share the same characteristics, are

empirically indistinguishable within its class and individual behavior is explained from the knowledge of class membership, e.g., because someone is an 'A' he or she must be like all other 'A'." (Krippendorff 1992, 11) Figure 2 is a diagram of the Type I non-trivial machine.



History dependent
Synthetically determinable
Unpredictable

Figure 2. Type I Non-Trivial Machine (von Foerster 1991, 70)

Type II: Non-Linear Dynamic System

The Type II and III non-trivial machines arises with a shift in observation from that of inputs, outputs, and states (as in the trivial and Type I non-trivial machines) to that of relations, dynamics, and process. When viewed as a state determined system, inputs to a Type II non-trivial machine provide initial conditions for a dynamics of interaction that never produces the same output, i.e., history does not repeat itself. In such a system, input and output are not what is observationally relevant. In order to acquire insights into the system, the focus of attention must shift to the dynamic patterns of relations (structure). Attempts to identify constraints on states or outputs

are likely to result in an observation of shifting constraint boundaries. That is, the system appears to be continuously generating new alternatives. When observed from the point of view of process, however, the dynamic patterns of relations exhibit a stability in the form of stable patterns of relations as opposed to stable internal states. These systems are structure determined and, as such, are history independent with respect to structure. Describing a system as structure determined assumes that the system responds to instructions or orientations; as long as these instructions or orientations are observable, an explanation of behavior is possible in the form of patterns of relations. A chaotic system is an example of a Type II non-trivial machine. (Note: The Type II non-trivial machine could be called a trivial, non-trivial machine, indicating a choice to describe it and explain its behavior as history independent and structure determined.)

Characteristics of this type of system include:

1. **Disproportionality.** The relationship between a system and its components are disproportionate. "Changes in one part or element of the system do not lead to a proportionate change in other parts of the system. A small change may have a large effect, and a large change may have a small effect." (Goldstein 1994, 23)

2. **The whole is greater than the sum of the parts.** "A system and its parts are interrelated and interactive." (Goldstein 1994, 23) Information flows are multidirectional.

3. **Unpredictable outcomes.** "Events take place and structures emerge that cannot be anticipated. This makes the dynamics of change into a process that is evolutionary, organic and serendipitous." (Goldstein 1994, 50-51)

The non-linearity described by the above characteristics is created "by iterations of information feeding back on itself and changing in the process." (Wheatley 1992, 125)

Wheatley further states:

> After countless iterations, their [information's] tracks materialize into form, creating detailed shapes at finer and finer level. Everywhere in this minutely detailed fractal landscape, there is self-similarity. There is pattern within pattern within pattern. There is no end to them, no scale small enough that these intricate shapes cease to form. Because these formations go on forever, there is no way to ever gain a finite measurement of them. (Wheatley 1992, 128)

Figure 3 is a representation of a Type II behavior as applied to human interaction.

Krippendorff describes the interaction between the 'I' and 'you' as follows:

> The symmetry in the *I-you* relationships lies in that the *I* of one person corresponds to the ***you*** of the other. Each person is the other's other and each person evaluates the other by how well it conforms to the role assigned to it. Should discomformities be experienced, each person has the option of either changing its own construction of the ***you***, forcing the other into compliance or modifying its own *I* in compliance with the other's demand. Thus each person's ***you*** responds to the constraining efforts by the other's *I* and the constructive efforts by the own *I*. (Krippendorff 1992, 13).

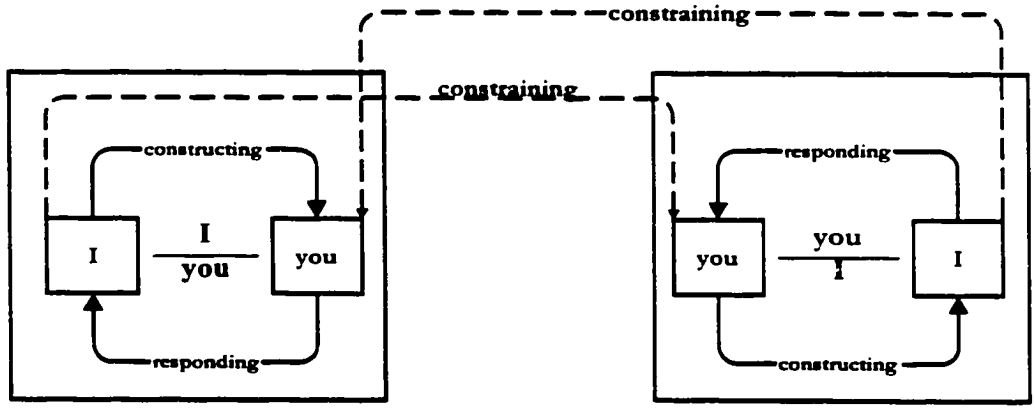


Figure 3. The Type II Non-Trivial Machine (Krippendorff 1992, 14)

Figure 4 represents these relations as described by Wheatley.

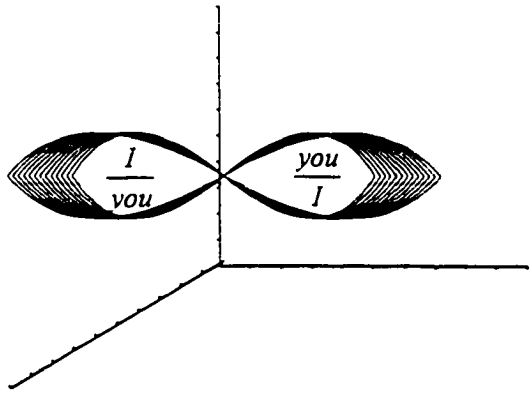


Figure 4. Pattern of Relations

The best way of imagining this type of system is by the following interchange:

I: I have a problem, will you fix it?

You: I have solved your problem, will you continue?

I: I have a concern, will you look into it?

You: I have researched your concern, will you continue?

Figure 4 provides insight into this type of system, where the focus is not on the input/output of relations, but on the structure resulting from the interchange between I and you.

Non-linearity and chaos are mentioned because of their role in 'self-organization.' Since the Type II non-trivial machine is described as a non-linear dynamic system, it has the potential to self-organize or dissipate information in order to recreate itself into new forms or processes. Self-organization is responsive to the demands placed on a system as a result of change or disturbance. This responsiveness is not random or incoherent, "instead, it evolves to greater independence and

resiliency to adapt and maintain a coherent identity throughout history. What endures is process—dynamic, adaptive, creative." (Wheatley 1992, 98)

Type III: Observing System

In the Type II and Type III non-trivial machines, outputs become inputs and are indistinguishable as such. In the Type III non-trivial machine, circularity in the dynamics of interactions renders the system closed to organization and hence unobservable, except through a projection of a quality of the observer (memory) on the observed. (Such a projection could be a quality like living, human, self-conscious social participant, etc.) When such a projection is not made, the observing system will not be recognized as a system, but as a heap, a mess, an incongruous glob of erratic motion, if recognized at all. Explaining the behavior of a Type III non-trivial machine requires us to refer to ourselves. While these systems are described as structure determined, the closure in the operational dynamics of the system permits the eigenrelations (the stable patterns of relations or attractors) of the structure to shift in order to maintain the invariant organization (the system's identity) embedded therein. When we observe these systems as structure determined, we assume them to be history independent; yet, we experience ourselves as history dependent (with memory). When we project ourselves onto the system being observed, we require a history of eigenrelations in order to explain the invariance observed. The Type III non-trivial machine is observed through an oscillation between history dependence (projecting) and history independence (observing). The Type III non-trivial machine could be called a non-trivial, non-trivial machine, indicating a choice to describe it and explain its behavior as history dependent and structure determined. The oscillatory aspect of

this approach suggests non-stationary understanding and knowledge. A dynamic logic, as opposed to the prevailing time-less logic, appears called for to serve as an anchor for this new concept of knowledge.

Interaction between 'observing systems' can be described as:

> ...a continuous process of becoming autonomous, making space available for the other, and thereby simultaneously liberating oneself and freeing the other from mutual impositions. [This process] is a continuous mutual emancipation resulting in the creation of joint realities. (Krippendorff 1992, 19)

Ceruti states that "the difficult art between the system and the observer is emphasized by how the observer has to construct the domain of his/her experience by decomposing it into systems and into the most adequate systemic hierarchies for his/her aim." (Ceruti 1994, 80) He further states:

> A system's functioning is determined by the web of interrelationships and interactions of its parts. The dyadic relationship between system and environment becomes at least a triad: system, subsystems, environment. By breaking open this black box, the hierarchy and stratification of systems appear. The observer's choice shows itself as being essential and constitutive in determining this hierarchy and stratification. The concepts which operational analysis seemed capable of defining both objectively and independently, are understood now as a product of the interaction between system and observer. (Ceruti 1994, 81)

Summary

Observation of the trivial and Type I non-trivial machine requires the observer to select a "clock" through which the observations will be made. The interests of the observer dictate that clock. (Note: The word "clock" is used as a metaphor for a concept of time and its associated dynamics. It should not be equated to a metric for time.) Observations of the Type II non-trivial machine requires the observer to search for a clock that will maintain a synchronicity with the clock of the system being

observed for the duration of the observations. The interests of the observer may have to be altered in order to find an adequate clock. Observation of the Type III non-trivial machine requires the observer to enter into a process of seeking synchronicity with the observed. The type III non-trivial machine is, at least metaphorically, "observing" the observer. The observer determines what constitutes history in accordance with the clock(s) being employed, which may change as the observation processes unfolds. (Neustadt and May, 1986) If that process involves interactions in language, it is a dialogic process.

A focus on social transformation with respect to the distinctions between trivial and non-trivial machines provides a perspective based in cybernetic inquiry that may be useful in understanding how to explore processes by which the experience and expertise of those involved in and affected by the transfer of technology is made unconditionally available to all members and aspects of the organization.

This research, as a knowledge process itself, requires two roles of the researcher: observation and provocation. As such, the researcher becomes an active participant in a process of social transformation. Research on knowledge processes that recognizes itself as a knowledge process requires new research approaches. This chapter has provided a categorization of the dynamics of knowledge processes as described by von Foerster's distinction between trivial and non-trivial machines.

CHAPTER 3

THEORETICAL FRAMEWORK

Cybernetic inquiry in the previous chapter explored several approaches to social transformation by making distinctions between trivial and non-trivial machines. These distinctions provide a basis for understanding the dynamics of knowledge processes and for an alternative to traditional perspectives on organizational structure and organizational change. A premise of the research reported here is that the dynamics of knowledge processes are best described by the 'observing system' with its potential to serve as a conceptual mechanism for unconditional participation in technology assimilation and social transformation. This chapter describes an alternative theoretical framework for knowledge processes, as an extension of a framework developed by Nonaka and Takeuchi (1995), in which the concept of the observing system is paramount. This framework helps explain how new knowledge can emerge as a consequence of technology transfer. Characteristics of an observing system provide insight into knowledge processes at the individual, organizational, and societal levels. The final section of this chapter presents a theoretical model of a knowledge creating process.

The Need for an Alternative Theoretical Framework

Technology transfer in an organization takes place when upper-level management decides to acquire new technology to solve problems using engineering and scientific knowledge, as seen in Figure 5.

Figure 5. Technology Acquisition Process

The difficulty with this process is with the requirement for assimilation of these new technologies into every aspect of the organization. Werther, et al., state that the assimilation process is best accomplished by the "development of effective social structures that embrace new technologies." (Werther, et al. 1994, 23-24) Holzner and Marx identify three components governing the social structure of an organization that facilitate change in the organization and the behavior of its members. The development of these components coincide with Sutton and Sutton's belief that organizations embrace new technologies by identifying the relationships that emerge as a result of how changes in technology alter the nature of tasks, people and the organization. (Sutton and Sutton 1990, 123) The components governing organizational social structure are identified by Holzner and Marx as:

- Cultural components that rely upon methods to change individual or group values, attitudes, or role perceptions by using ideological, indoctrinitive, emotional, symbolic, group dynamic and other sub-cognitive methods.
- Technical components that rely on cognitive information on new practices or services to induce fresh new action patterns and intellectual commitments to changed roles and activities.
- Policy components that rely on the redistribution of power, redefinition of rewards, manipulation of resources, or the use of influence to produce behavioral change. (Holzner and Marx 1979, 254)

Organizations that do not include these components in a process that encourages its members to embrace new technologies greatly limit the potential use

of new technology within the organization. It is believed by Argyris that 'set' hierarchical roles have a strong influence on how assimilation strategies in the organization can take place. He further states that members have typically been "dependent upon and submissive to their superiors, where they experience a very short time perspective and low feelings of responsibility about their work." (Argyris 1971, B-276) These types of employees are described by Argyris as:

> Those employees who prefer to experience some degree of challenge, to have some control, to make some decisions will tend to feel frustration and a sense of psychological failure. They may adapt to the frustration and failure by such activities as apathy, indifference, work slow downs, goldbricking, the creation of unions, absenteeism and turnover. Those employees who do not prefer challenging work or control over their work activities will not tend to feel frustrated. They will tend to report satisfaction and involvement, but the latter will not be deep or enduring. (1971, B-276)

Superiors in the chain are equally affected because:

> ...the formal design tends to require executives who need to manage an intended rational world, to direct, control, reward and penalize others, and to suppress their own and others' emotionality. Executives with these needs and skills tend to be ineffective in creating and maintaining effective interpersonal relationships; they fear emotionality and are almost completely unaware of ways to obtain employee commitment that is internal and genuine. This results in upper level systems that have more conformity, mistrust, antagonism, defensiveness, and closeness than individuality, trust, concern and openness. (1971, B-276)

Members in the organization have "to engage in an interpretive process that informs their attitudes towards competing social practices." (Simpson 1995, 89) These social practices, governed by the cultural, operational and political components of the organization create 'new' meanings that aim to increase the organization's operational capacities and reduce the complexity resulting from the transfer of technology. Conflict or contradiction in performance occurs when the actions of all members in

the organization are required to 'fit' into the same technology acquisition process to solve problems that the use of the technology has promised to 'fix.' Simpson describes this interpretive and conflict resolution process as 'repetition,' where:

> Repetition is the struggle against technology to keep open the field in which meaningful differences appear, and thus to combat the marginalization of those practices that we engage in not for their utility, but for what they are, for what they tell us about ourselves and for what they make of us. (Simpson 1995, 69)

He further states that repetition "has as its basic components *technè* (fabrication or making); *praxis* (action proper or doing); and *play* (subjective expressiveness) in which we find ourselves (events and situation) and the activity that we undertake." (Simpson 1995, 69) Repetition resulting from this interpretive process produces alternative meanings, ideas and decisions about how new technologies introduced into the organization affect members in the social structure. Repetition then provides the substance for knowledge processes.

According to Peter Drucker (1988), the basic economic resource, or means of production, in post-capitalist society will be knowledge. Waitley echoes this view by stating that "yesterday natural resources defined power; today knowledge is power." (Waitley 1995, 2) There are two types of knowledge as defined by Ikujiro Nonaka. "One is *explicit knowledge*, which can be articulated in formal language, including grammatical statements, mathematical expressions, specifications, manual, and so forth." (Nonaka and Takeuchi 1995, viii) This type of knowledge is transmitted to individuals formally and easily. *Tacit knowledge* is defined as a "personal knowledge embedded in individual experience and involves intangible factors such as personal belief, perspective, and the value system." (Nonaka and Takeuchi 1995, viii) Tacit

knowledge drives the individual passions, intuitions and hunches for problem solving and task completion. This type of knowledge, unlike explicit knowledge, has been overlooked as a critical component of collective human behavior because no prescribed calculus for sharing this type of knowledge exists.

Utilizing these types of knowledge in the organization will be 'knowledge workers,' whose primary obligation will center around allocating knowledge to productive use, similar to how capitalists knew how to "allocate capital to productive use." (Drucker 1993, 8) The key to this type of knowledge responsibility is that "everyone in the organization will be constantly thinking through what information he or she needs to do the job and to make a contribution." (Drucker 1993, 49) Nonaka states that "the one source of lasting competitive advantage is knowledge, where successful companies will consistently create new knowledge, disseminate it widely throughout the organization, and quickly embody it in new technologies and products." (Nonaka 1991, 96)

Role of the Observing System

The observing system's "functioning is determined by the web of interrelationships and interactions of its parts." (Ceruti 1994, 81) These interrelationships are the product of how "the observer has to construct the domain of his/her experience by decomposing it into systems and into the most adequate systemic hierarchies for her/his aims." (Ceruti 1994, 80) The observing system is capable of constructing this web of interrelationships based on attributes that distinguish the trivial machine from non-trivial machines. (See Chapter 2.) The distinguishing features of the concept of the observing system are important to

understanding and creating new meanings from the process of repetition, the two types of knowledge (explicit and tacit), and the concept of unconditional participation in the knowledge conversion process. The focus of this observing system framework is on the dynamics of knowledge processes, social transformation and technology assimilation. These dynamics exhibit different attributes at the individual, organizational and societal levels.

Individual Level

Autonomy and participativity are two attributes that aim to describe the role of the 'observing system' at the individual level. Ceruti proposes that the observer is the system and is so because of its autopoietic organization. (See Chapter 2.)

Understanding the observing system at the individual level is recognizing that "the proliferation and irreducibility of points of view is not a contingent moment due to the loss or the non-identification of a privileged point of observation, but the constructive strategy of the system itself; ... what appears as noise, and therefore as destructive of information, may, from the point of view of an observer in a specific system, appear instead as a creator of new information to someone outside the system." (Ceruti 1994, 88)

Autonomy

Krippendorff describes autonomy as an:

> Attribute of an organizationally closed system, i.e., a system whose organization is self-explanatory and by implication circular. The understanding of autonomous systems requires references neither to events outside that system, e.g., causes (causality), nor to a metasystem[1] of which it may be a part for reasons other than what constitutes it organization. Autonomous systems possess (a) a recursive form of organization of (b) processes which continually constitute their own unity by maintaining (c) a boundary within which its organization is realized. (Krippendorff 1986, 5)

This description of autonomy provides an understanding for the observing system at the individual level. Ceruti states that "the emphasis is placed on the active character of the system." (Ceruti 1994, 91) He further states that:

> The environment does not determine the nature of the system itself, its unity and identity. It is rather the system itself which selects from among all the environmental stimuli and the possible interactions with the environment. (Ceruti 1994, 91)

The ability of the observing system to function at the individual level as an autonomous entity is realized by its concept of time. One approach to explaining the observing system's concept of time is to derive it from the components of social time. Williams explains that "social time is defined as the sense of time through which human societies collectively trace their past and contemplate their future." (Williams 1991, 147) There are two dimensions of social time: (1) linear form—"identified as geochronological; representing events as fixed in time and place, unchangeable and unchanging," and (2) non-linear form—"identified as mind time, in which past, present,

[1] This term may be synonymous with Suprasystems as defined by Felix Geyer. (See Chapter 2.) Krippendorff refers to a metasystem as "a system of a logical type higher than a given system." He further states that "a metasystem can consider criteria or decide on propositions the system of lower ordinality may no be able to reflect or decide upon." (Krippendorff 1986, 50)

and future are seen as mental constructs." (Williams 1991, 147) Williams also states that:

> In the mind, the arrow of time points in both directions. Because we change our ideas about the past, the meaning of the past (what it is we know about the past) also changes. This means that an event occurring in the present may simultaneously change the past and future. It can reshape our understanding of the past and, thus, effect our decisions regarding the future. In this sense, the past as well as the future, is fluid, protean. Mind time, the non-linear dimension of social time, links past, present, and future in a continuing evolving process. (Williams 1991, 147)

Participativity

One approach to participation assumes that knowledge produces or allows for the introduction and development of specific relationships that determine an individual's 'reality,' which once defined, may promote how perturbations in the environment can be met, clarified and resolved. Ceruti defines the introduction and the development of relationships as 'categorization.'

> Categories are defined as the interface between knowledge and reality. Their nature seems to be characterizable by an irreducible principle of complementarity between functions. They arise within a specific corpus of knowledge. They result from complex webs of constructive procedures which are never completed or exhaustive. Their function is to establish the prior conditions which select experience and discern the admissible problems from the inadmissible, while establishing a perimeter around the horizon of meaning. (Ceruti 1994, 74)

Categorization is a consequence of observers moving toward synchronicity within a system. This process of categorization includes "evoking multiple meanings through the powers of observation." (Wheatley 1992, 65) Wheatley further states that "reality is only revealed through an active construction of participation." (Wheatley 1992, 65) The construction of realities is likened to what Wheatley describes as a quantum

universe which constitutes an environment "rich in relationships." (Wheatley 1992, 68) In this environment, "nothing happens without something encountering something else; nothing is independent of the relationships that occur." (Wheatley 1992, 68) The observing system at the individual level, then, seeks to continuously create 'realities' by participating in a process that includes its many interactions. In that process, the creation, transformation, maintenance, and dissolution of distinctions occur. These distinctions are the substance of knowledge, the traces of the knowledge process.

Organizational Level

The essence of a knowledge process as described by Nonaka (1991) involves a focus on the active and subjective nature of knowledge that is deeply rooted in the individual's value system. Putting this 'information' into action is difficult because of how organizations have handled information in the past. Information has traditionally been viewed as a 'thing,' and treated as "a quantity, as 'bits' to be transmitted and received." (Wheatley 1992, 102) Wheatley also states that the content of this information has often been ignored for various reasons:

1. Training has encouraged looking for "big numbers, important trends, and major variances." (Wheatley 1992, 108) This has resulted in removing disturbances and contradictions in order to provide comfortable statistics.
2. Conflicting information tends to be pieced together in order to yield desirable outcomes.
3. The focus on parts of the organization rather than on the whole organization has led to fear, because of the ambiguous and complex nature of piecemeal information.
4. Members of the organization accept that point-to-point connection is what holds the system together.
5. "Complexity only adds to task, thus requiring to track more things, handle more pieces, and make more connections." (Wheatley 1992, 109-110)

Nonaka contends that the organizational level must provide Intention, Autonomy(mentioned earlier), Fluctuation/Creative Chaos, Redundancy and Requisite Variety to its organizational members if the process of creating knowledge is to be continuous.

Intention

A knowledge creating organization system is one "that arrives at its present and future through the elimination of alternatives rather than through a process of direct purposive selection of futures." (Morgan 1983, 348-349) "The essence of this strategy lies in developing the organizational capability to acquire, create, accumulate, and exploit knowledge." (Nonaka and Takeuchi 1995, 74) Current organizations have developed strategies that involve goal-seeking processes which an enterprise can adapt to the contingencies of its environment in a way that allows it to survive. (Morgan 1982) The difficulty with this approach is that "strategic action involves the selection and conscious pursuit of specific goals and a purposive adaptation to an environment." (Morgan 1983, 346) This attempt to mold organization-environment adaptation in accordance with a predetermined end in mind increases the probabilities of organizational failure, because the goals were defined by the present. This means that

> ...organized forms do not actively seek or orient themselves toward achievement of a desired future state. Rather, they arrive at any given state through processes of adjustment which eliminate other possible system states. The existence of a particular form is necessarily dependent on the exclusion of other possible forms. (Morgan 1983, 347)

Morgan also states that organizations operating with predetermined goals in mind may "create future problems which manifest themselves in terms of new adaptive requirements." (Morgan 1983, 349) The organization that creates knowledge has one

goal, and that is to "conceptualize a vision about what kind of knowledge should be developed and to operationalize it into a management system for implementation." (Nonaka and Takeuchi 1995, 74) This type of goal seeking is seen as a "strategic action that embodies and reflects a systemic wisdom." (Morgan 1983, 352)

Fluctuation and Creative Chaos

Nonaka and Takeuchi describe 'fluctuation and creative chaos' as two essential ingredients that "stimulate the interaction between the organization and the external environment." (Nonaka and Takeuchi 1995, 78) Fluctuation has been described by Ashby as a 'disturbance,' "which moves a system from one state to another." (Ashby 1956, 78) With the introduction of disturbance, Ashby states that the "equilibrium is unstable." (Ashby 1956, 78) However, an unstable environment may lead "members of the organization to face a 'breakdown' of routines, habits, or cognitive frameworks." (Nonaka and Takeuchi 1995, 78) They further state that:

> a breakdown demands that we turn our attention to dialogue as a means of social interaction, thus helping us to create new concepts. This continuous process of questioning and reconsidering existing premises by individual members of the organization fosters organizational knowledge creation. (Nonaka and Takeuchi 1995, 78-79)

The purposeful use of ambiguity, blurred organizational vision and fluctuation is seen by Nonaka and Takeuchi as 'creative chaos,' which can serve to trigger a "reflection-in-action process [that] induces and strengthens the subjective commitment of individuals." (Nonaka and Takeuchi 1995, 80) Goldstein describes "this spontaneous regrouping of energy, the release of creativity and the activation of the system's inherent resources as the process of self-organization." (Goldstein, pp. 36-51)

Redundancy

The fourth condition enabling the development of knowledge processes is 'redundancy.' Nonaka describes redundancy as the "conscious overlapping of company information, business activities, and managerial responsibilities." (Nonaka 1991, 102) He further states that 'redundancy' is "important because it encourages frequent dialogue and communication, helps create a common cognitive ground among employees, facilitates the transfer of tacit knowledge, and spreads new explicit knowledge throughout the organization so it can be internalized by employees." (Nonaka 1991, 102)

An organization is comprised of operational processes made up of "*levels*-items, patterns and possibly patterns of patterns," where "choices are not all at the same level." (Bateson 1967, 31) Bateson describes 'redundancy' as "a patterning or predictability of particular events with a larger aggregate of events." (Bateson 1967, 31) He derived this notion, "by considering first the maximum of information which might be carried by the given item and then considering how this total might be reduced by knowledge of the surrounding patterns of which the given item is a component part." (Bateson 1967, 31)

Nonaka states that "redundancy of information facilitates the interchange between hierarchy and nonhierachy." (Nonaka and Takeuchi 1995, 81) He cites McCulloch's 'principle of redundancy of potential command,'—that is "each part of an entire system carries the same degree of importance and has the potential of becoming its leader." (Nonaka and Takeuchi 1995, 81) This is accomplished by 1) overlapping

divisions of labor and responsibility, and 2) strategically rotating personnel around the company.

Requisite Variety

Nonaka and Takeuchi's description of 'requisite variety' is based on Ashby's Law of Requisite Variety, which implies "that an organization's internal diversity must match the variety and complexity of the environment in order to deal with challenges posed by the environment." (Nonaka and Takeuchi 1995, 82) They further state that:

> Organizational members can cope with many contingencies if they possess requisite variety ["or information" (Ashby 1956, 151)] which can be enhanced by combing information differently, flexibly, and quickly, and by providing equal access to information throughout the organization. To maximize variety, everyone in the organization should be assured of the fastest access to the broadest variety of necessary information, going through the fewest steps. (1995, 82)

The need for 'requisite variety' is to ensure equity within the organizational social structure in order to maximize different interpretations of new information.

The concept of the observing system at the organizational level for the assimilation of technology through dialogue can generate new conceptual models of how technology could be used at all levels. In turn, the "application of that knowledge may produce new templates or models for the patterns of personal and collective conscience among those who possess, apply, or are affected by that knowledge." (Holzner and Marx 1979, 32) Over time, such "knowledge is applied to increasing ranges of people and situations; the new models of/for consciousness that derive from it are first disseminated and circulated, then discussed and rationalized, and finally, taken for granted." (Holzner and Marx 1979, 32)

Societal Level

The role of the observing system at the individual and organizational level is to ensure the motivation for and possibility of unconditional participation in knowledge processes, social transformation and technology assimilation. The role of the observing system at the societal level is to ensure an environment that encourages dialogue with respect of all of the attributes and characteristics described previously. Dialogue is defined here as the process used to create new action patterns and relationships by a mutual desire to share information in such a way as to move toward a synchronicity. This type of process emerges from created fields where "every employee has energy to contribute; in a field-filled space, there are no unimportant players." (Wheatley 1992, 56) In order to facilitate dialogue, society must embrace participatory processes, where acting locally allows each participant to move toward a synchronicity. Wheatley submits that at the local level:

> We are more likely to become synchronized with that system, and thus to have an impact. These changes in small places, however, create large-system change, not because they build one upon the other, but because they share in the unbroken wholeness that has united them all along. Our activities in one part of the whole create non-local causes that emerge far from us. This model of change—of small starts, surprises, unseen connections, quantum leaps—matches our experience more closely than our favored models of incremental changes. (Wheatley 1992, 42-43).

An environment that encourages unconditional participation through a dialogic process is necessary to ensure that the multiplicity of interactions can elicit the potentialities that provide the genuine richness that exists within the organization and its social structure. Dialogic process at the societal level drives the knowledge conversion process and acts as the basis for knowledge processes. Nonaka and

Takeuchi describe five phases of a knowledge process that occur in a dialogue-friendly environment:

> Phase I: Sharing Tacit Knowledge. The basis of knowledge in the organization resides with the individual. Nonaka stated that experience and knowledge is so ingrained within the individual, that it is often taken for granted. Sharing tacit knowledge must be amplified within the organization in such a way as to trigger dialogue. This often means that "the individual emotions, feelings, and mental models have to build mutual trust." (Nonaka 1991, 85)
>
> Phase 2: Creating Concepts. Nonaka describes this as the most intense phase because 'dialogue' must be continuous in order to transform 'emotions, feelings, mental models,' and experience new concepts that can be tested. He equates this phase to 'externalization.'
>
> Phase 3: Justifying Concepts. Concepts developed in Phase 2 are researched and developed to determine if "newly created concepts are worthwhile for the organization." (Nonaka and Takeuchi 1995, 86)
>
> Phase 4: Building an Archetype. Concepts justified in Phase 3 are developed into concrete designs, models or procedures. These prototypes of new strategies are distributed throughout organization so that different functions can determine the magnitude of impact their particular area will experience once the concept is implemented.
>
> Phase 5: Cross-leveling of Knowledge. Once a concept is implemented, this phase ensures the regeneration of the knowledge creating process by continuous dialogue, intra-organizationally and inter-organizationally.

The Knowledge Spiral

The knowledge spiral, as described by Nonaka and Takeuchi (1995), provides a process for members in an organization to continuously develop new products, services and knowledge through dialogue. This dialogue allows for tacit knowledge from organizational members to be made explicitly available to other organizational members. The conversion of tacit knowledge into explicit knowledge is accomplished in four modes, based on epistemological and ontological dimensions.

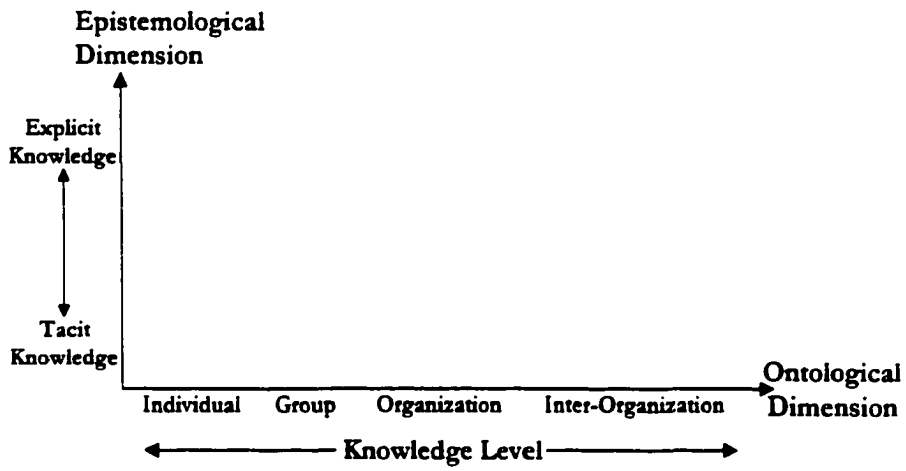


Figure 6. Two Dimensions of Knowledge (Nonaka and Takeuchi 1995, 57)

The 'epistemological' dimension	Explicit Knowledge (Objective)
Knowledge of Experience (Body)	Knowledge of Rationality (Mind)
Simultaneous Knowledge (Here and Now)	Sequential Knowledge (There and Then)
Analog Knowledge (Practice)	Digital Knowledge (Theory)

Table 1. Dimensions of Knowledge (Nonaka and Takeuchi 1995, 61)

The importance of this dimension is that "human beings create knowledge by involving themselves with objects, that is, through self-involvement and commitment,

or what Polanyi called 'indwelling.' To know something is to create its image or pattern by tacitly integrating particulars." (Nonaka and Takeuchi 1995, 60)

Furthermore:

> In order to understand the pattern as a meaningful whole, it is necessary to integrate one's body with the particulars. Thus indwelling breaks the traditional dichotomies between mind and body, reason and emotion, subject and object, and knower and known. Therefore, scientific objectivity is not a sole source of knowledge. (Nonaka and Takeuchi 1995, 60)

The tacit aspect of knowledge entails "mental models such as schemata, paradigms, perspectives, beliefs and viewpoints." (Nonaka and Takeuchi 1995, 60) These 'tools' help individuals understand and interpret their reality. Tacit knowledge also entails a technical aspect, which includes "concrete know-how, crafts, and skills." (Nonaka and Takeuchi 1995, 60) The mental models and technical aspect of tacit knowledge make up the cognitive elements of tacit knowledge and "refer to an individual's images of reality and visions for the future, that is, *what is* and *what ought to be.*" (Nonaka and Takeuchi 1995, 60)

The 'ontological' dimension "is concerned with the levels of knowledge creating entities (individual, group, organizational, and inter-organizational)." (Nonaka and Takeuchi 1995, 57) According to the authors, "knowledge is created only by individuals." (Nonaka and Takeuchi 1995, 59) As individuals make their knowledge available to others, groups are formed. "Organizational knowledge creation ... should be understood as a process that 'organizationally' amplifies the knowledge created by individuals and crystallizes it as a part of the knowledge network of the organization. This process takes place within an expanding 'community of interaction,' which crosses intra- and inter-organizational levels and boundaries." (Nonaka and Takeuchi

1995, 59) The underlying assumption of this process is "that human knowledge is created and expanded through social interaction between tacit knowledge and explicit knowledge." (Nonaka and Takeuchi 1995, 61)

Knowledge conversion consists of four modes. The first mode is socialization and entails the "process of sharing experiences and thereby creating tacit knowledge such as shared mental models and technical skills." (Nonaka and Takeuchi 1995, 62) This process yields 'sympathized knowledge,' or shared mental models that are recognized by others in the group. Once sympathized knowledge is constructed by the group, the next mode of knowledge conversion, externalization, begins. This mode yields 'conceptual knowledge' at the organizational level in which the "continuous and dynamic interaction between tacit and explicit knowledge" occurs. (Nonaka and Takeuchi 1995, 70) This type of knowledge is "triggered by meaningful dialogue or collective reflection, in which the use of appropriate metaphor or analogy helps members to articulate hidden tacit knowledge that is otherwise hard to communicate." (Nonaka and Takeuchi 1995, 71) The use of analogy and metaphor is then 'combined' with procedures, algorithms and other forms of explicit knowledge in the organization. The third mode of knowledge conversion, combination, produces a form of 'systemic' knowledge that permits testing and/or researching of the tacit information that has made its way through the knowledge spiral with procedures, specifications, etc., that are already in place. Once this phase is done and decisions are made to incorporate new parameters based on the input of tacit knowledge, the final mode of knowledge conversion is reached. Internalization entails the incorporation of 'operational' knowledge in the organization. This type of knowledge is considered

'explicit,' because it can be shared with other members of the organization in the form of manuals, policies, services, etc.

These four modes, Socialization, Externalization, Combination, and Internalization are summarized below and depicted in Table 2.

1. Socialization. The process of sharing experiences, mental models and technical skills. This is the first step in conversion, because the individual's personal knowledge, is introduced into the organization. Nonaka and Takeuchi state that "without some form of shared experience, it is extremely difficult for one person to project her- or himself into another individual's thinking process." (Nonaka and Takeuchi 1995,. 63)

2. Externalization. The process of "articulating tacit knowledge into explicit concepts." This is triggered by dialogue using "metaphors, analogies, concepts, hypotheses, and/or models." The goal of this process is to help promote 'reflection' and 'interaction' at all levels of the organization. (Nonaka and Takeuchi 1995, 64)

3. Combination. "The process of systematizing concepts into a knowledge system through such media as documents, meetings, telephone conversations or computerized communication networks. Reconfiguration of existing information through sorting, adding, combining, and categorizing of explicit knowledge (as conducted in computer databases) can lead to new knowledge." (Nonaka and Takeuchi 1995, 67)

4. Internalization. The "process of embodying explicit knowledge into tacit knowledge." This process is accomplished by sharing the new knowledge throughout the organization in the form of documents, manuals, diagrams, etc. (Nonaka and Takeuchi 1995, 69)

		To	
		Tacit Knowledge	**Explicit Knowledge**
From	**Tacit Knowledge**	**Socialization**	**Externalization**
	Explicit Knowledge	**Internalization**	**Combination**

Table 2. Four Modes of Knowledge Conversion (Nonaka and Takeuchi 1995, 72)

According to Nonaka, the focus of knowledge conversion is:

> The recognition that creating new knowledge is not simply a matter of processing objective information. Rather it depends on tapping the tacit and often highly subjective insights, intuitions, and hunches of individual employees and making those insights available for testing and use by the company as a whole. The key to this process is personal commitment, the employees' sense of identity with the enterprise and mission. Mobilizing that commitment and embodying tacit knowledge in actual technologies and products requires managers who are as comfortable with images, symbols, analogies and metaphors as they are with hard numbers measuring market share, productivity, or ROI [return on investment]. (Nonaka 1991, 97)

Figure 7 represents the components of a theoretical model of the Knowledge Spiral.

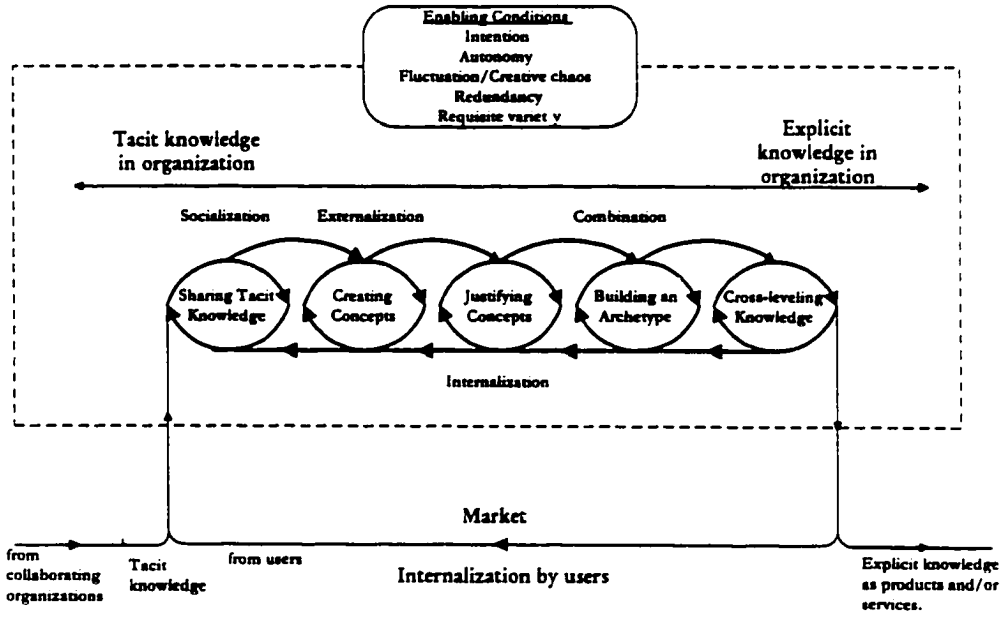


Figure 7. Operational Components of the Knowledge Spiral (Nonaka and Takeuchi, p. 84)

Summary

The theory of knowledge processes presented in this chapter provides a framework for thinking about what is going on in the research process as it unfolds. It is not intended as a generator of hypotheses. Rather, the propositions in the next chapter are alternatives to hypotheses when the research questions of interest are of the 'undecidable' type. Since the research is itself a knowledge process, and the subject of interest is the desirability of the propositions, the research approach must be a process oriented one, where dialogic processes begun have the potential for becoming ongoing. The dynamics of knowledge processes presented in Chapter 2 provide an understanding of how the knowledge creating processes introduced in the Spiral of Knowledge can be used in a research project to mimic an ongoing dialogic process at the individual, organizational and societal levels.

CHAPTER 4

PROPOSITIONS ON CYBERNETICS AND SOCIAL TRANSFORMATION

Research in knowledge processes generates questions which are in principle undecidable. The Propositions[1] in this chapter are intended as a way to address undecidable questions and are offered as an alternative to traditional research hypotheses. Presented as false statements, their truth is seen as desirable and necessary for social transformation through the use of knowledge processes. These propositions are based on a theory of knowledge processes that progresses from the trivial to the non-trivial (Types I, II, and III) machine. They serve as the framework for a process oriented research approach by providing a guide for the formulation of questions, scenarios and interpretation of responses.

Motivation: Society and Power

Proposition 1. In knowledge-creating organizations, power relationships are trivial.

We take as a premise that knowledge arises as a consequence of the power relationships embedded in the economic and political structures of the organization. Introducing the rhetoric of 'empowerment' into the organization does not alter the embedded power relationships and may mask their presence.

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[1]The idea for this approach to research of knowledge processes has numerous roots. Attendance at a series of conferences resulted in exposure to the concept of the false statement, first presented by the composer Herbert Brün, and the concept of the 'undecidable' question, first presented by the cybernetician, Heinz von Foerster. The subsequent collaboration between Larry Richards and this researcher led to the propositional approach. These propositions were first presented by Richards and Young at the American Society for Cybernetics Conference, May 1995, Chicago, Illinois and will be published in the Fall of 1996.

Proposition 2. Organizations possess adequate 'strategies' for trivializing power relationships in the knowledge society.

There are many ways of dealing with power relationships at the individual level. (Krippendorff, 1995) Current economic and political strategies for dealing with power relationships at the organization and societal level are inadequate. Heinz von Foerster's description of the non-trivial machine may offer an understanding of power relationships and that can transcend the logical traps of current political structures.

Cybernetics

Proposition 3. The word 'cybernetics' is used exclusively to indicate a vocabulary for talking, and hence thinking, about the dynamics of relations and behavior.

This proposition does not preclude topics other than the dynamics of relations and behavior arising in conversations around cybernetics. To the contrary, any subject matter is relevant material for these conversations. What distinguishes cybernetics from other fields of endeavor is its specific focus on dynamics, particularly on circular dynamics. Systems of particular interest are those greedy for perturbations. Living systems and social systems are foremost in this category. To try to include everything under the rubric of cybernetics, even if historically justifiable, is to water down those concepts that can be contributions of special importance, particularly as they might apply to social transformation. A central focus on dynamics distinguishes cybernetics from those approaches to description and explanation that focus on objects and energy, that is, virtually all the sciences. When those dynamics circle back on themselves, cybernetics also distinguishes itself from the humanities as currently promoted.

"Cybernetics is a way of thinking, not a collection of facts. Thinking involves concepts: forming them and relating them to each other." (von Glasersfeld 1992, 1) It is a way of thinking about questions, about questioning, and about ways of thinking (of which it is one). This recursive aspect of cybernetics (a way of thinking about thinking) requires a conceptual focus different from that of other fields of endeavor. That focus is dynamics and process, rather than substance and objects.

"Cybernetics arose when the notions of self-regulation, autonomy, and hierarchies of organization and functioning inside organisms were analyzed logically, mathematically and conceptually." (von Glasersfeld 1992, 2) The results of these notions have "led to the crystallization of concepts such as circular causality, feedback, equilibrium, adaptation, control and most important, perhaps, the concepts of function, system, and model." (von Glasersfeld 1992, 2) Even though these notions and concepts have been used in other disciplines in a variety of contexts, the focus of cybernetics is on "the systematic interrelation of the concepts that have been shaped and associated with these terms in an interdisciplinary analysis." (von Glasersfeld 1992, 2)

Proposition 4. The vocabulary of cybernetics is promoted by 'teachers' as offering a framework for exploring strategies for social transformation (including the trivialization of power relationships), such that the exploration becomes wanted.

While the rigor of cybernetics may help generate alternatives to the numerous religions and therapies that claim to offer approaches to individual mental health, this proposition suggests that when taken out of the context of the social world in which we live or might live, these approaches isolate the individual from that world. The

interest is in facilitating participation in, and provoking thinking on, the social processes from which these and other ideas emerge.

Social Transformation

Proposition 5. Social transformation is seen as distinct from continuous improvement, and as desirable.

While those interested in continuous improvement might talk about 'saving the world,' those interested in social transformation would talk about 'creating a new one.'

Proposition 6. Social transformation is recognized as a process of (1) changing thinking and (2) transforming history.

(1) Thinking is used in its social context. Ways of thinking are social phenomena and are carried in the prevailing language. Cybernetics offers a way of thinking about ways of thinking. (2) The challenge of transforming history is that it requires that no history (trace) of that transformation remain; otherwise, it is an addition, not a transformation. This proposition suggests that history is continuously being transformed, and that there is also a challenge in preserving desirable history in such a way as to keep it from being transformed.

Proposition 7. The history of social transformation is a history of participation, not a history of celebrity.

Proposition 8. It is widely accepted that participation in social transformation can occur through (1) the identification of a logical anomaly, (2) the creation of a provocation or perturbation around that anomaly (a pivot), and (3) the recognition and avoidance of undesirable consequences resulting from the dynamics triggered by that perturbation.

(1) The recognition of anomalies requires social alertness, a readiness for 'listening.' (2) Turning an anomaly into a provocation is a creative act, limited only by

the ingenuity and timing of the provocateur(s). It is most accessible to those primed to crafting 'whenness,' as well as 'whatness.' (3) Avoidance involves the work of organizing, educating, and, when necessary, leading.

Proposition 9. Every individual, having the potential to participate in such a process, is given access to all knowledge in order to work collectively to increase alternatives and decrease power relationships.

The metaphors 'to increase' and 'to decrease' are used here not to imply a quantity relationship, which is always relative, but to indicate a direction, or ethic, with respect to participation in social transformation. In accordance with the Type III non-trivial machine, participation is realized as a continual elicitation of individual self-descriptions (projections), through which awareness of desires, responsibilities, and freedoms emerges as a social consciousness.

Proposition 10. In the knowledge society, social transformation occurs as a non-violent activity.

Proposition 11. The perturbations in cybernetics (as in teaching) are made in love and with an attention to time.

Love is a dynamic that links the biological domain to the social domain. In the biological domain, love arises as a preference for recurrent interactions between organisms; in the social domain, it is a celebration of the other. This proposition should not be seen as an appeal to altruism. Rather, in the spirit of the Type III non-trivial machine, where we see ourselves through the eyes of the other, an appeal to altruism is not necessary when we accept that 'I am better off when you are better off.' Attention to time manifests itself as patience or impatience, or as some other temporal behavior; it is added to this proposition to emphasize the needed craftsmanship.

Knowledge Processes

Proposition 12. Participation in knowledge processes is encouraged at three (at least) different levels: the technical or operational level of the individual, the organizational or policy level, and the societal level, where it is recognized that these levels represent logical domains.

An alternative view of 'technology' is described by Simpson as being a "constellation of knowledge, processes, skills and products whose aim is to control and transform" at the global level. (Simpson 1995, 17) He further states that this knowledge is often the result of "functional relationships or laws" that "offer us guidance in the selection of courses of action which are adequate for the realization of a given end or for the solution of a given problem and, further, places at our disposal the means to that realization." (Simpson 1995, 16-17) The importance of this description is the focus on the different domains from which knowledge is drawn, i.e., functional relationships.

Proposition 13. It is widely recognized that knowledge processes critical for social transformation occur between logical domains, and that participation in these processes requires a sensitivity to emotionality and the admissibility of alternate concepts of time.

On the one hand, knowledge can be seen as rational, because it supports various theories, scientific laws and concepts. The other form of knowledge that is not easily transmitted and does not support any particular scientific theory is that resulting from "a set of rules which are not known as such to the person following them and result in a skill that cannot be fully accounted for in terms of their particulars." (Polanyi 1958, 49-50) This skill or set of rules to achieve a certain skill is best formulated as 'tacit knowledge.' "Tacit knowledge has an important cognitive dimension. It consists of

mental models, beliefs, and perspectives so ingrained that we take them for granted, and cannot easily articulate them." (Nonaka 1991, 98) These descriptions of tacit knowledge are necessary to understand what the 'observer' of a system experiences as a result of participation in knowledge processes.

Proposition 14. Artistic endeavor is accepted as an appropriate and desirable mode of participation in knowledge processes and is recognized as offering an exploration of new logics of emotion and time.

Maturana and Varela state that knowing about our knowing is:

> ...traditionally elusive for our Western Culture. We are keyed to action [and results] and not to reflection, so that our personal life is generally blind to itself. It is as though a taboo tells us: It is forbidden to know about knowing. Actually not knowing is what makes up our world of experience, which is the closest world to us. Maybe one of the reasons why we avoid tapping the roots of our knowledge is that it gives us a slightly dizzy sensation due to the circularity entailed in using the instrument of analysis to analyze the instrument of analysis. (Maturana and Varela 1992, 24)

The process of knowing, or knowing how *we* know, is embedded in our actions and experiences on both the personal and professional level. Individuals as observers of a system always have these tools of 'reflection' available for future experiences and actions. "This circularity, this connection between action and experience, this inseparability between a particular way of being and how the world appears to us, tells us that every act of knowing brings forth a world." (Maturana and Varela 1992, 26) This tacit component of the observer's system needs to be made centrally available to others in the organization. This process of combining the tacit component of an observer's system to that of an explicit or dominant form of knowledge is accomplished through a dialogic process.

Dialogic Process

Proposition 15. Dialogic process is recognized as the predominant mode for creating new action patterns and working relationships through a mutual desire to share information based on experience and expertise in such a way as to move toward a synchronicity. In this process, the creation, transformation, maintenance, and dissolution of distinctions occur. Such distinctions are the substance of knowledge.

In order to facilitate 'dialogue,' the organization must engage in participatory processes, where acting locally allows each observer or member of the organization to move toward a synchronicity that includes the flow of simultaneous events within each observer's system. (Wheatley 1992)

A dialogic process is necessary to ensure that the multiplicity of interactions can elicit the potentialities that can provide the genuine richness that exists within the organization and its social structure.

Technology

Proposition 16. A technology, with a basis in the concept of the non-trivial machine, exists to facilitate and stimulate dialogic process on a global level.

Such technologies do exist in rudimentary form at the local level. At the global level, it is suggested that the technology must be of the non-trivial machine type, and that the framework presented here must itself become subject to transformation as a consequence of the technology it generates and the dialogue facilitated and stimulated by that technology. We suggest that the non-triviality will be in the software, and that it might manifest itself as a desirable form of 'virus' with non-linear dynamic characteristics.

The Cybernetician

Proposition 17. The label 'cybernetician' is used to speak of a craftsperson in time. This craftsmanship is directed toward a technology of knowledge. (Richards 1993)

Time is a different sort of 'medium' from all other media of the craftsperson. (Boscolo and Bertrando 1993; Hall 1983) And, all craftspeople deal with time. It is proposed that the cybernetician deal with it explicitly. Time cannot be dealt with independently of other media. Hence, the craftsperson in time must have another medium to work with—any medium will do. The tools of the craftsperson are amplitude (intensity), pace (speed/rate), duration, event (emphasis/timing), sequence (history), periodicity (rhythm), and synchronicity (including perturbations thereto).

Summary

The propositions in this chapter were introduced as false statements to provide a framework for knowledge processes. Knowledge processes aim to gather information based on changes in organizational dynamics such, that "a fresh way to think about managerial roles and responsibilities, organizational design, and business practices are achieved." (Nonaka 1991, 97) These propositions suggest the desirability of knowledge systems in which dialogic process becomes commonplace. Dialogue, in this respect, would allow for a *mutual* desire to create or use ordinary, everyday information to create new action patterns. One goal of such processes is to address the changes in organizational dynamics resulting from transferring new technologies into the organization. Movement toward making these propositions truthful is desirable, because "new detailed knowledge at our command has been rising exponentially, but the additions to our ways of thinking happen so slowly as to go essentially

undetected." (Hainer 1968, 9) While these specific propositions may appear utopian, the intent was to provide a set of guidelines that would serve as initial boundaries for a questioning process. As a consequence of the research process, which was itself a knowledge process, the potential for transforming these propositions was always present. This approach is what best characterizes this research as exploratory.

CHAPTER 5

RESEARCH DESIGN AND METHODOLOGY

The research design was driven by the need to explore a methodology in which the experience and expertise of those involved in and affected by the transfer of technology could be made centrally available to all members and all operational aspects of the organization. One goal of a methodology is to facilitate the dissemination of information to include "actual decisions, behaviors and privately expressed attitudes toward technology" (Rubenstien 1994, 338), as well as the process that facilitates this dissemination itself. The approach to this research design is guided by what Heinz von Foerster calls the "undecidable question," which he explains by stating that "only questions which are in principle undecidable, we can decide." (von Foerster 1995, 2) One of the undecidable questions for this research is: ***How can participation in knowledge processes (and in particular, dialogic process) be encouraged?***

Research Objective

The objective of this research has been to explore a methodology where the participation of organizational members includes their perceptions, ideologies, and attitudes resulting from the transfer of technology and the effects they have on the assimilation of that technology. The focus of the research is implied by the following question:

> **How do (or might) organizational personnel contribute to a knowledge process that facilitates the assimilation of new technologies?**

To further define the research, the central question was approached by addressing four supporting research questions:

1. **How are (or might) organizational personnel (be) affected by new technologies?**
2. **How has (or might) knowledge sharing with respect to the assimilation of new technologies been (be)defined in the organization?**
3. **How do (or might) organizational personnel participate in this process?**
4. **How do (or might) organizational personnel perceive the utilization of a knowledge process resulting from the sharing of experience as a contribution towards sustaining the organization's competitive advantage?**

Research Alternatives

Chapter 4 introduced a set of propositions that serve as the foundation for this research, *Exploring Knowledge Processes for Technology Assimilation*. Each proposition was formulated as a statement that is currently false and whose truth would be desirable. The interest is primarily in the desirability of these propositions, rather than in their feasibility. The authors[1] state that these propositions concern the domains of cybernetics and social transformation, and suggest that a concept of knowledge processes offers an avenue for connecting these domains. The focus of this research, then, is on exploring alternative processes in which these propositions might come to be recognized as true statements. The research process, as a knowledge process itself, must mimic one of the alternatives; the theory suggests that this process should be conceptualized as a dialogic process. While statistical analysis would be appropriate in

[1]These propositions were first presented by Laurence D. Richards and. Rochelle K. Young at the American Society for Cybernetics Conference, May 1995 Chicago, Illinois and will published in Fall 1996.

testing hypotheses, it is an interpretation of the dynamics of the dialogue arising from action research that throws light on the desirability of propositions.

Conflicts in Engineering Knowledge Processes

According to Peter Brödner, there is a struggle between two engineering cultures on "the nature and function of technology, on the way of seeing the world, and on the human's being in the world." (Brödner 1995, 249) The two paradigms he uses are the 'closed world' paradigm and the 'open development' paradigm, where "both paradigms have brought about whole cultures with traditions, institutions, and philosophies." (Brödner 1995, 249) The 'closed world' paradigm, he explains, "is interwoven with the rise of technology and science, and has clearly become the predominant way of seeing the world." (Brödner 1995, 249)

> All real world phenomena, the properties and relations of its objects, can ultimately, and at least in principle, be transformed by human cognition into objectified, explicitly stated, propositional knowledge. Human cognition and this kind of knowledge would then represent the real-world phenomena so completely that they could be modeled, explained and simulated in all aspects, and, consequently, could be reproduced by smart machines. (Brödner 1995, 249)

The 'open development' paradigm, "does not deny the fundamental human ability to form explicit, conceptual, and propositional knowledge, but it contests the completeness of this knowledge,"

> ...and assumes the primary existence of practical experience, a body of tacit knowledge grown with a person's acting in the world. This can be transformed into explicit theoretical knowledge under specific circumstances and to a principally limited extent only "experts know more than they can put in words." (Schön, 1983) Human interaction with the environment, thus unfolds a dialectic of a form and process through which practical experience is partly formalized and objectified as language, tools or machines (i.e., form) the use of which, in turn, produces new experiences (i.e., process) as the basis for further objectification. (Brödner 1995, 249)

The difficulty with these contrasting paradigms is the problem of how to design a process that will include both aspects, collectively, through a process of dialogue. Knowledge processes, according to Nonaka "do not operate in a closed system but in an open system [in] which knowledge is constantly exchanged with the outside environment." (Nonaka and Takeuchi 1995, 84-85)

Traditional Representation of the Research Design

The anatomy of the research design mirrors Rubinstein's 'anatomy of a problem' in Figure 8. The purpose of this design is to 'model' the research process in terms of: a perceived present or initial state; a perceived and desired goal or end state; and perceived obstacles that prevent bridging the gap between the present and goal state.

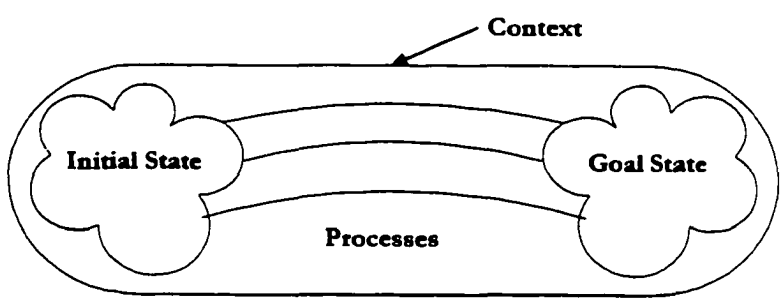

Figure 8. Anatomy of a Research Process

The context of the problem "is the frame of reference the researcher considers." (Rubenstein 1986, 8) The research process using this 'anatomy' is depicted in Figure 9.

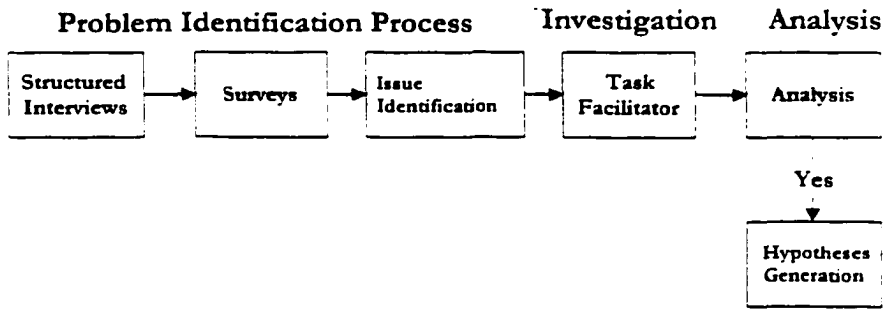

Figure 9. Research Design Process

The design of a knowledge process mimics this research design by using a dialogic process as the primary means of mediating each component in the research. Unlike the traditional approach, the goal of the knowledge process is not to generate hypotheses, but to generate a continuous dialogue. Figure 10 is a representation of this process.

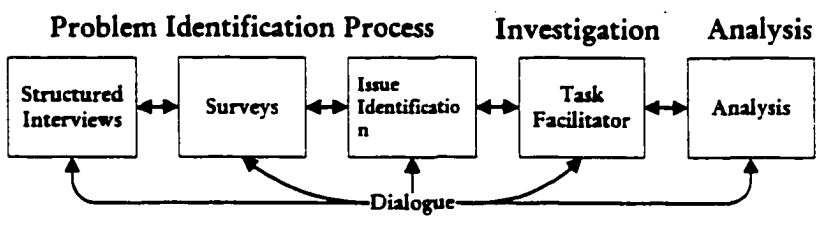

Figure 10. Knowledge Process Design

The Need For An Alternative

The following story is told by Klaus Krippendorff in *Redesigning Design: An Invitation to a Responsible Future*:

> A software manufacturer hires a team of graphic artists, linguists, and communication experts to develop the interface for a radically new computer application. The team soon runs against the preconceptions of programmers who know exactly what can and should be done. They end up accusing the interface designers for being "dreamers," "user advocates" and "playing more with color than with logic." Their criticism is supported by people in sales who present themselves as being "in touch with" what buyers want. The management is warned about the exorbitant costs of these strange interface ideas, gets cold feet over the mounting conflicts and fires the design team, being assured that it is no longer needed. Indeed, the manufacturer puts a rather sophisticated product on the market. But soon thereafter, a competitor announces a similar but more user-friendly product that happens to feature many of the interface ideas the programmers had judged impossible. In the end, the latter drives the programmers' brain child off the market. How could the designers fail despite their apparently correct ideas? (Krippendorff 1994, 2)

Krippendorff explains that:

> In this environment, matters are decided in conversations, in pitching arguments against each other and in seeking consensus. Indeed, the design of complex computer interfaces is, much like these interfaces themselves, a fundamentally dialogical process. It cannot exclude any of its stakeholders and involves a good deal of listening and negotiation. For whatever reason, the design team was unable to make itself a part of that conversation. Standing by itself, its monological conceptualizations of the design process carried no weight against the "authoritatively ingrained" claims of "technical know-how" (about programming), of "knowing buyer" (by sales) and of "hard evidence" (on costs). The designers' expertise in users' conceptions did not extend to the social problem of getting the conflicting stakeholders to say yes. (Krippendorff 1994, 2-3)

The reason for telling this story here is to highlight the need for alternatives to traditional research design processes. An important element in redesigning a research process is the need for participation from organizational members through dialogue. The outcome of a system "cannot survive within [the organizational] culture—be

conceived, produced, used, maintained, etc.—without being meaningful to those who can move it through its defining process." (Krippendorff 1994, 17) The dialogue describes a continuous process of participation and involves all stakeholders from every echelon of the organization. The need for dialogue to transcend hierarchies is paramount for the introduction of perturbations (predictable or unpredictable) into the organization. Dialogic process is "necessary to reduce inequality in the research context." (Schrijvers 1991, 172) A dialogic process incorporated into a research design could entail:

> A possibility that loosens us from habit and custom and turns us back to contemplate ourselves just as we may be beginning to realize that we have no clear idea of what we are doing. The experience may be exhilarating or frightening or both, but it is generally irreversible...subject and object fuse...Reflexive knowledge, then, contains not only messages, but also information as to how it came into being, the process by which it was contained. (Myerhoff and Ruby, quoted in Schrijvers 1991, 172)

The process of dialogue for defining an alternative approach to research results in the "total dynamics of continuing (self)-research, including sympathetic identification and creative production for not only the researcher, but also those who choose to participate." (Schrijvers 1991, 168) Schrijvers describes this dynamic process as:

> the reciprocal manner of exchange and communication during the research interaction, between the researcher and the subjects of research. It indicates a continuing process of actual communication between people who respect and value each others' contribution and, in that regard, are equals in their dialogical relationship. Throughout this communication the participants influence each other's points of view. This can lead to the transformation of the initial concepts and conceptions of the researcher and the other participants. (Schrijvers 1991, 168)

Attributes of an alternative research design would include five aspects that characterize the totality of a dialogical process:

1. *Dynamic*: The research focuses on change; the results do not reflect an artificial, static situation, but the dynamics of life.
2. *Exchange:* the terms 'researcher' and 'researched' loose their distinctive meanings because they are changing places continuously; both are ego and alter, subject and object; active and passive; the interpretation of both are open for discussion.
3. *Ideal of egalitarian relations*: the researcher and the subjects of research become more acutely aware of the power inequalities that separate them. The less powerful sense an increased effort on the more powerful to take a perspective from below. This in itself can facilitate the development of more egalitarian relationships. The process can be aided by verbalizing the differences.
4. *Shared objectives*: the objectives and the priorities of the research are determined by all participants. In this sense the researcher and funding agency loses the prerogative to regulate this stage of the research process.
5. *Shared defining power*: not only the researcher, but all participants are empowered to construct concepts and categories, discuss results and determine the course and outcome of the research. (Schrijvers 1991, 170)

Perspective for Knowledge Processes

There is a need to design a research process that includes attributes of both the 'closed world' and 'open development' paradigms. There is, therefore, a need for traditional aspects of the research process to accommodate the 'closed world' paradigm as described by Brödner. An alternative research process also incorporates elements of an 'open development' paradigm, to include the observing system, the body of tacit knowledge (researcher and subjects), and the

dialogic process. This combination of both research design processes is defined as a knowledge process and is facilitated by dialogue. The knowledge process for this research contains certain elements of the Knowledge Spiral as defined by Nonaka and Takeuchi. Figure 7 (Chapter 3) presents the conceptual model of this Spiral. This model was selected because of the recurrence of the dialogic process as a constant component of the Spiral.

Transforming information, for use by an observing system in a knowledge process, is viewed by Wheatley as a way of providing sustaining nourishment to the organization and self. She suggests that participation "facilitates it own intelligence." (Wheatley 1992, 108) She also states that "in a constantly evolving dynamic universe, information is the fundamental ingredient, the key source of structuration—the process of creating structure. Something we cannot see, touch, or get our hands around is out there organizing life." (Wheatley 1992, 104)

Establishing an environment for a continuous process of creating knowledge starts by treating each individual in the organization as an observing system and recognizing that the organization, its members, operational processes, etc., are a part of that observer's system. The circularity in this type of environment ensures that the organization as a whole will move towards developing different levels of knowledge to accommodate the organization.

The dynamic interactions among specialists, middle managers and senior managers render a knowledge process that is based on self-reference. This reflexivity is described by Krippendorff as "the participation of the knower in the process of knowing, and seeks to understand as a circular process of constructing realities that

constitutes itself as viable within a medium." (Krippendorff 1985, 29) He further states that this 'knowing,' "emphasizes the social construction of emotions, persons, interpersonal relationships, etc." (Krippendorff 1985, 28) The goal of this research process is to understand better how participation in a dialogue conjoins 'trivial' and 'non-trivial' processes that, in turn, create new action patterns in which people are not only contributors, but also participants.

Research Design

This project was exploratory and based on an action research methodology. Action research aims to contribute knowledge that will help people understand the nature of a problem so that they can more effectively control their environment. (Patton 1990) This type of research methodology is desirable because it "encourages joint collaboration within a mutually acceptable ethical framework to solve organizational or community problems." (Patton 1990, 129) In action research, "the professional researcher is responsible not simply to organizational heads, but structure relations so as to be accountable also to lower-level officials and the rank and file." (Patton 1990, 168) This approach allows for organization members at various levels to participate in the research process to include the creation, dissemination and representation of information shared throughout the research.

The field site for this study is a large state-supported university. The focus of the research was on knowledge processes in support of the assimilation of technology, specifically, distance learning technology. The levels of knowledge processes were assumed to be: (1) the level of the individual teacher and student, where the prevailing technology impacts teaching and learning styles; (2) the level of the university, where

the prevailing policies impact the acceptance and mode of use of the technology; and, (3) the level of societal education, where the prevailing thinking and rhetoric on education impacts the policies of the university.

One of the primary elements of research with respect to technology assimilation is to study an organization in which technology transfer is in progress. This project focused on a large university which is currently using a new technology. The university is currently using a form of distance learning technology also known as 'televised course teaching.' The role of this technology is to create and sustain a competitive advantage in the area of 'distance learning.' Distance learning is a means by which degree and non-degree seeking students may receive course instruction via satellite 'in the same manner' in which students located at the host campus receives it. Televised course teaching affects the majority of university personnel and operations, directly or indirectly, with respect to the overall goal of this form of technology.

Information about the distance education initiative at this university was acquired through numerous informal discussions conducted in preparation for the formal aspect of the research. This information was then verified from the data generated by the research. The distance education initiative began without a large budget appropriation designated for this purpose. Rather, resources were re-allocated within the university in order to purchase the technology, renovate classrooms, and hire technical and administrative staff. Due to the departmentalization of budgets within a typical university, the ability to provide appropriate incentives for faculty to participate in the initiative was limited. It tended to be implemented more by edict and promise of future resources that by an appeal to the educational value of the

technology. The politics that this situation engendered was one of resistance, reluctance and skepticism. As this distance education initiative grew, the university was able over time to acquire special appropriations for expanding the technology. However, there remained very few resources which could be used as incentives for departmental and individual faculty participation. As a result, the culture surrounding distance education and its advocates tended to be of the 'closed' world type. Faculty and administrators alike could see little benefit and many personal costs to expressing their views on the immediate and long term implications for both educational practice and policy.

It is in this context that research on participation in knowledge processes at this university was proposed. The methodological difficulty that this posed was that the researcher would be addressing issues that are normally reserved for selected faculty committees and administrators. As a student, this researcher was put into a situation where the respondents saw her not only as a student, but also as someone asking questions about a highly controversial subject. This researcher—respondent relationship required special efforts at maintaining confidentiality, while serving as an intervention designed to provoke creative thinking on knowledge processes. In this respect, the researcher became a focal point for facilitating discussion on issues not often discussed in public. For this research to be successful, respondents had to feel that their input would be an important contribution to the research and would not be taken out of context, while preserving their anonymity.

Sutton and Sutton maintain that new technology affects the organization, its people, their tasks and vice versa. This research addresses the roles, perceptions and

ideologies of faculty and staff members, administrative support services people, students and those involved with the development and research of technologies affecting televised course teaching. The purpose for including various echelons of the university is to provide a 'complete' organizational profile within which this technology has become a part.

The university's faculty, staff, technicians, programmers, administrators and students were sampled for this research. Maximum variation sampling was used because "this strategy for purposeful sampling aims at capturing and describing the central themes or principal outcomes that cut across a great deal of participant or program variation." (Patton 1990, 172) This type of strategy was important because "any common patterns that emerge from great variation are of particular interest and value in capturing the core experiences and central, shared aspects or impacts of a program" (Patton 1990, 172) The goal in applying maximum variation sampling is to reduce the probability of "generalized findings to all people or all groups," and to look for "information that elucidates programmatic variation and significant common patterns within that variation." (Patton 1990, 172)

This research project combined action research and maximum variation sampling to yield an organizational profile commensurate with how televised course teaching has impacted on the university community. The participants' responsibilities were divided into three areas. The first area requested that participants respond to personal interviews. These interviews were to define the scope of the organizational profile. The second area requested that participants respond to a survey/questionnaire. The purpose of this questionnaire was to request more information based on the

information received during the personal interviews. A dialogic vehicle in the form of a newsletter was prepared, based on the results from the survey, and distributed throughout the organization. Comments and responses to the 'vehicle' were welcomed and encouraged. The final request of the participants was to participate in exit or project summary interviews. Here, participants were asked to provide their comments and insights on the research project and their participation in the project. They did this in the presence of the researcher.

This project was conducted in four phases. The instruments used in this study included Pilot Interviews (Phase 1), Questionnaires (Phase 2), Dialogic Vehicle (Phase 3), and Project Summary (Phase 4).

Phase 1

"The purpose of interviewing is to find out what is in and on someone else's mind." (Patton 1990, 278) The assumption of the interviewing process is "that the perspective of others is meaningful, knowable, and able to be made explicit." (Patton 1990, 278) The Pilot Interview was used in the first phase of this study. This interview was necessary so that the overall organizational profile for how the university is impacted by televised course teaching could be established. Questions in this pilot interview were 'open-ended'– "those that supply a frame of reference for respondents' answers, but put a minimum of restraint on the answers and their expression." (Kerlinger 1986, 442) The reason behind using 'open-ended' interviews was to develop a context for how people are feeling, to include their thoughts and intentions. This was necessary because these attributes are not observable and, therefore, must be solicited by personal interviewing. These pilot interviews were

directed to at least one person each representing faculty, staff, administrators, technicians, technology experts and students. The goal of this instrument was to establish an organizational profile that addresses issues concerning how new technologies impact the university community.

Phase 2

Phase 2 utilized a questionnaire as the means to solicit responses to questions that best address the current climate with respect to how technology has been introduced, transferred and used by the university community. This tool is located in Appendix 1. The questionnaire was built on the results of the Pilot Interviews conducted in Phase 1 of this study. The questionnaire utilized open-ended questions.

Phase 3

The primary tool for this phase of the research was the 'Dialogic Vehicle.' The purpose of this tool is multifaceted and is described by Joke Schrijvers as a way to "reduce inequality in the research context." (Schrijvers 1991, 172) She also states that participants in this process will "look for new vision and an alternative way of developing a new construction of knowledge." (Schrijvers 1991, 172)

This 'vehicle' was used as a 'projective' tool, and took the form of a newsletter. The idea of projection allows for "values, attitudes, needs, and wishes, as well as impulses and motives" to be "projected upon objects and behaviors outside of the individual." (Kerlinger 1986, 471) This Dialogic Vehicle was created from the responses of the previous phases (which included a scenario) to prompt the participants into providing more comments and responses. The goal of this device was to allow participants to 'act' within a dialogic process to issues and concerns that affect them

and the university as a result of the transfer or usage of new technologies. The newsletter was disseminated throughout the university, requesting that comments and responses be returned to the researcher.

Phase 4

Phase 4 employed an exit or project summary interview. The purpose of this interview was to discuss the 'dialogic vehicle' with participants. The 'vehicle' facilitated these interviews and allowed participants to discuss issues they felt relevant or necessary to technology assimilation and or the 'dialogic vehicle' itself. The goal or hope of this phase was not only to encourage a continued dialogic process, but also to prompt participants to reflect on how their responses address technology as an integral part of their performance and the need to construct new knowledge for technology assimilation. Results from these interviews could be made available in a next iteration of the dialogic vehicle.

Methods of Analysis

The data was organized with respect to each research phase. All interviews were conducted by the researcher. Face-to-face interviews were tape recorded, transcribed and placed into a database for easy access and reference. Responses from the survey/questionnaire were combined and placed into a database for easy access and reference. Though the Dialogic Vehicle requested comments and responses, no written ones were received, although project summary interviews did indicate that it had generated some discussion.

Data Collection

The purpose for conducting interviews was to gather information pertaining to the actual decisions, behaviors and privately expressed concerns relating to one's experience with distance learning technology. The interview was "an exploratory device to help identify relations and to guide other phases of the research." (Kerlinger 1986, 440) The interview was designed using *funnel* 'open-ended,' questions. Funnel questions are "directed toward getting information on a single important topic or a single set of related topics. The funnel starts with a broad question and narrows down progressively to the important or specific point or points." (Kerlinger 1986, 443) This was necessary to ensure flexibility, "encourage cooperation and achieve rapport, and to make better estimates of respondents' true intentions, beliefs, and attitudes" regarding their experience with distance learning technologies. (Kerlinger 1986, 443)

The survey used in this research was created in part as a result of the interviews in Phase 1 and the knowledge of the researcher. A Scenario was developed to create "some basic features both of an environment where action takes place, and of the elements of this environment that perform the actions." (Kohout 1990, 17) This was necessary because the activity of a system is closely linked to goal-oriented behavior and is usually directed at changing the environment from an undesired state to a desired state. In order to achieve this successfully, the system has to possess an 'internal mode' of the world in which it is a part. (Kohout 1990) The Scenario is located in Appendix 1.

Data collection for the Dialogic Vehicle was conducted similarly to that of the Scenario/Survey. The results from the Scenario/Survey were summarized and placed into the format of a 'newsletter.' This vehicle is located in Appendix 2.

Data Analysis

Qualitative analysis methods were used to analyze the results of the interviews conducted in Phases 1 and 4. "The purpose of qualitative inquiry is to produce findings" [and] "to make sense of massive amounts of data, reduce the volume of information, identify significant patterns, and construct a framework for communicating the essences of what the data reveal." (Patton 1990, 371-372) A content analysis method was the primary tool used to analyze the data. "Content analysis is the process of identifying, coding, and categorizing the primary patterns in the data." (Patton 1990, 381) Critical aspects of this methodology rely upon the coding of the information received during the interview process. There are several designs associated with Content Analysis. The Content Analysis for inferring relations as described by Krippendorff was used to analyze the data. This design seeks to "*estimate* some phenomena in the context of the data." (Krippendorff 1980, 50) This method is also used to "differentiate between cases where the content analyst has reasons to believe that the research design corresponds to models, or replicates the relationships between data." (Krippendorff 1980, 50)

"The process of labeling the various kinds of data and establishing a data index is the first step in content analysis." (Patton 1990, 382) This was accomplished by establishing 'recording units.' Krippendorff describes these units as "the specific segment of content that is characterized by placing it into a given category."

(Krippendorff 1980, 58) He further states that "dependencies that might exist within sampling units are retained in the individual description of its recording unit." (Krippendorff 1980, 58) The focus of this first step was on establishing recording units for the members interviewed during Phases 1 and 4.

The second stage of the content analysis was the characterization of 'context units.' Krippendorff says that a 'context unit' "sets limits to the contextual information that entered the description of the recording units." (Krippendorff 1980, 59) The purpose for defining context units is to allow the researcher to "recognize and make explicit the fact that symbols codetermine their interpretation and that they derive their meanings in part from the immediate environment in which they occur." (Krippendorff 1980, 59) This was necessary for this project, because these units are not independent nor can they be characterized separately. Context units were based on the following:

- Syntactical Units: Items are 'natural' relative to the grammar of a communications medium. They do not require judgments on meaning.
- Referential Units: Items may be defined by particular objects, events, persons, acts, or ideas to which an expression refers.
- Propositional Units: Items are required to possess a certain structure within the reference in which they are used.
- Thematic Units: Items are identified by their correspondence to a particular structural definition of the content of narratives, explanations, or interpretation. They are distinguished from each other on conceptual grounds and are contrasted with the remaining portion

> of irrelevant material by their possessing the desired structural properties. (Krippendorff 1980, 61-63)

The results of the Content Analysis were used in creating interrelationship 'directed graphs' (digraphs), to show connections between the responses given by those interviewed. Bossert says this "tool takes a central idea, issue, or problem and maps out the logical or sequential links among related items." (Bossert 1991, 65) These digraphs are used when "issues are sufficiently complex and the interrelationships between ideas are difficult to determine, the feeling that the symptoms of a problem are only being discussed and the process is reiterative." (Bossert 1991, 65-66) Digraphs were used to organize the results of the content analysis from Phase 1, Phase 2 and Phase 4.

CHAPTER 6

DATA ANALYSIS

Technology assimilation motivates knowledge processes for making the attitudes, desires, perceptions and ideologies of organizational members unconditionally available to others within the organization who may also be experiencing the transfer of new technology. The research process used here mimics a knowledge process, where both are designed to define or understand a problem, to investigate the problem by identifying issues and to find solutions to the problem.

This alternative to a traditional research approach incorporated a dialogic process that allowed participants to move toward a synchronicity "in which there were no fixed roles, a strong sense of individuality, and problem solutions based on innovation and creativity." (Hyman 1993, 58) This approach is also based on a theory of an observing system, where dialogic process often resembles "a whirlwind of total confusion." (Hyman 1993, 58) This confusion allows for the generation of patterns within one's environment so that the creation, transformation, maintenance and dissolution of distinctions occur. The goal of this methodology was to move toward a continuous knowledge process with the potential to facilitate social transformation. The purpose of this chapter is to provide the results and interpretations of the research process as it pertains to the researcher's involvement with the research site.

Phase 1: Developing the Organizational Profile

The purpose of Phase 1 was to "structure the unknown by placing stimuli into some kind of framework." (Weick 1995, 4) The interviews provided a process in

which people could contribute their concerns, in the form of questions, to which others could respond in succeeding interviews. The framework for the interviews centered quite generally on how new technology impacts the people, the tasks, and the organization. Contact was made with those representing administration, faculty, staff and students. The following introduction was used by the researcher to explain the research objective:

> I am interested in how technology is assimilated into the organization. I will define 'distance learning technology' as a form of technology and the university as an organization. I believe that technology assimilation depends on the pattern in which information flows. I also believe that knowledge or a knowledge process emerges once information is shared and a continuation of sharing, per se, contributes to how members of the organization view a reality. In this case, the assimilation of 'distance learning technology' into this university's social structure.
>
> I am not particularly interested in the details of the technology, but I am interested in the details you provide me based on your understanding of and experience with the technology. My goal today is to ask you what you would be interested in knowing about this assimilation process from others, to include administration, faculty members, students, staff support, or anyone else associated with this new technology.

A total of six people were interviewed for creating the organizational profile. Members selected included administrators, faculty and students. Thirty minutes for each interview was requested. The first interview set the tone for succeeding interviews. Since all interviewees were given the opportunity to operate in their own frame of reference, not all concerns were directed to each participant for the succeeding interviews. Respondents were able to react to the introduction in the areas with which they were most comfortable and also to come up with questions that they would be interested in asking others. Some of the areas participants chose included performance

in the actual classroom, and administering, developing and marketing the new technologies. The following is a sample taken from the first interviewee:

> I would like to know from the distant learner how important it is to see the faculty member?
>
> I want to know why distance students always evaluate the instructor/faculty less positively than their on campus counterparts?
>
> How important is it to have students talk to one another in the context of the course, without the faculty knowing what the questions are?
>
> I want to know why it is important for faculty to see the students during class.

Explanations were provided based on the capability of the technology, individual learning preferences from the student, and the role of the faculty involved with distance learning:

> Evolving technology could provide two-way video to enhance the communication process, but distance learning is less reliant on the non-verbal feedback from the student. This face-to-face feedback may hinder the learning process. When a faculty member sees a student, he or she evaluates that student based on non-verbal feedback—age, size, ethnicity, culture, attitude (perceived) whatever you get. The focus should be on the learning process. If they change the technology to two-way video, something will be given up.

Some of these concerns were addressed to the next interviewee. This was done to identify similar concerns and/or to provide a source of information about those concerns. The next person contacted was not a student, and therefore, the first two questions 'I would like to know from the distant learner...?' and 'I want to know why distance students...?,' were not addressed. Questions concerning student interaction were addressed:

RESEARCHER: How do you feel about students conferencing or having sidebars while you are lecturing by asking other students questions for understanding?

RESPONDENT X: Well, if it has to do with the topic of the discussion, that's fine, but if it's about family, hobbies, I would feel annoyed. In fact, this can be handled. I have a way of stopping that by making a loud sound, just to let them know that I will not tolerate side discussions. If not, they can go outside of the classroom.

RESEARCHER: What if the purpose of the discussion was to clarify something you said. Would you then permit a sidebar?

RESPONDENT X: If indeed the student understood what I meant, then it is not a real problem. It is good for me to say, 'I think you have the right idea and that's the way I want you to understand it'. On the other hand, if the student understood it in a way that I did not mean, then it also gives me the opportunity to tell them 'that is not what I meant.'

Respondent X as well other respondents were given the opportunity to address concerns raised by previous interviewees, and to add their own.

RESPONDENT X: I would like to *know* if we could possibly get the cooperation of industry to allow us to video tape some of their activities [for use in class presentations]?

Currently, I can show processes that are static. It would be nice if I could show the diagrams in video format so the principle features of the process could reinforce what I am trying to tell the students. In other words, I do not want to spend the time to go to the companies myself and negotiate the taping of the video. It would be nice if the university had an organization, where I could go to them and tell them of my needs and possible sources and they do the negotiating, etc.

RESPONDENT X: How can the university provide a technical support facility by talking with industry–arrange video taping, talk with organizations that have huge databases and arrange for loans with some of this material?

I really think we need technical support. If I show my students a video of the latest taping I acquired five years ago, the tape is already at least eight years old. It takes time to look for more current material. I need upgraded material, better material and I need someone to help me search the databases. Making them aware of these kinds of resources is important, as compared to starting from scratch.

A content analysis was performed on these responses as well as on other information gathered from those interviewed. The results of this analysis provided the basis for the 'Organizational Profile.'

Results of Content Analysis

The content analysis was conducted on responses from administrators, students, and faculty. They were promised anonymity, and therefore any information they provided during the interview that might link them specifically to their response was sanitized to ensure confidentiality. The results of the content analysis provided two main themes that were further broken down into specialized areas. Table 3 depicts the central themes and their subcategories.

Themes For Knowledge Processes	
Interaction	Technology
Student and Faculty	Expectations
Student and Student	Reliability
Faculty and Administration	Cost

Table 3. Themes For Knowledge Processes

Interaction

Questions were raised concerning different types of interaction. This central theme was further broken down into three subcategories. Issues for each type of interaction are summarized as follows:

Student and Faculty. This type of interaction addresses verbal and non-verbal communication during class and outside of the classroom.

> When a faculty member sees a student, he or she evaluates that student based on non-verbal feedback—age, size, ethnicity, culture, attitude (perceived) or whatever you get. Distance learning is less reliant on the feedback from the student. This face-to-face feedback may hinder the learning process.
>
> I want to be able to look that person in the eye and say this is where we are moving. My philosophy in teaching is being able to get the students into their chairs and keeping them interested in the material.
>
> Put the students behind a curtain. Why would we want human interface at all?

Student and Student. This type of interaction addresses verbal communication during class.

> In traditional classrooms, you are not permitted to talk with your neighbor. In a distance classroom, you have to do that. Sometimes this is necessary because the faculty member is not satisfying the student's need. Can students serve as mentors to each other without the faculty member knowing about it?
>
> It distracts others trying to get information from the instructor.

Faculty and Administration. This type of interaction focuses on the need for interaction between faculty members and administration.

> The faculty needs to understand that they have to think differently about this type of classroom.
>
> I mentioned to a top administrator that there was a problem with the distance classroom. The person responded by saying that 'if there is, then it's a faculty problem.'

Technology

The respondents were concerned about the attributes of the technology.

Expectations: The issues in this sub-category address design, ease of use, and performance in the distant classroom.

> How do you design an electronic medium to mimic a traditional classroom?
>
> Two-way video will solve the problem of instructors not being able to see the student.
>
> Is there a data rate available to carry a live lecture and computer image and produce a quality picture?
>
> The technology needs to be user friendly.

Reliability: The primary concern with this attribute was whether or not the instructor and student could be guaranteed that the technology would work with no breakdowns.

Cost: The focus on the cost issue was based on whether or not the university had funds to buy and maintain the best equipment.

Results from the Digraphs

Digraphs were used as an analytical tool to show the interrelationships between the central themes. These interrelationships focused on the levels of interaction coupled with the use of technology for distance learning. Responses were linked to issues concerning learning, technology, industry, and higher education. Figure 11 illustrates these results.

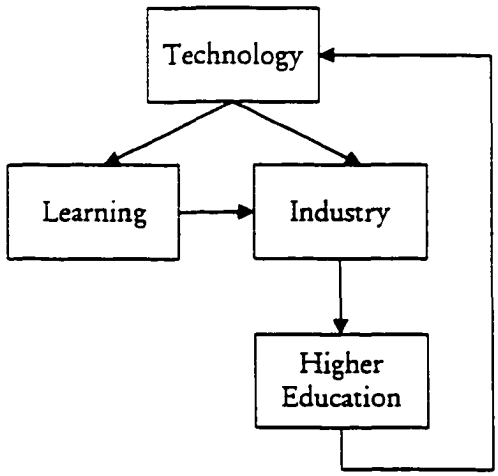

Figure 11. Interrelationships Between Central Themes

Learning

Learning issues focused on whether or not learning experiences would be enhanced by the use of technology for distance learning. The relationships drawn for this area included how instructors view their role in the learning process with the added technology, if using the technology would enhance or hurt their performance in the classroom, and if the type of course being taught makes a difference.

> I really think (the technology) helped out in the class. Instead of having a straight shot from the back of the room, there was an overhead camera. This camera allowed for depth space and would zoom in and tighten up to what I was working with. What made it even better was that the cameras in the back of the room allowed the technician to superimpose shots, and therefore my students could see several things simultaneously. So while my hands were playing on the keyboard, there would also be a box that would show me talking about what I was doing or answering one of the student's questions.

> In the type of courses I teach, experiments have to be done and the students have to do them. How do you arrange for an experiment to be done in the lab, or even a computer lab? Do people have access to computers and is the software compatible? My concern is that the televised format may provide the best format for all courses.

Another concern about learning was the compatibility of students' learning styles with an instructor's performance or teaching style with learning technologies:

> It seems to me that the instructor has to crystallize the whole problem—make it so clear cut that the student has to spend less and less effort in thinking and researching the material. Instead of the student making the effort of learning, it is the instructor now forcing him/herself to clarify the things to students. In the more conventional class, the student has got to do the research and has got to do the thinking.
>
> What library? There is a difference in going into a library and cruising. The sites may have a couple of volumes and that's it. Many distance learners are in rural areas and so getting to the library may be hard.
>
> I had a student refuse to attend the live lectures. He would go and get the tapes after class. He later told me that he had the opportunity to slow down and replay the tapes on areas he did not understand. He aced the entire course.
>
> When you ask (the distant sites) 'are you there?,' they sometimes do not respond. People get up, milling around, get something to eat, and then come back.

Technology

Those interviewed felt that the overall effectiveness of technology for distance learning has implications for the need for instructors and the nature of student participation.

> In a lot of ways, this same technology that replaced autoworkers on an assembly line with robotics is meant to replace faculty. The more distance learning you do, the less faculty you need.
>
> ...then all you need are actors to come in. They've done studies apparently, I've heard about these where actors have passed as faculty members to give lectures and have been seen as better by the students.
>
> Will there be 'world lecturers' and the universities act as facilitators?
>
> I wonder why distance students always evaluate the instructor/faculty less positively than their on campus counterparts?
>
> Students do not respond in a computer conferencing classroom—which makes sense—if you are in a small discussion and someone says something,

> you don't repeat it. There will be more problems with homework assignments because faculty members can't make judgments in the difference of people's work.
>
> I had to be more clearly organized and prepared than ever before. When you are on TV, you can't have dead air. If you stop talking for a minute it becomes very awkward. I found this to be very positive and not pressuring.
>
> Faculty will be able to interact with the students and the students with the teacher and each other. And everyone in the classroom will see the exchange between the instructor and student(s) involved [with two-way video].
>
> Would students be afraid to press a button? Will they interact? One could wonder as to whether or not the apprehension is due to the student paying attention. Is it easier to raise your hand in the classroom?
>
> They (students) are sharing and collaborating on projects.

Industry

There were issues concerning the possible contributions industry could provide for distance learning.

> I use tapes (video and audio) and CDs. The technician can cue it up immediately. I could talk about a particular artist and then have the technician roll the tape so people could see them perform or something like that.
>
> If we could possibly get the cooperation of industry to allow us to video tape some of their activities, let's say a robotics system. Now, I have to show static diagrams of the process. It would be nice if I could show videos with its principle features. This allows me to reinforce what I am trying to tell the students.

Higher Education

Numerous responses focused on challenging the 'order' of higher education because these issues could not be addressed by policy changes.

> Our motivation with this technology is to ensure that everybody [students] has the same experience. When the technology is used only for one-way transmission, like lectures, email, it degrades the learning experience. A

certain class of people who do not have access to high quality technology don't have nor can share the same experience with those who do.

I see that there are more disadvantages to distance learning than advantages. For example, in a more conventional class, students have to spend more time reading the textbook, thinking and questioning.

How will this help graduate courses? How will this motivate the students?

I want to know if the culture of the classroom is discipline specific or communicative specific? Is the culture related to the area, like engineer and nursing, or across locations in specific culture lines?

The only person to ask me to slow my lecture pace was a minority female. Does this mean this medium is best for minorities? She did the best in the class.

One of my colleagues gets $10,000 for teaching on TV. Does this mean that professors will have to become entertainers?

Efforts are being made to bring together faculty in similar disciplines in distance learning to collaborate on how these faculty use technologies in the distance learning classrooms. What technologies work and where does it work and does not.

Higher education is being held accountable and is asked why don't these students have the necessary skills even though they have been charged premium tuition rates.

The Decision

Once the analysis of the data was completed and supporting ideologies were included with the data, a decision was necessary for developing the organizational profile. The results of the organizational profile would be central for developing a tool to invite participation throughout the university in addressing the issues raised above. A scenario accompanied by a survey using open-ended questions was the tool used to investigate the concerns raised by those interviewed in Phase 1. This tool, entitled **Technology in the Organization,** is located in Appendix 1.

Phase 2: Survey Analysis

One thousand surveys were distributed through the campus mail system. Of those distributed, thirteen were completed and returned; one person-to-person interview was conducted and one person declined to complete the survey, returning it to the researcher. Quantitative analysis was ruled out because only 1.5% of the total sample was returned. Four educational administrators, ten faculty members, and one student participated. A content analysis was used to analyze each section of the survey. The analysis of this survey was best served by comparing the content of responses from each of the three respondent groups with the Phase 1 responses used to develop the organizational profile. The results from this phase provide the input for the Dialogic Vehicle in Phase 3.

Responses to Scenario

Section 1

1. Given the above scenario, do you believe that this type of technology will become commonplace in the classroom?

A) All Educational Administrators said yes.

B) Seven of ten Instructional Faculty said yes.

C) Three of ten Instructional Faculty said no.

D) One Student responding said yes.

Some respondents felt that funding for technology acquisition was an issue. Others felt that current building limitations and the faculty/staff transition into this type of classroom were also hindrances.

2. How do you think your experience in the learning process will help or hurt your performance in a classroom setting such as this?

Respondents opinions were based on three different interactive levels:

A) Interaction with students. Dialogue/discussions may be obsolete in this type of setting.

B) Interaction with technology. Ease of use with computers helps the learning process for this type of setting.

C) Interaction with self. Current teaching styles would have to be altered.

3. How will using this technology help or hurt your efforts in delivering up-to-date course material in your area of specialty?

The majority believed that this type of technology will help them deliver up-to-date course material; however, the following issues were raised:

A) Will the most important aspects of education (learning how to think and how to communicate thoughts) be served in this type of classroom?

B) Will course materials for instructors be available in a 'virtual' format?

C) Will instructor preparation increase and student preparation decrease?

4. What 'features' would you like to see in this virtual classroom?

The most common responses were:

Additions to the classroom include large screen monitors, answer pads (real-time computations), and multiple media access.

Ease of equipment use with absolutely *no* breakdowns ever.

Technicians who maintain the equipment.

Climate controlled (A/C and heating) classrooms equipped with comfortable accommodations for instructors.

Group and individual training sessions for instructors.

Section 2: Roles and Perceptions

5. *What would you like to* know *from others (faculty, administration, students, etc.) regarding this scenario?*

For Administration

Will dialogue in the learning process be abandoned?

Is there a place where one could observe the application of this technology?

How much time will be given to adjust to this type of learning process and is there an understanding that additional preparation time and resources will be necessary?

Cost.

For Faculty

What does faculty think about the abandonment of dialogic-based education (approve or disapprove)?

How will interactions between student-faculty and student-student be affected?

How will faculty members delegate responsibility in their classrooms to support such technology?

For Students

What form of learning is most valuable (dialogue/discussion-based or material presentation)?

Will the effort be made to contact/interact with other students both at distant and local sites; and for which of the two will the effort be greater?

6. *What do you think people in roles other than your own would say about this scenario?*

Barbaric, backward
Not needed
Threatened, afraid
Time consuming
Slowly accepted
Will be here sooner than expected

Excited, Enthused
Demanded by students
Disappointed
Control faculty in the classroom
Students will *still* control their learning experiences

7. What impact, if any, would this type of scenario have on your role in the educational/learning experience?

Reinforces the idea of re-engineering education and opens the creative flow for re-structuring education in other areas.

It will increase our roles, i.e., training will be required at various stages.

[I'll] be more of a facilitator than a lecturer.

Rise of the 'star' system in the faculty.

Burn me out.

Enhance some aspects and demanding on others.

Very little.

Increase my knowledge of the technology-more meaningful and interesting.

Will [I] be able to provide adequate office hours for students (distant and local)?

Section 3: Role of Knowledge Process

A knowledge process is driven by dialogue and may be facilitated through a device such as a newsletter, a 'private room' (on-line) or a forum to move toward understanding and resolving issues concerning technology transfer.

8. Would you be interested in hearing about others' responses to this scenario?

Nine people said yes.

One person said yes, but only for Administration and Engineering.

Three people said no.

One person responded "not particularly, but if it is an inevitable occurrence, all should be informed."

9. What suggestions do you have in making others' views available for discussion?

Various media to include newsletters, memos to faculty, articles in the campus newspaper; and newsgroups and/or focus groups via e-mail.

One respondent wanted to participate through email, but did not have electronic access.

One respondent wanted to know the magnitude of support with regard to what people are thinking about change in this environment.

10. Would you participate in a knowledge process with the understanding that your contributions are welcome at all levels of your institution and would in no way subject you to punitive recourse?

Ten people said yes.

Three people said no.

One person believed the phrase 'welcome at all levels of your institution,' to be *dubious.*

11. How do you think participation in such a Knowledge Process could be encouraged?

Make it required.

Through forums, focus groups, newsgroups, coupled with hands on experience/demos, etc.

Identify how participation benefits; if no benefits, why bother?

Some believe that such participation would cause people on the faculty to lose their jobs.

Expose people to the new technology.

Question 12. Last Thought: This questionnaire is being distributed to explore the possibilities for assimilating new technology into any organization in which human beings have a role. I understand that some of you who will receive this will be cynical both tot the technologies and to the possibility of serious participation in a Knowledge Process. To those of you in this category, any thoughts you may have in this respect would also be greatly appreciated.

Administrators

As long as university decision processes remain structured as they are, there is little chance that faculty or student participation in decisions of the magnitude of the 'virtual classroom' will make any difference. The

bureaucratic form of organization works to squelch opinion as it works its way to the top. It is much more likely that we will make a difference by participating in the society wide debate through conferences and publications.

Faculty

I am not in this category but appreciate your solicitation of my views.

Only skeptical that serious understanding will be given to upkeep and support staff–teachers are not techno-wizards.

Good luck–class act techno lectures would be cool as it gets–but developing a 30+ hours a semester for a given class would be murderous.

I am interested in your reference to the 'multi-media' technician; is this for each classroom?

My cynicism comes from the inability (or lack of caring) to provide the basics to the present classrooms. A classroom compounded by sophisticated electro-mechanical devices is a nightmare.

Student

I am cynical because many students here don't care about learning and I would hate to see them rewarded with technologies. Encourage the motivated by rewarding their efforts.

Results of Content Analysis

The final section of the survey concerned participation in knowledge processes. This aspect of the analysis focused on the 'willingness' of the participants to participate in a process in which they could discuss their concerns mentioned throughout the survey, and about the survey itself. A factor that may inhibit participation in knowledge processes is now assumed to be some form of 'fear,' or other emotion, or a perception about the 'art of knowing,' that any 'real' effort to participate in a process in order to facilitate change through high levels of interaction, specifically dialogue, without it being mandated, is useless.

Responses encouraged making others' views available through various media. It was assumed, based on one response, that an electronic (email) means for distribution, of this survey in particular, would not serve everyone on the campus. Due to these circumstances, a newsletter (paper) was developed for making the responses from this phase of the research centrally available to the same individuals to which the survey was distributed.

Phase 3: Dialogic Vehicle

The responses from the survey were used to develop the Dialogic Vehicle as described in Chapter 4. One thousand newsletters, entitled *The Results*, were distributed through campus mail. There were no written responses to this phase of the research and, therefore, no analysis was conducted. This newsletter appears in Appendix 2.

The objective of the newsletter was to make centrally available the results from those who responded to the survey. The following request was made by the researcher:

> This newsletter is part of a research project on participation in organizational knowledge processes. The assimilation of educational technology into a university is recognized as a controversial matter, and the responses reported here support that. I am particularly interested in organization-wide sharing of perceptions, ideas, and opinions that could contribute to the decision making process with respect to how this technology is implemented. In particular, I would like to solicit suggestions for ways to implement the technology in such a way as to enhance the educational experience and to expand the participation of all stakeholders (students, faculty, admin., etc.) in these decisions concerning implementation.

Since there were no responses to this phase, the decision to terminate the research with exit or project summary interviews was made.

Phase 4: Project Termination

The final phase of the research was conducted by interviewing six members of the faculty, staff and administration. This sample size was consistent with the number of interviews conducted for the development of the organizational profile. Four of the six participants were also interviewed during Phase 1 and the 'new' interviewees replaced the members who could not participate.

The exit interview consisted of seven open-ended questions that required a response from the interviewee. The questions were designed to solicit responses on the scenario, the results from the survey, the general willingness to participate in a dialogic process, and the affects of power relationships. The final area of the interview requested that participants provide questions concerning what they would like to *know* from others, including the researcher.

The responses from the exit interviews were analyzed with respect to the 'virtual classroom' as described in Phase 2. The marked difference with these interviews, as compared to those conducted in Phase 1 of the research, was the result of the interviewees projecting themselves into the classroom of the future and recognizing its present day limitations. From this, they seemed to be aware of the potential of the technology, their performance with respect to the technology and the overwhelming agreement that a process of knowledge, facilitated by dialogue, needs to be in place to ensure a smooth transition. The themes from the responses to these interviews were categorized into Technology, Faculty, Academic, and Administrative issues with

respect to Higher Education (Figure 12). One last category of responses was related to issues surrounding power relationships, both present and future, that affect participation in dialogic processes.

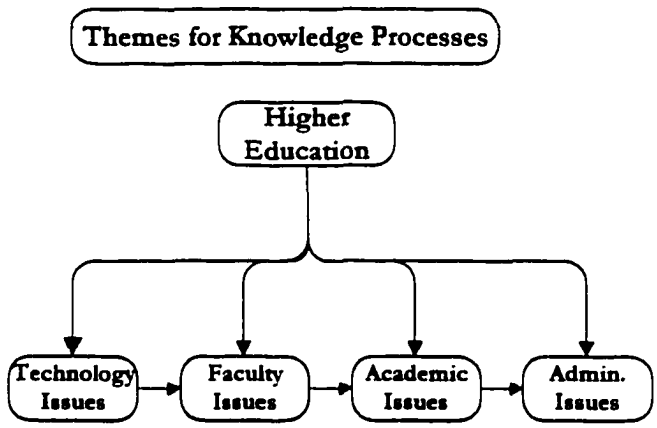

Figure 12. Central Themes for Phase 4

Technology Issues

The primary concerns of the participants with respect to their vision of the virtual classroom were issues surrounding the technology itself.

> I ended up thinking about how I would go about using the technology differently if I were a high-level administrator. I would identify key faculty and key instructors to develop a library of materials, mostly video, pictorials, interviews and other professional clips from television and have these materials accessible to instructors for preparing their courses.
>
> The advantage of technology is to be able to access, not interact with, tremendous numbers of people in large geographic areas and to take advantage of the ability to pre-prepare materials of high quality.
>
> If you want to use Internet in one of your classes, all you have to do is go to your lesson planner and insert the icon for the Internet. Once this icon is placed on your lesson plan, all you have to do is ask the technician to run the lesson plan and the sequence of events to occur in your class, including the use of the Internet. These software tools will be the key ingredient for using this technology in the classroom.

> I like the light pen especially. I can circle anything I want like the football commentators. It is very effective. Unfortunately, not all studios have this feature. For now, the audio system needs much improvement and I cannot see the students. In five years time, I want to see the students, because I like to see how people react to what I am saying to them. Without that technology, we will be no more in progressing than where we are right now.
>
> There is something about multiple media presentations. You can introduce Shakespearean literature with the technology, instead of the students just reading the text and trying to figure our what is being said. You can also introduce virtual reality and the students can also interact.
>
> The information highway is here to stay. It will pick up tremendously. They will see more things on CD ROM, students will be given tablets to take notes and the notes will automatically be transcribed into CD ROM.

Faculty Issues

Several responses addressed the new role of faculty with respect to learning and their role in the classroom. These ideas resulted when respondents were asked to 'project' themselves into the 'virtual classroom.'

> The instructor has to take a totally different approach. Now, he/she has to think and plan what material (and in what form) will be presented and has to plan his/her way of doing things. He/she also has to literally plan how the interaction is going to take place and who is going to interact at what time.
>
> I'd have to remind myself to stay in the range of the camera. Once I become used to it, it will become natural to me. So, when I am given the technology, I cannot fall back into my old style.
>
> Some instructors don't use the technology because of their lack of interest. In the future, each station will have their own computers that will allow students to download the instructor's notes. This will allow for the students to participate more and also give the instructor the opportunity to become more creative in the class using the technology.
>
> I would want to have everything that I do in class prepared ahead of time except for the question and answer period. I would be there live and introduce each of the materials presented and it would be completely organized ahead of time. There are certain obvious things that are necessary for this to work. The equipment has to always work. It would

> discourage a class when students do not always know when they come to that class if the class will be transmitted or will there be a technical problem. It completely destroys the continuity of the class.
>
> Bandwidth now, or five years from now, is not even close to the bandwidth we have when we are face-to-face with the students. It's a different medium, and that's why it's a different form of teaching, an entirely different kind of experience for both the student and the instructor.

Academic Issues

These concerns primarily address providing students with the same learning experience, student-teacher interaction, and the level of courses to be taught using distance learning technologies.

> I don't think any teacher would say they'd want to use students as guinea pigs for testing technology, on the other hand, we're always experimenting with what we do in the class, trying new things; sometimes they work, sometimes they don't.
>
> You know what the TV takes away, there's an energy you bring to the classroom. It's part of the individual dynamics when you move around. This dynamic builds up energy creates enthusiasm and motivates the students.
>
> In the past, I gave challenging conceptualized tests. Now, I have to give concrete tests and then make sure that I have gone over all of the material before I give an exam. My ideal question for exams is to try to stretch people. It doesn't work well now. Some of my creativeness may be jaded by the level and ability and, more so, the motivation the students come into class with.
>
> I need to communicate with the students. Why can't they have some of the same technology I have for real-time communication, like the light pen. If they had this tool, they could write down their problem or equation and I would see it. This is a lot easier than the student trying to explain it to me.
>
> The truth is that most students are very complacent because they're getting something that they wouldn't have been able to receive otherwise. Something is better than nothing. In California, students are suing the school because they were told that they would learn certain things, and since they didn't, they are holding the schools accountable. Take the next

> step, and that could happen to any program, that doesn't mean only distance learning, but any program promised on campus.

Administrative Issues

Eck has described the provision of support for distance learning technology as "the most difficult and one of the most costly issues to address." (Eck 1994, 5) Support services include library access, advising, and quality of technology acquisition. Those participating in this phase of the research had a lot to say about support services and the maintenance of this type of technology.

> At this time, some of the kinds of problems that exist, exist not because the technology is not developed yet, but the resources needed to make it work the way it ought to work, are not available. This includes information systems, the registrar's office, the coordinators, etc. Instructors cannot give exams and have them never show up to the sites. Things like heating and air conditioning when the instructors are teaching. This is not new technology.
>
> I think the credibility needs to be returned to the classroom; even the buildings are outdated. Ventilation is poor, the classes aren't wired for data lines, etc.—and they want to put whole degrees on TV? My issue is not with the possibilities of the technology, it is with the way this technology is delivered.
>
> If you talk about five years from now, there will be technology we can't even imagine right now. I would anticipate the conduct of the class will be a lot of fun. We are at a dawn of new technology and more money should be spent on the most basic elements of this technology–audio and visual support.
>
> The service shouldn't be 'fixed,' but it should be changeable for what the users say. It is absolutely necessary for this type of technology, because it is always evolving and there is no fixed paradigm for this technology, so it cannot be fixed. I foresee no fixed platform for this for a long time.
>
> Quality is something very hard to put your finger on. You can usually tell when it is not there. When it is there, the question is 'how good?' We all realize that we have some problems and the only way to solve them is to get input from those who count.

> We receive new equipment and we are expected to know how to operate it immediately. I put myself in the student's shoes and sometimes I know what he/she is going through. I am supposed to provide a service and I am still learning how to use the equipment.

Participation in a Dialogic Process

The components in Figure 12 represent issues that concerned the participants in this phase. The diagram shows directional arrows going from one component to the next respective component. This means that Technology Issues will affect Faculty Issues and so forth. Directional arrows also depict the manner in which respondents felt 'Higher Education' affected these components. The purpose for the directional arrows was to show how information flows from 'Higher Education' to the other components in the diagram. And, how each component 'affects' the others. Because of these types of information flows, participants expressed that, even though they may be willing to participate in a dialogic process, they believe that the power relationships deeply embedded in 'Higher Education' prohibit their contributions from having any impact.

> There are two aspects that relate to two kinds of information sharing. The first one has to do with teaching, teaching skills, with teaching approaches, styles and things to do with students. The second type of information has to do with the role of the university; it includes the form of educating students and relates to what drives universities to do what they do, in and out of the classroom, as a broader, more philosophical issue about education. A lot has to do with technology's fundamental changes in the role of universities, the form of education it provides, the role of the faculty; it has ramifications that address the entire structure. The sharing of these kinds of information has been a problem at universities for as far back as I am aware.
>
> I think the behavior that has been learned here is that when you disagree with certain people, you'll get brushed aside very quickly. University people are the hardest to change.

If administrators keep ignoring the problems of the instructor, the instructor will say, 'the heck with it, why do I keep doing this with no help in sight.' It becomes a question of finding time to fix the system both on the administrator's part and the educator's part. There has to be a respect from all sides during this dialogic process. It should not be a one-way conversation or effort from either side. The dialogue should be geared toward improving the system.

Maybe there will be an explosion with the technology, but if you don't take care of the human aspect, you're not going to achieve much. Back in the seventies, people came up with a lot of computer uses only to see them all fail, why? Because of the lack of attention given to the people who use the technology. And, therefore, if you don't pay attention to those using this technology, the relationship between the instructors and students will also suffer.

I still think in the next five years dialogue on the system limitations will still be seen as a positive contribution. Once money comes into play, that may change.

The problem is that everyone is in a hurry. They are running out of time to make a name for themselves. Everybody should contribute something. And as a result, you bypass inputs needed. We need to have some sort of participatory environment here and we don't. Sometimes our hands are tied when we try to make it happen. I worry about how well things are thought through.

A committee to include all stakeholders needs to be attacked comprehensively. Unless one is formed, nothing will happen. Decisions will continue to be made without the input of the faculty. At some point, the faculty is going to have to say, 'time out, we are going to address some issues.'

We don't have a dialogic process. We sort of dictate to them what we want them to do. All of these things come down as edicts and faculty are told that they will teach such and such or we'll use a carrot and offer them additional faculty positions, or adjuncts or whatever if they will do what we want. That is not how to get input in the decision making process. That's coercion.

The people in the higher ups don't know the technical specifications. They don't know how the technology actually performs. They may have managerial skills, but they have to depend on inputs from those who know and use the technology.

How can someone influence thinking? How are issues going to be made? These kinds of things seem to happen as a result of a surge of certain opinions nationwide; when these opinions reach a certain level of

> influence, that is when things start to change. If there is a possibility in participating in a process that could really make a difference, somehow, not necessarily that of my own opinion, it would be followed up on, but the group could or would have an influence on the way things are done, where policies are established. It's hard to imagine.

Summary of Analysis

Content analysis on the data collected throughout this research generated numerous themes and topics as expressed by those who participated. Phase 1 of the research focused on developing an organizational profile that would establish different knowledge domains for members to express their actual opinions, concerns and attitudes based on their experience and/or knowledge of how new technology impacts them within the organization. Participants in this phase were also given the opportunity to ask others to help them move toward an understanding by expressing their concerns in questions of wanting to *know*.

The results of Phase 1 were used to establish a scenario of what could happen within five years as these new technologies move toward their potentials. In Phase 2, participants were asked to complete a survey that was rooted in the concept of 'participation.' Participation, in this respect, was embedded in their responses to the scenario and their perceived roles in this type of environment, and by projecting themselves into the roles of others. Responses varied for this phase, and a content analysis was conducted to yield a composite of their responses and the interrelationships that emerged. One issue that seemed important to most of the participants was to make others' responses centrally available via email, forum, newsletter and/or other media that campus personnel might have access to.

Phase 3 utilized a Dialogic Vehicle. This tool was developed in order to stimulate the dialogic process. The responses from the survey were summarized and the researcher solicited suggestions on how to create a process in which all stakeholders affected by the transfer of technology could make their contributions available to others. This process would have provided the seed from which different levels of knowledge processes could grow. There were no written responses during this phase, and in the interest of time, the decision to terminate the research was made. However, there were numerous indications that the newsletter did indeed stimulate some discussions within the university, in both oral and written form.

Phase 4 represented the project termination. The focus for this phase was to inquire about the research process. Participants' responses were analyzed using a content analysis and more themes emerged with their concerns. The issues raised during this project have implications and provide a basis for future research.

CHAPTER 7

INTERPRETATION OF RESULTS

The intent of this study has been to explore a process in which the experience and expertise of those involved in and affected by the transfer of technology could be made unconditionally available to all members and operational aspects of the organization. The focus of the research was implied by the following question:

> **How do (or might) organizational personnel contribute to a knowledge process that facilitates the assimilation of new technologies?**

This central question was further defined by four supporting research questions::

1. **How are (or might) organizational personnel (be) affected by new technologies?**
2. **How has (or might) knowledge sharing with respect to the assimilation of new technologies been (be) defined in the organization?**
3. **How do (or might) organizational personnel participate in this process?**
4. **How do (or might) organizational personnel perceive the utilization of a knowledge process resulting from the sharing of experience as a contribution towards sustaining the organization's competitive advantage?**

The basis for a response to each research question rests with an interpretation of the findings generated from the data analysis for each of the four phases of the research. The three levels of knowledge as a key descriptor of knowledge processes received strong support from those who participated in the research. These levels of knowledge, as described in Chapter 1, are (1) the level of the individual teacher and student, where the prevailing technology impacts teaching and learning styles; (2) the level of the university, where the prevailing policies impact the acceptance and mode of

use of the technology; and, (3) the level of societal education, where the prevailing thinking and rhetoric on education impact the policies of the university.

Question One

Sutton and Sutton state that, when new technologies are introduced into the organization, "technology will alter the nature of tasks and vice versa; tasks to be done will affect the people and vice versa; and changes in people change the organization and vice versa." (Sutton and Sutton 1990, 123)

The discussion of technology assimilation during Phase 1 of the research generated a variety of concerns. Recognizing that the change of technology would affect the way in which instructors interact with students prompted the first interviewee to ask the question:

> I would like to know, from the distant learner, how important it is to see the faculty member?

Throughout the research, numerous interviewees stated that seeing the student allowed them to provide energy and motivation, and to determine the student's awareness. The focus was then shifted to the types of technology that would allow them to see the student, versus the type of technology available during the interview. The scenario in Phase 2 generated an 'ideal classroom' in which the faculty member could see the student—all students, and vice versa. This condition prompted another interviewee to make the following statement:

> Bandwidth now, or five years from now, is not even close to the bandwidth we have when we are face-to-face with the students. It's a different medium, and that's why it's a different form of teaching, an entirely different kind of experience for both the student and the instructor.

The importance in these two comments and others, concerning the need to see the student, suggest that people within the organization are aware that the introduction of technology will affect them in some way. Further probing on this idea led members to acknowledge that the present and future technology would require them to become more organized and prepared to provide instruction for distance learning. This led to the need for rethinking how lesson plans would be prepared and presented in 'virtual' format. One interviewee provided the following comment on how technology would be available to assist instructors with their lesson planning:

> You can plan your class and put it into a lesson planner and that lesson plan is an active lesson that you can take into the classroom. If you want to use the Internet during one of your classes, you can select an icon and say, 'put this into my lesson plan,' at the time and point in which you want to use it. This is an active tool, and is enabled by software. You can also do this with simulation tools, videos, etc.

This line of reasoning prompted those responding to the survey questions to inquire about what type of presentations would dominate in this environment and how much preparation time would be required:

> Would it be possible to continue with a dialogic format in this type setting or will this technology make small class discussions obsolete?
>
> Instead of the student making the effort of learning, now it is the instructor forcing himself to clarify things to the student. The learning shifts from the student to the instructor. It seems to me that the instructor has to crystallize the whole problem—make it so clear cut that the student has to spend less time and less effort thinking and researching the material.

These issues affecting tasks and people led to questions about how the organization would change to accommodate the changes produced by technology. One focus was on the reward and incentive system that would affect those using these technologies. Participants expressed concern for junior faculty, the time needed to

prepare and adjust to the technology, monetary compensation, and the possibility of reducing the number of faculty once this type of technology reached full potential. This prompted the need to review other deeper issues including the role of higher education with respect to technology, faculty, academics and administrative functions.

The survey in Phase 2 requested that participants express how they think others would feel about the 'virtual classroom,' as described by the scenario. They were also asked the same question with respect to themselves. Responses matched the different aspects of the organizational components as described by Holzner and Marx, and in some cases, these responses also showed the types of relationships that may emerge as a result of the respondents' perceptions. Respondents expressed that others would be threatened and scared and believed the technology would be seen as barbaric and backward. These perceptions led to an assumption that the technology might be used for other aspects of higher education:

> I think administrators see an opportunity to control what faculty do in the classroom. I think students see an opportunity to control their own learning experiences irrespective of faculty facilitation.
>
> I think that the high technology, virtual classroom will lend itself to the 'star' system of faculty. Those that present themselves well in the televised medium will become high paid performers; those that do not will become low paid teaching assistants/tutors. As a proponent of the dialogic approach, I see myself in the latter.

During the exit interviews, participants were asked how they view power relationships now and whether or not these types of relationships would be present during the transitioning to the 'virtual classroom'? Some respondents felt that, once the technology was developed, incentives to introduce new uses of the technology would be unwelcomed, because when the product is purchased it is up to the vendor to

work out problems or make modifications, not the faculty. Others felt that money alone is not enough incentive for faculty to teach large classes, with large caseloads. They believed that, if this became the case, they would be assembly line workers as opposed to educators. One person believed that if current hierarchies remain intact five years from now, the role of the university and of higher education would have to change:

> The power of the nation's universities to provide higher education may be challenged by the private sector, once it [distance education technology] catches on, because there are certain needs that are not being met by these schools. That it could happen in 5 years is a little bit short. It would be a form of education that would use technology, and use it very well. It would provide a mix of the technology and traditional education. But, they will do it less expensively than the university would think about doing it now. We'd get to a point where change would have to take place.

Questions Two and Three

Informing the response to these two research questions were events outside of the actual research project. After the interviews were conducted during Phase 1 and prior to the scenario/survey in Phase 2, for example, an internal university memo was distributed to all administrators and faculty. This memo solicited input in response to a "strategic integration of classroom technology to facilitate effective instruction" for ensuring that technology in the classroom was part of the university's "commitment to technological change and innovation." Volunteers were invited to participate in focus groups where they would be asked to "think critically about their own perceptions of what teaching and learning are, and then to think creatively about what teaching and learning could be at the university." The input from these focus groups would be instrumental in developing a schedule and plan for faculty and staff seminars. The

memo stressed that these focus groups would meet four or five times total, over a course of a week and would not require a *significant investment* of the participants' time. The memo[1] stated that these focus groups were necessary, because a "successful plan of this scope [could] not be developed in a vacuum."

The purpose of the memo was to provide an opportunity for faculty and administrators to "speak freely in a series of meetings about [their] concerns, wishes, and frustrations related to using technologically based teaching materials."[2] The results of these meetings provided a guide for a "teaching with technology blueprint for the university." Respondents to the Phase 2 survey and Phase 4 interviews did not mention whether or not they participated in this forum, but stressed that if forums of this type were available *and* if their contributions would be welcomed at all levels of the university, they would be willing to participate. Other suggested vehicles for participation included 'chat rooms' through the Internet, newsletters, and working lunches.

The significance of these two questions was also understood by respondents, who indicated their belief that their opinions, arising from their experience with the technology, would not be welcomed at all levels of the organization:

[1] This memo was distributed to university faculty and staff members in September 1995.

[2] The results of these sessions were made available in another memo that was distributed to university faculty and administrators in January 1996.

> ...as long as university decision making processes remain structured as they are, there is little chance that faculty or student participation in decisions of the magnitude of the 'virtual classroom' will make a difference. The bureaucratic form of organization works to squelch opinion as it works its way to the top. It is much more likely that we will make a difference by participating in the society wide debate through conferences and publications.
>
> Participation is encouraged when it is seen as making a difference, at least sometimes. If it makes no difference, why bother.

Other comments were submitted to the researcher during the exit interviews. Participants wanted the opportunity to participate in issues surrounding the future of distance learning technologies. Some participants felt that policy and the whole idea of higher education would have to be re-engineered to meet the evolving needs of the technology. Still others had difficulty imagining how their input would be able to influence the dominant information held by "authorities" on this process, to include administrators.

> How can someone influence thinking about something like the 'time needed to prepare?' How are issues going to be made? These kinds of things seem to happen as a result of a surge of certain opinions nationwide; when these opinions reach a certain level of influence, that's when things start to change. Ways to participate on how writing an article for the Chronicle, for conferences, just trying to influence. If there is a possibility in participating in a process that could really make a difference, somehow, not necessarily that of my own opinion, it would be followed up on, but the group could or would have an influence on the way things are done, where policies are established. It's hard to imagine.

Question Four

Informing the response to this research question were insights about the different levels of knowledge as seen through the eyes of the participants. These different levels of knowledge addressed different ways in which the current and future use of the technology might affect the organization. One issue that was addressed was

the timing with respect to how the technology is being implemented. Respondents believed that 'everybody was in a hurry,' and the rush to conclusions for implementing any technology would result in it not being well thought out. This issue was also raised to stress the need for input from those involved in using the technology. Inhibiting the process for knowledge sharing may contribute to future inadequacies in the system.

Issues supporting the need for re-engineering and restructuring aspects of the incentives and rewards for using technology were addressed by participants. The overwhelming concern was with the 'star' faculty system, in which those performing 'extraordinarily' on TV would be given the greatest rewards and incentives to continue high performance. Participants felt that this type of approach would not lend itself to developing future educators within the domain of higher education. They believed that a closer look at the types of courses being taught on television and at what level (graduate versus undergraduate) was needed. One participant stated that if the movement toward changing teachers to celebrity performers was to be the case, then the educational system should look more closely at the emergence of the 'world lecturer,' where universities would act primarily as the facilitator for classroom instruction.

Finally, respondents felt that the use of technology required 'progressive thinkers.' The importance of this concept applied to a variety of university activities and policies. The primary issue mentioned in this category was the need to rethink the incentive and reward system and, as Holzner and Marx have described, the redistribution of power. Respondents felt that there was a need to progress towards an

open dialogue for exchanging ideas and not to let those who consider themselves experts make all of the decisions. Participation in such a process would be to influence current ideologies so that recognizing the full potential of the technology might be possible.

Response to the Primary Research Question

The research focused on knowledge processes for technology assimilation. These processes could provide a continuous source of education and inspiration about a technology's impact on the social components in the organization. The difficulty with this concept is that different levels of knowledge processes transcend different levels of the organization with respect to the governing organizational components: cultural, technical and political. This is seen as difficult because members at different levels of the organization experience and envision the use of technology in numerous ways, and in that sense, the use of the technology is never exhausted. The problem with the assimilation process is not the need to educate organizational personnel continuously, but rather the lack of focus on all levels of the organization to supply that need. In one sense, this need at each level is assumed to be understood by others in different parts of the organization. This false presumption leads to the inability of an assimilation process to begin. Informing the response to the primary research question rests with this dilemma.

Participants in the research were able to reach a consensus (without knowing others' responses) that participation in such a process required support from the top of the organizational hierarchy. This type of support meant that information concerning

new technological developments and future directions of technology use would have to be available to all members and aspects of the organization. A few people mentioned that this could be accomplished by establishing a steering committee that would serve as the go-between for high-level administration and the functional areas involved with using and supporting the technology on a daily basis. This belief is based on the possibility that if there is a way to express concerns or ideas, and make a difference, that the concept of a knowledge process would be possible and successful.

One university solicitation for participation during the period of this research was limited to the realm of teaching tools and techniques that would assist faculty members in adapting to technology in the classroom and was not intended to address deep issues. Other issues that participants wanted to address included the poor quality of the technology. The idea of quality was also extended to the ability of the student to learn from this medium and the possible quality of education this type of medium promises to deliver. Reward and incentive issues were addressed frequently, despite current policies in place to compensate those teaching by providing time off and additional pay for large class loads.

In conclusion, and based on the data analysis from each phase, organizational personnel do not participate unconditionally in knowledge processes for technology assimilation. This conclusion supports the theory developed by the researcher as described in Chapters 2, 3 and 4. The importance of this conclusion is that respondents overwhelmingly believed that the concept of a knowledge process facilitated by dialogue was necessary in order to provide adequate opportunities to conjoin organizational members' experience with the expectations of new technology,

and then to make this knowledge unconditionally available to other organizational members. The concept of 'externalization,' as defined by Nonaka and Takeuchi (1995), would permit participation in knowledge processes. Cybernetic Inquiry, as defined by the Propositions in Chapter 4, provides more than adequate strategies for a dialogic process; but, as mentioned in Chapter 4, the propositions are currently false. However, their truth would be desirable in making participation in knowledge processes for technology assimilation a vehicle for social transformation in organizations experiencing new technologies.

CHAPTER 8

IMPLICATIONS

This chapter discusses some implications of the research for the observing system approach to knowledge processes. These implications are driven by the propositions on cybernetics and social transformation presented in Chapter 4. Due to the exploratory nature of the research, the research findings in Chapter 6 must be viewed as descriptive. In essence, the research stands as a descriptive exploration of knowledge processes in support of technology assimilation. The methodology for this research included pilot and exit interviews, a scenario/survey, and a Dialogic Vehicle. The research process was designed to engineer two contrasting, yet dependent paradigms and, as such, is supported as an extension of a traditional research approach. Although the research findings are descriptive, they provide some insights on participation in knowledge processes.

These insights lead to conclusions with respect to the following:

1. Implications of propositions on cybernetic inquiry;
2. Implications for application of the knowledge spiral;
3. Implications on participation in social transformation.

Implications of Propositions on Cybernetic Inquiry

The research was based on a set of propositions that are currently false and whose truth would be desirable. These propositions suggest that everyone has the ability to participate in social transformation, and that cybernetics points to an opportunity do so in a particular way. The research findings provide an example of

how cybernetics can be used to guide the exploration of knowledge processes. The theory of dialogue implied by these processes is based on von Foerster's distinction between trivial and non-trivial machines.

Dialogic process allows autonomous entities to 'categorize' elements of their environment in such a way as to enhance their awareness of their surroundings as well as the surroundings of others. Dialogue can be initiated by a mutual desire to share information based on experience and expertise, creating an asynchronous dynamics that moves toward synchronicity. In order to facilitate 'dialogue,' the organization must engage in participatory processes "where acting locally allows each observer or member of the organization to move toward a synchronicity that includes the flow of simultaneous events" within each observer's system. (Wheatley 1992, 42) These simultaneous events may be categorized in one's environment coinciding, for example, with Holzner and Marx's (1979) description of organizational components. Though these components are ambiguous, they do offer guidance to the people within the organization experiencing the transfer of new technologies. Referring to Figure 13, one notices that though the organization has autonomous components, they are all 'attracted' to the 'organization' of the organization. These components are capable of "maintaining an identity, while changing form." (Wheatley 1992, 90) Wheatley explains that:

> Part of their viability comes from their internal capacity to create structures that fit the moment. Neither form nor function alone dictates how the system is constructed. Instead, form and function engage in a fluid process where the system may maintain itself in its present form or evolve to a new order. The system possesses the capacity for spontaneously emerging structures, depending on what is required. It is not locked into any one form but instead is capable of organizing information in the structure that best suits the present need. (Wheatley 1992, 90-91)

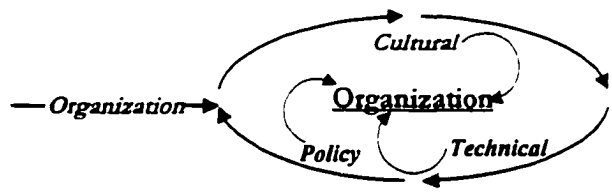

Figure 13. Interaction of Organizational Components

The capacity for spontaneity can be described by the concept of the 'observing system'. The components of the observing system take form when an attractor is present. When a disturbance or perturbation threatens the system's stability, instead of focusing on the source of the disturbance, the observing system organizes its components in order to structure information that will suit its present need. This results in the system's ability to recognize the disturbance as a part of its own system. This movement toward synchronicity (accepting the disturbance as part of the system), entails the creation, transformation, maintenance and dissolution of distinctions provided by the disturbance itself. These distinctions are the substance of knowledge and the traces of a knowledge process.

The observing system relies on the "utilization of environmental order." (von Foerster 1981, 5) Observing systems can create new structure in their environment by admitting alternate concepts of time. These alternate concepts of time permit the observing system to adapt to perturbations in its environment. This process entails

'self-reference,' that provides meaning between action and experience. Maturana and Varela explain that "this connection between action and experience, this inseparability between a way of being and how the world appears to us, tells us that every act of knowing brings forth a world." (Maturana and Varela 1992, 26) The possibility of social transformation arises with new patterns of thought and action, new distinctions created by knowledge processes that occur as a consequence of the dynamics between logical domains. Participation in these processes requires a sensitivity to emotionality and the admissibility of alternative concepts of time.

The development of knowledge processes for technology assimilation is based on the ability of those involved with new technology to create new action patterns in order to adapt to their environment. The creation of new action patterns may result from how tasks, roles, policies, etc., have changed as a result of new technology. Dialogue facilitates the movement toward synchronization of action for both individual members and the organization as a whole.

The desirability of the propositions, if true, is based in the need for spontaneity, categorization and development of new action patterns. These propositions are founded in cybernetic inquiry and ensure a primary focus on dynamics, particularly circular dynamics; they offer alternative ways of thinking about ways of thinking and serve as a mode for formulating the 'undecidable question,' as described by Heinz von Foerster. The other issue raised by these propositions is the desirability of social transformation. If these propositions were true, then social transformation would entail (1) changing thinking and (2) transforming history. Declaring 'power' obsolete, and social transformation as a *non-violent* activity desirable, would permit members of

an organization to construct their realities based on their perception of how technology causes a 'disturbance' to their environment.

Throughout the research process, participants were able to express concerns that would affect their performance with the new technology. Some concerns centered around the technology itself, in terms of quality and reliability. Other concerns addressed their separate roles as educators, administrators, technicians, etc., in order to stress that the technology should be adapted to fit the roles of people rather than vice versa. These concerns were the essential ingredients for the development of a 'knowledge spiral,' as described in theory by Nonaka and Takeuchi (1995). This theoretical model integrates and explains the implications of von Foerster's (1991) distinction between trivial and non-trivial machines.

Implications for Application of the Knowledge Spiral

The research was conducted with the assumption that the theoretical description of the 'knowledge spiral' could be applied to an organization experiencing 'fluctuation' or "a breakdown of routines, habits, or cognitive frameworks." (Nonaka and Takeuchi 1995, 78) The fluctuation for this research site was the use of distance learning technologies. The significance of this fluctuation is that virtually all organizational members at the research site are, or would be, affected by these technologies in due time. Initially, only those ***knowing*** about distance learning technology, either by direct experience or by providing administrative support, were contacted in order to develop an organizational profile. The interviews conducted during Phase 1 of the research sought to gather 'tacit' knowledge from those interviewed in the form of experience and technical skill or craft. The objective of

asking the interviewees 'what they wanted to *know* from others,' was to bring other members of the organization into the socialization process. The requests of the first interviewee were shared with the others interviewed during Phase 1. Other interviewees in turn made their requests known to the researcher in such a way as to allow the focus of the research to be shifted from the researcher back to organizational members. In other words, the specific criteria used for exploring knowledge processes for technology assimilation shifted as a consequence of the requests by those interviewed. Members wanted to *know* about levels of interaction, the future use of the technology, whether or not buildings would be redesigned to accommodate new technology, and other areas that may affect them once these technologies became commonplace. These issues provided the foundation for the scenario/survey used in Phase 2.

The scenario developed for Phase 2 was an attempt to 'externalize' the requests of those interviewed in Phase 1, by projecting members into a future (5 years) setting in which these technologies might be commonplace for both distance and local classroom settings. The questions in the survey requested that members share tacit, as well as explicit, knowledge based on their experience in either or both the distance and traditional classroom. The survey questions also requested that members project themselves into the role of the other, so that they could perceive that the technology was capable of impacting all members of the organization. Again, their responses displayed more tacit knowledge. The next set of questions in the survey attempted to pursue the issue of 'externalization' with respect to making their responses, as well as others' responses, available to the organization as a whole. Finally, the plea for

participating in a knowledge process was made at the end of the survey to see if members were willing to participate at the organizational level, which would have entailed "moving up through expanding communities of interaction, that crossed sectional, departmental, divisional and organizational boundaries." (Nonaka and Takeuchi 1995, 72) Members were encouraged to respond as though their contributions would be welcomed at all levels of the organization. The results of their responses were made available in Phase 3, the 'Dialogic Vehicle,' in the form of a newsletter. This vehicle provided responses to what people were thinking and feeling as a result of their projected experience in the scenario as described in Phase 2. This last attempt at externalization, aimed at stimulating the remaining modes of knowledge conversion, combination and internalization, was not explicitly observed because no written responses to the newsletter were received. However, it was reported in numerous informal conversations that discussions of the issues were stimulated by having raised them to a little higher level of visibility.

Phase 4 of the research served as the project termination, as well as a vehicle to allow members participating to reflect on the previous three phases. The issue of dialogue was raised with respect to knowledge processes, as well as the process of making issues affecting personnel available for the organization to 'work with.' This phase provided one very important insight relating to the distinction between the trivial and non-trivial machine: members were aware of and felt capable of constructing their own realities resulting from the introduction of new technologies into their routines. Members also believed that their contributions would make a difference if there was a way to 'influence' the current and dominant form of thinking

at the research site. Most of all, members were aware of current power structures in place that inhibit their participation and would also inhibit the participation of others.

Implications for Participation in Social Transformation

The knowledge spiral was used to provide a concept of participation at the individual, organizational, and societal levels. This type of participation recognized that individual contributions, resulting from experience, skill, craft, and insight in the form of tacit knowledge, provide the organization with a core of knowledge that is never exhausted. The mobilization and conversion of that knowledge is necessary so that knowledge from individuals can be made explicitly available to other members in the organization. This type of process may provide new products, services and the like, but, most of all, creates an environment where dialogue is continuous and encouraged. The significance of this type of participation is that it expands through all echelons of the hierarchy. Drucker contends that in this type of environment, "everyone in the organization will be constantly thinking through what information he or she needs to do the job and to make a contribution." (Drucker 1993, 49) Organizational knowledge, therefore, will be the product of the dynamic interaction among senior managers, middle managers and specialists.

The analysis of the data in Chapter 6 provided insight into the numerous issues members at the research site had concerns about. In this respect, an assessment of their abilities to construct a reality based on a disturbance in the form of new technologies was accomplished. Respondents also saw the need to make the concerns of others available to the organization as a whole. The necessity of making the viewpoints of

others available does coincide with the concept of socialization. In other words, everyone is entitled to their own opinions, constructions in this case, and making them known throughout the organization. In order to mobilize the views of self and others, the next mode of knowledge conversion, externalization, has to take place. This process is dependent upon the dialogic process, for without it, the search for further explanations that permits the movement toward synchronicity for organizational members and the organization as a whole will not take place. Information in this respect is represented by the construction of relations in the field of the observing system. The construction of relations, expressing them as concerns, opinions, etc., while possibly satisfying the requirements for continuous improvement, does not satisfy the requirements for social transformation.

Characteristics of the trivial machine render it predictable, reliable and unable to *know* about all the interrelationships and interactions within its environment. The *other* may treat a person as a trivial machine. With this type of construction of their other, the capacity to construct relations is mute. In the absence of dialogue, the description of persons as trivial machines becomes a 'truth,' or a matter of fact that becomes acceptable as a dominant form of information about that person. A trivial machine is useful as a tool for conceptualizing business activities such as the acquisition of new technologies, services or products. Its reliability and predictability makes it a valuable asset to the organization. However, when applied to people and the interactions among people, it fails to capture the potential for creativity and ingenuity that humans possess.

Characteristics of the Type I non-trivial machine render it incompletely observable because this type of machine possesses self-reference. Constructing people using this concept requires assumptions similar to those of the trivial machine—namely, with enough information *the other* could fully explain and predict the system's behavior in terms of its current states and inputs; however, the amount of information that would be required to do so adequately far exceeds the capacity of any known or imaginable processor, human or otherwise. The research site showed numerous examples that fit this concept of machine. The most obvious of these examples occurred when participants made reference to *they*, as their *other* and as the source of problems associated with the use of the technology. After a series of complaints, *they* and the *other*, accept the fact that the technology will be used. The dominant form of information sharing is top-down while the dominant form of complaint sharing is between ranks. Thus, the real issues affecting individuals and their environment are not raised, because the *other* only sees it as a complaint and/or frustration but knows that *they* will still use the technology. This type of vicious cycle stymies the assimilation process because there is little or no discussion about the technology's impact on the organization.

The Type II non-trivial machine may best describe the dominant form of interaction and relationships at the research site. Krippendorff (1992) explains that when constructing people as people, there is a likelihood of dialogue, but it is constrained by the limited concept of relationships between people in this type of system (non-linear dynamic system). Dialogue in this concept of system is more of a cause and effect type of exchange—an interchange. This leads to fixing the technology

when it is broken, and providing forums for teaching with technology, for example, but not addressing the deeper issues of changes in policy and social structure.

Conclusion

The overriding conclusion of this research is that organizational members tend not to view each other or the interactions between each other, from the perspective of the pure Type III non-trivial machine, the observing system. Yet, there were numerous indications that people, particularly at the lower end of the organizational hierarchy (instructors, technicians, students), would welcome such a shift, and many felt that is was necessary to realize fully the potential of the technology. Others were more cynical. The theory supports the notion that unconditional participation in knowledge processes requires that the concept of the observing system be the dominant mode for constructing each other, that this process occurs in dialogue, and that this dialogue is seen as much more than an information exchange—it is a dynamic that is uniquely human, that ties people together at an emotional level, and that creates and transforms knowledge in the process.

CHAPTER 9

RESEARCH CONTRIBUTIONS AND DIRECTIONS

The purpose for this research was to explore knowledge processes for technology assimilation. The concept of knowledge processes included the idea of social transformation through dialogic processes. Enabling conditions for these dialogic processes were outlined in a set of propositions that are still currently false and whose truthfulness is desirable. These propositions treat knowledge processes as a progression from the trivial machine to the Types I, II, and III, non-trivial machines. The attributes of this progression suggest that members of an organization can be active participants in a social transformation. The results of this research render several contributions, as well as some reflections of the researcher on the methodology for addressing undecidable questions. The final section of this chapter suggests areas for future research.

Contributions

This research makes several contributions to cybernetic inquiry, the academic literature on knowledge processes, and theory of social transformation. These contributions are described below.

Cybernetic Inquiry

This research demonstrates the value of the distinction between trivial and non-trivial machines for describing human participation in organizations. This demonstration outlined a progression from the trivial machine through the non-trivial

machines Types I, II, and III. This progression emphasized the various modes through which autonomous entities may participate in organizations. Attributes of the trivial machine provided guidance for autonomous entities to "carve out any part of the universe and call it a system." (Geyer 1994, 3) When the system is formed, they also have the ability to define subsystems, suprasystems, etc. Attributes of the non-trivial machine, e.g., self-organization, self-referencing and self-production (autopoiesis), give autonomous entities the ability to reflect on the systems, subsystems, and suprasystems that they have created. Both the trivial and non-trivial machines permit a 'self-dialogue,' which permits human beings to move toward synchronization in response to a disturbance in their reality. The concept of moving toward synchronization permits the progression from routine, trivial machine processes (information systems) to creative, observing system processes (dialogue), first within the individual and then within the organization. This progression is seen as particularly desirable when it reaches the societal level, where the concept of power becomes trivialized, permitting autonomous entities to construct continuously the information they need to move toward synchronization.

One consequence of this contribution is an alternative explanation of participative behavior in knowledge processes in the organization which allows each individual to participate in any phase at any time. This notion permits the movement toward synchronization and mutual understanding between the individual and the group level. This results in generating new insights into the management of technology with respect to the individual, the group and the organization.

Knowledge Processes

The research contributes to the academic literature on knowledge processes by building on ideas in design methodology and by designing a research process that addresses the 'closed world' versus the 'open development' paradigms. These contrasting yet dependent paradigms were seen in the attributes of the trivial versus the non-trivial machine. These attributes suggested a need to include the self-reflection of the observed and observer (if the distinction is necessary) in a process that includes the construction of their realities. This notion was further supported by the distinction between tacit and explicit knowledge. The tacit aspect of knowledge concerns personal experience and/or performance as a result of skill and expertise. The explicit aspect of knowledge represents the dominant form of information already in place. In order to conjoin these different aspects of knowledge, it was necessary to design a research process that included the closed world and open development perspective through a continuous dialogic process. An example of this process is represented by the Spiral of Knowledge.

The dilemma with the notion of closed world versus open development paradigms, with two types of knowledge needing to be shared, has shown that different levels of knowledge generation emerge from different people in the organization. This is demonstrated when personnel project themselves into the role of the *other*. The different levels of knowledge are seen to affect and transcend the organizational components, as outlined by Holzner and Marx (1979), suggesting that issues better addressed by an open development paradigm be explicitly included in a

research design process as well as in organizational decision making processes. The literature used in this research provided theoretical boundaries and suggests that alternate research design processes be developed for further expanding these boundaries.

Social Transformation

The propositions presented in Chapter 4 outlined a possible approach to the transformation of social organizations, and society itself, by providing enabling conditions for individuals wanting to participate in the generation of knowledge processes. Though these propositions were outlined for technology assimilation, the concept of 'technology,' as described in Chapter 4, removes the traditional definition so that it can be treated as a form of knowledge itself. Therefore, a technology of knowledge can be seen as a knowledge of knowledge which constitutes the creation, dissemination, maintenance, and dissolution of distinctions. This contribution is seen as desirable and could possibly render the testing of the following hypothesis:

> **Organizational members participate in knowledge processes for technology assimilation when the propositions on cybernetics and social transformation are true.**

Redesigning the Methodology for Future Application

The methodology for this research was designed so that a traditional research approach could be linked to a research approach that has yet to be defined. The traditional aspects of this design included problem formulation, investigation, and analysis with the possibility of generating hypotheses. The undefined research

approach labeled as an 'alternative' sought to follow the elements of the traditional approach, but also to allow reflections from the researcher and participants. As Schrijvers has noted, once a research design involving a dialogic process is underway, the roles of the researcher and researched become interchangeable because they are able to reflect on how they are being changed during the research process.

The methodology for this research design also sought to find a medium in which tacit knowledge could be conjoined with explicit knowledge. Explicit knowledge is the dominant form of acceptable, objectified knowledge at the research site and for the majority of organizations. Brödner has described the dilemma as "engineering cultures in conflict." (Brödner 1995, 249) One culture is characterized as being in the 'closed world paradigm' and starts with "the development of computer systems and cognitive science." (Brödner 1995, 251) He further explains that this dominant culture:

> ...became a common and taken-for-granted belief to see the real-work as a 'system' that was considered as being controllable, analyzable, comprehensible, and formally describable. The structure and dynamics of this 'system' were assumed to be subject to complete formal modeling. Completely formalized mathematical descriptions, or at least other explicit propositional knowledge, would thus allow for entirely rational acting, i.e. to achieve chosen objectives under given frame conditions in the best possible way. Moreover, this would allow [technology] to imitate human abilities and replace skills by machine artifacts. (Brödner 1995, 251)

The counter position to this closed world paradigm is described by Brödner as the 'open development paradigm,' and "does not deny the fundamental human ability to form explicit, conceptual propositional knowledge, but contests the completeness of this knowledge." (Brödner, p. 249) He further explains that:

> Humans are considered to be thinking and acting agents having bodies with developed sensitivity and motor activity. Driven by their needs, they consciously and purposefully act in and interfere with the environment that has been growing with them. Through their acting and interventions, they cause environmental changes and experience the effects through their senses. Thus they find meaning of their actions in the effects produced. These experiences provide them with the meaningful context of past actions (with its intentions and effects) and deliver the scope of expectations for future actions. Since they experience their acting and the environmental changes as a coherent whole (that need not be fitted by rules), they know how to act in a goal-oriented fashion even in uncertainty or unstructured situations. (Brödner 1995, 252)

The design of a methodology that incorporates both these cultures proved to be extremely difficult. Brödner notes that the closed world paradigm "cannot cope with a process that is likely to increase the inconsistency, [because] the less the reactions of such a system can then be understood or foreseen, the less its results can be verified. Its maintenance becomes a nightmare." (Brödner 1995, 253) The focus for the redesign of the methodology to engineer two conflicting cultures must rely upon:

> objectifying and explicating parts of human experience (such as concepts or tools and machines) that may lead to deeper insights, and improved or even new artifacts. In this never ending spiral of open development, it is the bodily experience and the embodied tacit knowledge that forms the core of human skill, expertise, and competence. Gathering experience through the use of artifacts, exploring their functions and meaning, and adapting to new situations or new ways of using them; this is what constitutes its abundance and ingenuity. Explicit theoretical knowledge, on the other hand, is in principle incomplete and limited in validity. It is therefore impossible to completely specify the functional requirements for a technical system ex ante. For the same reason, its usability cannot be tested without the users. (Brödner 1995, 253)

A redesigned methodology to explore knowledge processes for technology assimilation would seek to provide a means for the users of the system and those that acquire the system to be included in a process that includes dialogue. The research

analysis provided insights on the difficulties of the dialogic process. The perception of power and its affects on superiors and subordinates was described by Argyris in Chapter 2 and similarly described by the characteristics of the trivial machine and the non-trivial machine Types I and II, both of which cause an organization to exist "within a closed system of reality, constructions, institutionalized attitudes, rationalizations, beliefs, habits of thought and action and experiences accepted as such." (Krippendorff 1989, 177) The result of this type of governing process renders the organization *demonstrably non-viable*, because members are unable to examine the changes in the organization to include tasks, people and the organization itself.

The redesign of a methodology would explicitly include the propositions on cybernetics and social transformation by Richards and Young. These propositions provide a foundation for research on knowledge processes and the technology of knowledge. These propositions confront the need to possess adequate strategies for trivializing power relationships. Declaring 'power' obsolete may be a liberating experience for the individual; unless universal, this declaration does not alter economic and political structures. Including these propositions explicitly may encourage members of an organization to participate unconditionally in the research as well as in their own knowledge processes.

The last ingredient for the redesign would incorporate an exploration of the use of alternative clocks and concepts of time. During the research, it was evident that not all members of the organization saw the need for participation in knowledge processes for technology assimilation. This was seen during Phases 2 and 3 by the lack of responses from the organization as a whole. Quite a few people responding did not

feel threatened by the system designed for the scenario, because they believed that the cost of the technology would prohibit it from coming to the research site in the near future. Others, responding from different timeframes, saw it as imminent. Alternate concepts of time may be facilitated by initiating focus groups or forums throughout the research process to act as a mechanism for dialogue. For the research reported here, the status of the researcher as a doctoral student precluded the effective use of the focus group as a research instrument. There remains substantial doubt about the effectiveness of focus groups in any organization where they are not fully supported and encouraged by the top administrators in the organization. This presents a dilemma for all research on knowledge processes that attempts to address propositions like: "In a knowledge society, power relationships are trivial."

Alternative concepts of time would require that all information pertaining to the use of the technology, to include future upgrades, costs, reliability, etc., be made available to all members of the organization. With this information available, it would be possible for the researcher to design scenarios that may trigger members of the organization to participate when they see the need, and thus allow them to interact with members of the organization having similar needs. These types of scenarios would have to be distributed throughout the organization on a continuous basis. This type of practice in theory is similar to that seen in the knowledge spiral. A knowledge creating company, as defined by Nonaka and Takeuchi, is one whose members will participate when they know that their contributions are welcome at all levels of the organization and at any time.

Future Directions For the Research

The research generated important findings with respect to exploring knowledge processes for technology assimilation. Future directions for the research are implied by the cybernetic perspective based on a progression from the trivial machine to the observing system (Type III non-trivial machine) and the propositions on cybernetics and social transformation. The focus of future research would be to extend further alternative approaches to research designs when the research questions are of the undecidable type, including new ways for exploring the desirability of the propositions on cybernetics and social transformation.

Cybernetics

Proposition 3. The word 'cybernetics' is used exclusively to indicate a vocabulary for talking, and hence thinking, about the dynamics of relations and behavior.

Cybernetics was originally developed to understand communication between man and machine. This development has evolved over five decades into a vocabulary for describing and explaining computer thought, neural networks, artificial intelligence, and other forms of computer driven application. These applications are objectified by hard, mathematical derivations which are easily shared with others who understand the jargon associated with this field of endeavor. Future research in the field of 'cybernetics' might include the same rigor for understanding how the vocabulary of cybernetics can be used, as described by this proposition, for an observing system. An observing system is unlike a computer system in that it processes all types of knowledge—including hard, quantifiable data and its cousin, tacit knowledge, which has been described as highly subjective and driven by passion. This

type of exploration may result in the development of a new language to focus on dynamics, particularly on circular dynamics.

Proposition 4. The vocabulary of cybernetics is promoted by 'teachers' as offering a framework for exploring strategies for social transformation (including the trivialization of power relationships), such that the exploration becomes wanted.

Future research on this proposition would entail multi-disciplinary 'conversations' among scientists and humanists, offering their understanding of cybernetics to each other as well as the public at large. The interest here is in facilitating participation in, and provoking thinking on, the social processes from which these and other ideas emerge.

Society and Power

Proposition 1. In knowledge-creating organizations, power relationships are trivial.

Proposition 2. Organizations possess adequate 'strategies' for trivializing power relationships in the knowledge society.

Participants in the research believed that power was used to manipulate the environment in which technology was being introduced. They also believed that current power structures would not support the exponential growth of technology in the future. One participant suggested that members of the organization form steering committees to 'manage' the use of technology by acting as a sounding board for members of the organization experiencing the effects of technology. This participant saw only one drawback to this approach and that was the difficulty in being able to guarantee unconditional participation from all members in the process. Future areas of

research for these propositions would explore adequate strategies for trivializing power relationships at the individual, organization and societal levels.

Knowledge Processes

Proposition 12. Participation in knowledge processes is encouraged at three (at least) different levels: the technical or operational level of the individual, the organizational or policy level, and the societal level, where it is recognized that these levels represent distinct logical domains.

Proposition 13. It is widely recognized that knowledge processes critical for social transformation occur between logical domains, and that participation in these processes requires a sensitivity to emotionality and the admissibility of alternate concepts of time.

Proposition 14. Artistic endeavor is accepted as an appropriate and desirable mode of participation in knowledge processes and is recognized as offering an exploration of new logics of emotion and time.

Unconditional participation in knowledge processes requires that power relationships be trivialized. The desirability seen in these propositions begins with developing knowledge processes at all levels of the organization. Strategies to move toward the truthfulness of these propositions involve exploring a methodology through which organizational personnel can participate unconditionally and at all levels.

Dialogic Process

Proposition 15. Dialogic process is used to create new action patterns and relationships by a mutual desire to share information based on experience and expertise in such a way as to move toward a synchronicity. In this process, the creation, transformation, maintenance, and dissolution of distinctions occur. Such distinctions are the substance of knowledge.

Dialogue in current organizations exists to pass information from one level to the next, and vice versa. In this process, as described by Argyris, superiors and subordinates naturally progress to set roles in which the information they share is incomplete and conforms to the type of information each respective role is supposed to have. The desirability of dialogic process is in its ability to create new action patterns and relationships. One participant in the research believed that the researcher was the 'vehicle' for the dialogic process, and that, fortunately, the thoughts and perceptions of this participant were made available for others by the researcher. Future research in this area would include a strategy in which the concept of a dialogic process becomes the responsibility of every member of the organization, as opposed to one person. Dialogue and its role in knowledge processes thrives on these contributions.

Social Transformation

Proposition 5. Social transformation is seen as distinct from continuous improvement, and as desirable.

Proposition 6. Social transformation is recognized as a process of (1) changing thinking and (2) transforming history.

Proposition 7. The history of social transformation is a history of participation, not a history of celebrity.

Proposition 8. It is widely accepted that participation in social transformation can occur through (1) the identification of a logical anomaly, (2) the creation of a provocation or perturbation around that anomaly (a pivot), and (3) the recognition and avoidance of undesirable consequences resulting from the dynamics triggered by that perturbation.

Proposition 9. Every individual, having the potential to participate in such a process, is given access to all knowledge in order to work collectively to increase alternatives and decrease power relationships.

Proposition 10. In the knowledge society, social transformation occurs as a non-violent activity.

Proposition 11. The perturbations in cybernetics (as in teaching) are made in love and with an attention to time.

Future research approaches for exploring these propositions for social transformation, and their desirability, presents a challenge for traditional research processes. These approaches might include the approach this dissertation has taken, namely propositions in the form of false statements which if true would be desirable. Other approaches need to be identified as well.

Conclusion

The purpose of the research was to explore knowledge processes for technology assimilation. The goal of the research was to provide a description of the different levels of knowledge members of an organization could generate as a result of their participation. Participation, like knowledge processes, must be encouraged at all levels of the organization through dialogue, where the creation of new action patterns and the mutual desire to share them provides the basis for social transformation.

The propositions on cybernetics and social transformation were introduced as false statements in order to provide a basis for moving toward a synchronicity that would render them true, or transform them. This synchronicity is seen as a transformation marked by Heinz von Foerster's distinction between trivial and non-trivial machines. Current constructs supporting the trivial and non-trivial machine

(Types I and II) are not by themselves sufficient to support knowledge processes for social transformation.

The introduction of the 'observing system' (Type III non-trivial machine) provides a construct that permits unconditional participation from those who choose to embrace its concept. This non-trivial machine would possess adequate strategies for trivializing power relationships when the propositions outlined in the research are true. Future directions for this type of research are based on the desirability of moving toward a synchronization that will render the propositions on social transformation true and desirable, and transform them in the process.

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APPENDIX 1

SCENARIO/ SURVEY

The results of the interviews conducted in Phase I generated the Scenario/Survey entitled "Technology in the Organization." This scenario/survey provided a description of the project, its premise, a scenario of future technologies and a questionnaire.

Appendix 1 (Con't)

Technology in the Organization

I. DESCRIPTION OF PROJECT

The goal of this project is to develop a framework for social transformation by identifying different levels of knowledge as generated during the transfer of new technologies. These knowledge processes are intended to facilitate dialogue between or among members of the organization who experience directly or indirectly these new technologies.

II. PREMISE

There is a need to make centrally available the experience and expertise of those involved in and affected by the transfer of technology. This statement suggests that the dissemination of information resulting from this centralization must be included within a knowledge process so that members of the organization can better interpret their roles in the transfer of technology and also understand the immediate and long term effects of the technology itself. This project explores the notion of technology assimilation, which, when carried out, generates a knowledge process. This knowledge process then addresses the issues surrounding the actual decisions, behaviors and privately expressed attitudes toward technology and its role in the organizational social structure.*

SCENARIO: THE IDEAL CLASSROOM

Technology in the classroom is used to enhance the learning experience for the instructor and student. Instructors have used videos, static illustrations and live experiments to help their students visualize new concepts. Several advantages are associated with using classroom technology, including teleconferencing with area specialists, manufacturing simulations, performing artists and on-line personal computing for problem solving and desktop publishing. Since new technology in higher education has proved itself as 'necessary' for the student and instructor, system designers have been working to create a 'virtual' classroom in which all of these tools, including holographic imaging, are standard in 'on-campus' and 'distant-site' classrooms. The illustrations on the following page represent an 'ideal' classroom. The instructor console in Figure 1 is equipped to support all aspects of a virtual classroom including connections (voice, data and imagery) to individual personal computers used by students and a multi-media technician. Figure 2 portrays a normal classroom with students equipped with laptop computers and telephone headsets--enabling the students to 'side-bar' with instructors, other students, or guest lecturers, and to participate real-time in exercises involving data manipulation.

This type of classroom will provide uniform learning experiences for students as well as an equal availability of technical services to all faculty and staff. Instructors will have the opportunity to see all students and interact with them whether they are on campus or at a distant site. Students will also be able to familiarize themselves with other class members in person or via videoconferencing. The goals of this technology are to provide students with equal learning experiences and to provide instructors and students with state of the art resources for education and research.

This technology will be commonplace within five years. Prototypes of this virtual classroom will be used in state funded institutions, where traditional 'on-campus' and 'distant-site' classrooms are already successfully functioning. Information is needed from faculty and staff members who will be affected by this technology so that the transition is smooth and uninterrupted.

This description of a 'virtual' classroom and the following questionnaire (page 3) were designed to solicit information and opinions on how technology is assimilated into the social components of the organization. The results and analysis of the information will become a significant part of a Ph.D. dissertation in Engineering Management at Old Dominion University. If you wish to contact me for a personal interview or participate in a focus group concerning this project please, call me at x4161. Your cooperation is greatly appreciated.

Rochelle Young

*Please contact Rochelle Young, at 683-4161 or by email: rky100z@barbados.cc.odu.edu, if you have any questions.

Appendix 1 (Con't)

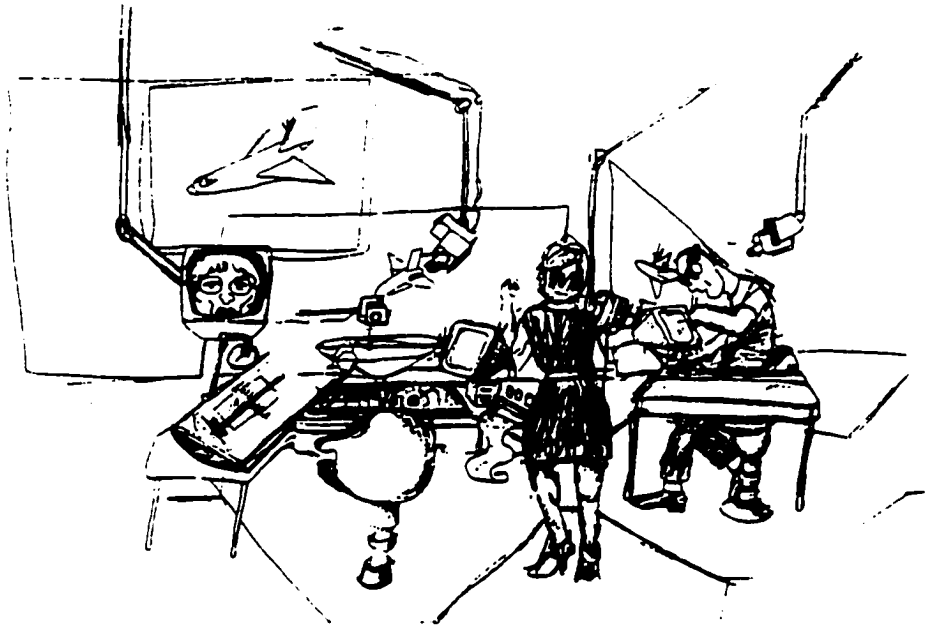


Figure 1

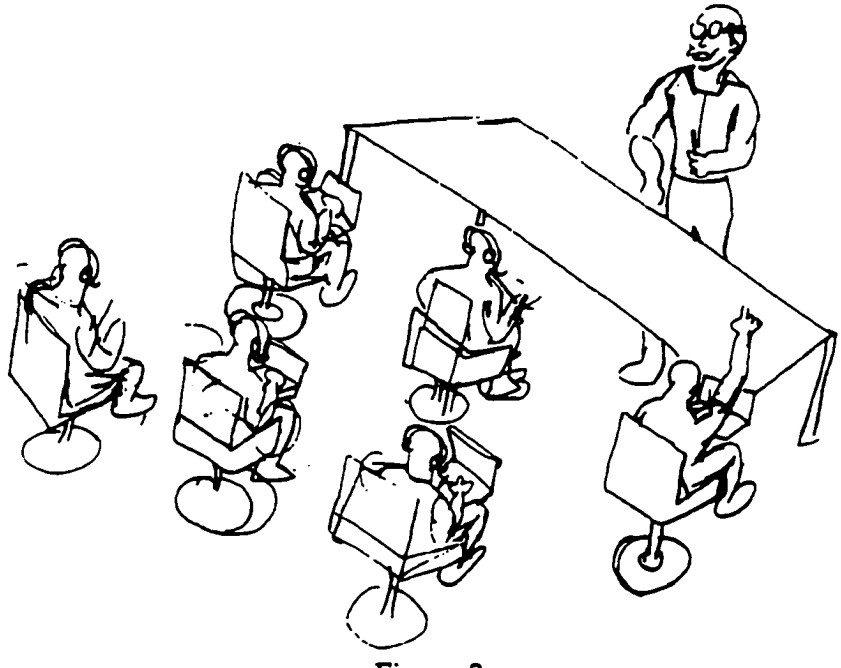


Figure 2

2

Appendix 1 (Con't)

QUESTIONNAIRE: YOU MAY ATTACH ADDITIONAL PAGES FOR YOUR RESPONSES.

SECTION 1: GENERAL RESPONSE TO SCENARIO

1. Given the above scenario, do you believe that this type of technology will become commonplace in the classroom?

2. How do think your experience in the learning process will help or hurt your performance in a classroom setting such as this?

3. How will using this technology help or hurt your efforts in delivering up-to-date course material in your area of specialty?

4. What 'features' would you like to see in this virtual classroom?

SECTION 2: ROLES AND PERCEPTIONS.

1. What would you like to know from others (faculty, administration, students, etc.) regarding this scenario?

2. What do you think people in roles other than your own would say about this scenario?

3. What impact, if any, would this type of scenario have on your role in the educational/learning experience?

Appendix 1 (Con't)

SECTION 3. ROLE OF KNOWLEDGE PROCESSES. *A Knowledge Process is driven by dialogue and maybe facilitated through a device such as a newsletter, a 'private room' (on-line) or a forum to move toward understanding and resolving issues concerning technology transfer.*

1. Would you be interested in hearing about other's responses to this scenario?

2. What suggestions do you have in making other's views available for discussion?

3. Would you participate in a knowledge process (in confidence or otherwise) with the understanding that your contributions are welcome at all levels of your institution and would in no way subject you to punitive recourse?

4. How do you think participation in such a Knowledge Process could be encouraged?

5. LAST THOUGHT. This questionnaire is being distributed to explore the possibilities for assimilating new technology into any organization in which human beings have a role. I understand that some of you who will receive this will be cynical both to the technologies and to the possibility of serious participation in a Knowledge Process. To those of you in this category, any thoughts you may have in this respect would also be greatly appreciated.

Which of the following *best* describes your current position (Check one)?

- ☐ Educational Administrator
- ☐ Instructional Faculty
- ☐ Instructional Support Staff
- ☐ Student

Return your responses to Rochelle Young, ODU, Department of Engineering Management, 43rd Street Modular, by November 15, 1995.

APPENDIX 2

DIALOGIC VEHICLE

Responses from the Scenario/Survey in Phase 2 were summarized to generate a newsletter entitled *The Results.* This newsletter highlighted the concerns of those who participated.

Appendix 2 (Con't)

Fall '95 Volume 1.1

The Results

Recently, a survey entitled *Technology in the Organization*, was used to explore Knowledge Processes for Technology Assimilation. This Newsletter summarizes your opinions with respect to the 'Virtual Classroom.'

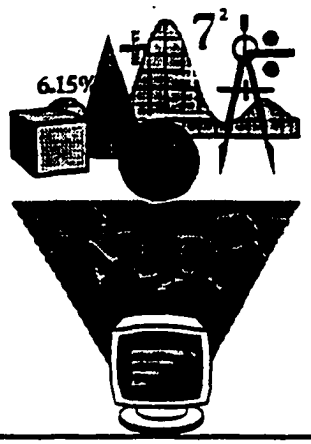
Virtual is In!

But several issues were raised concerning this scenario. Most of those responding to the survey thought that this type of classroom will be commonplace sometime in the future. Some mentioned funding as a constraint, as well as the rate of technological change, building and facility limitations, and instructor training--all of which may prohibit the 'ideal' classroom from making center stage in the next five years.

The classroom as a whole was seen as too much for some and appropriate for others only for certain types of learning. Some would like to see *answer pads* for 'real-time' problem solving exercises. In addition to answer pads, large screen monitors and multi-media access are believed to be vital for this type of learning. The overwhelming majority of respondents felt that this classroom should be equipped with technical support sufficient to ensure that the equipment ran in accordance with specs and with no breakdowns, ever. Also mentioned was the need for functional heating and air-conditioning facilities for the equipment and also for those who must work in this type of environment. Finally, some expressed the opinion that this classroom is already here and may be seen as our own TELETECHNET.

Experience counts and is seen as a must for those making a transition into this type of setting. Those responding to the survey believed that their experience with computers, software packages and teaching will help them in this classroom. Their biggest concerns can be categorized into three levels of interaction:

1. Interaction with students.
2. Interaction with technology.
3. Interaction with the organization.



Experience Counts

Interaction with students.

The issue of dialogic presentations versus material presentations was of great concern. Would it be possible to continue with a dialogic format in this type of setting, or will this technology make small class discussions obsolete? One person suggested that education is not solely about presenting hard, concrete facts to students. The essence of education is learning how to think and learning how to communicate. Is it possible that instructors will spend most of their time preparing lessons that will omit the students' research responsibilities, so that all material needed is presented in class and there is little or no need for searching other sources outside of the class? Responses also indicated that the 'visual' aspect of the technology might allow for more thinking and interaction among the students, but this interaction may not include the instructor.

Another issue with this level of interaction is whether or not it is important for the instructor to see the student, because this visual contact may hinder the learning processes. Is it possible that instructors may want to see students so that they may evaluate them based on non-verbal factors, which may include age, race, and/or gender?

Interaction with technology.

"If we don't adapt to fit the advancing technology we will become obsolete, and things are moving fast."

The technology provides new ways of testing students and faculty with the learning process. Responses suggested that the focus (at least at first) will be on how well the instructor uses the equipment or whether or not it is used at all. Some even believed that they would have no place in this type of setting because their focus would still be on motivating students to think and communicate their thoughts as opposed to becoming a 'star' performer in this type of setting. Other concerns at this level of interaction focused on the amount of time needed to prepare a lecture for a 'virtual classroom.' Time constraints were also linked to the need for up-to-date materials (videos, demonstrations, etc.) that may be used for lecturing purposes. It was suggested that establishing a Technical Facility to house current videos, references and demonstrations (in virtual format) would ease the tension for instructors teaching in this environment. Interacting with this technology might be made simple if learning how to use one piece of equipment would guarantee being able to use all other pieces of equipment in the classroom.

Interaction with the organization.

In addition to learning how to use new equipment and how to interact with students both locally and at distant sites, some respondents questioned whether or not there is anything left in it for them as individuals. The use of technology raises another question of how to compensate or reward instructors for providing lectures in this setting. A senior faculty member mentioned that the burden will fall on junior, untenured faculty. They will not only have to adapt to university life and standard criteria for tenure (publications and funded

Appendix 2 (Con't)

research), but also to the changing technology used for distant education. It was mentioned that this type of setting would hurt one's overall performance, because there are other issues pertinent to achieving tenure that must be focused on. Interaction with the organization includes other compensations such as monetary rewards, semesters off to prepare new courses, and the hope of achieving something other than technical efficiency.

What Do the Others Think?

Finding out what others are thinking was important to the respondents. For example, is it possible for this technology to be so advanced that some would see it as barbaric and backward? Still others suggested that people in roles other than their own would feel threatened, afraid, disappointed and unwanted. Quite a few believed that this technology would also be welcomed by technology enthusiasts. Whether or not some would be excited or disappointed leads to the issue of 'control.' A few responses suggested that this new technology will assist in controlling faculty behavior in and out of the classroom--monitoring the amount of time an instructor spends on lectures, homework, discussions, etc.--viewing them at any location around the campus or the state. Is it possible that this technology will allow every individual student to have an identical educational experience, and, at the same time, control their own learning processes?

Many respondents wanted to hear from others in different roles than their own. Here are a few responses:

For Administrators

- Will dialogue in the learning process be abandoned?
- Is there a place where one could observe the application of this technology?
- How much time will be given to adjust to this type of learning process and is there an understanding that additional preparation time and resources will be necessary?
- Cost?

For Faculty

- What do faculty think about the abandonment of dialogic-based education (approve or disapprove)?
- How will interactions between student-faculty and student-student be affected?
- How will faculty members delegate responsibility in their classrooms to support such technology?

For Students

- What form of learning is most valuable (dialogue/discussion-based or material presentation)?
- Will the effort be made to contact/interact with other students both at distant and local sites; and for which of the two will the effort be greater?

Impact on Education

Some believe that introducing new technology into education will require re-engineering and re-structuring of the educational process. The goal of this re-engineering would be to open channels for those at all levels having 'knowledge' to participate creatively in major decisions concerning education and technology. Others believe that their roles as educators will be changed to that of facilitators, with only a few faculty becoming 'stars.' The increase of technology knowledge may prove to be interesting and time consuming. Still, certain basic components of education would have to be provided.

The need for instructor training was addressed in the majority of respondents. First, training will be needed at various stages until implementation takes place--and then to keep instructors current. Second, training at an individual level is possible and requires flexibility among those in the training process. Finally, training itself will have to be redefined to meet the needs of the technology itself.

Participating in Decisions

Knowing about others' views was important to most respondents. The reasons for wanting to know included 'seeing how others were thinking.' The media suggested for making others' responses available included newsletters, e-mail, news groups (Internet), memos, demonstrations, and the like. Some felt that participating fully and truthfully in such decisions could result in some faculty members losing their jobs. Still others responded with the "why bother" attitude, indicating skepticism with respect to any difference their participation would make, while a few thought that managing change of this magnitude requires strong leadership from the top. Finally, one person felt that exposing the differences between the current and virtual environments may prove to be a welcomed form of participation in the long run.

Some Cynicism

Administrators

- "As long as university decision processes remain structured as they are, there is little chance that faculty or student participation in decisions of the magnitude of the 'virtual classroom' will make any difference. The bureaucratic form of organization works to squelch opinion as it works its way to the top. It is much more likely that we will make a difference by participating in the society wide debate through conferences and publications."

Faculty

- "I am not in this category but appreciate your solicitation of my views."
- "Only skeptical that serious understanding will be given to upkeep and support staff--teachers are not techno-wizards."
- "Good luck--class set techno features would be cool as it gets--but developing 30+ a semester for a given class would be murderous."
- "I am interested in your reference to the 'multi-media' technician; is this for each classroom?"
- "My cynicism comes from the inability (or lack of caring) to provide the basics to the present classrooms. A classroom compounded by sophisticated electro-mechanical devices is a nightmare."

Student

- "I am cynical because many students here don't care about learning and I would hate to see them rewarded with technologies. Encourage the motivated by rewarding their efforts."

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[1]Schwartz, Rachel A., The Virtual University, *ASEE Prism*, December 1995.

This newsletter is part of a research project on participation in organizational knowledge processes. The examination of educational technology into a university is recognized as a controversial matter, and the responses reported here support that. I am particularly interested in organization-wide sharing of perceptions, ideas, and opinions that could contribute to the decision making process with respect to how this technology is implemented. In particular, I would like to solicit suggestions for ways to implement the technology in such a way as to enhance the educational experience and to expand the participation of all stakeholders (students, faculty, admin, etc.) in these decisions concerning implementation.

Please send your thoughts to: **Rochelle Young**
Dept of EMMA, 43rd Street Modular or <rky100z@barbados.cc.odu.edu> by January 12, 1996.

Thank-you.

Rochelle Young

BIOGRAPHY

Miss Rochelle K. Young is a Presidential Fellow in the Department of Engineering Management at Old Dominion University in Norfolk, Virginia. She was born in Pittsburgh, Pennsylvania, on October 20, 1961. She has a Bachelor of Science degree in Microbiology from the University of Georgia, in Athens, and a Master of Science degree in Management from Colorado Technical University in Colorado Springs. Miss Young was previously employed by the United States Air Force where she attained the rank of Captain. She served as a Communications Officer for Headquarters Space Communications Division, Instructor at the United States Air Force Academy and Software Engineer at Headquarters Air Combat Command. Her research interests are in knowledge processes, technology assimilation, high performance teams, and organizing for innovation.