Sociological implications of technology: The historical treatment of technology in sociological theory and a proposal for empirical research

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SOCIOLOGICAL IMPLICATIONS OF TECHNOLOGY:
THE HISTORICAL TREATMENT OF TECHNOLOGY IN SOCIOLOGICAL
THEORY AND A PROPOSAL FOR EMPIRICAL RESEARCH

An Abstract of a Thesis
Submitted
In Partial Fulfillment
of the Requirements for the Degree
Master of Arts

Martin E. Hansen
University of Northern Iowa
May 1991
ABSTRACT

Technology, as a form of knowledge, can be an important explanatory variable in empirical sociological investigations. In this thesis the macro-historical concept of technology within the discipline of sociology is traced and critiqued, with special attention given to analytical misconceptions and reifications, e.g., confusing technology with its processes, products, and social consequences. An analytical model is initially presented which attempts to facilitate a better understanding of the dialectical interrelationships between technological, social, and natural (scientific) phenomena. Recent attempts to measure the effects of technology on social relationships are critiqued, particularly in their inadequate conceptualization and operationalization, confusion of cause and effect, lack of generalizability, and failure to empirically address technology's explanatory power. It is hypothesized that by knowing whether a person reifies technology (i.e., views it as an external autonomous force instead of a humanly constructed and maintained body of knowledge) one can more accurately predict whether a person finds technology uncontrollable or problematic throughout various dimensions of his or her social and psychological experience. Finally, a proposal for research is presented which could be used to empirically test this hypothesis based on statistical analyses of data obtained from a national random-sample mail survey.
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INTRODUCTION AND PROBLEM STATEMENT

Background Information

Technology permeates every aspect of our lives but is often misunderstood, taken-for-granted, or else goes relatively unnoticed. When technology becomes the subject of discourse we typically hear statements such as "technology is the answer to all our problems" or, on the other hand, that technology is the ultimate "source of all our problems." Jay Weinstein, one of the few academicians addressing the specific interrelationships of technological and sociological knowledge, asserted that such a dichotomy of opinion has typified attitudes about technology since the advent of modernity and the subsequential birth of the natural and social sciences (Weinstein, 1982). However, both these views (the answer to problems vs. the source of problems) are reifications of the larger social phenomenon of technology.

"Technology" is best defined as follows:

[The term] technology refers primarily to a system of knowledge intended to have practical bearing—know-how. It is knowledge designed to extend the capabilities of humans in dealing with their environment, to overcome constitutional and environmental limitations. . . . [In] using technology to refer specifically to a type of knowledge, it can be kept distinct from several closely related [yet different] things to which the term has also been applied: machinery, inventions, techniques [processes], and engineering. (Weinstein, 1982, pp. xi-xii)

As part of a larger social dialectic, technology is first and foremost a form of knowledge, i.e., "know-how." As with other forms of knowledge, technology can become reified (i.e., removed) from its origins as a humanly constructed and maintained body of knowledge and subsequently be seen as a "thing in itself." An example of this reification of technology is the tendency for some writers (e.g. Ogburn & Nimkoff, 1955) to refer to technology solely in the
context of machines and/or processes without taking into account the larger social dialectical process. Within this social dialectic, objectivation can be defined as the process by which people actively create, apply, and manifest (inter)subjective knowledge. Peter Berger and Thomas Luckmann (1967, p. 60) identified three moments in the social dialectic: (a) externalization, or the act of imposing the self on the material world; (b) objectivation, the realization of externalized products, and; (c) internalization, or the socialization of consciousness. Georg Hegel used the term objectification (sometimes translated as objectivation) in much the same way as Berger and Luckmann used externalization, while Karl Marx used the term to refer to a more active manipulation of the social and material world (Ritzer, 1988, p. 49). If objectivation is treated as the interactive social process by which people impose themselves on the world through action and intention, the Marxian sense of the term appears most appropriate for this analysis, (i.e., similar to Berger & Luckmann's externalization, but in a more material, active, and empirical sense). Most often, these objectivations, in the Marxian sense, are social processes with the intent to realize an objective end, product, or human artifact. People, in turn, experience these objects, products, or artifacts as objective reality. This interactive process of human experience will be referred to as subjectivation (i.e., similar to internalization, but also in a more active, empirical sense). Reification occurs when people artificially separate human knowledge from human action, artifacts, and experience. Within this social dialectic, reality is always a dynamic intersubjective phenomenon, with knowledge itself as a foundation. Furthermore, any separation or reification of subject and object is, quite literally, meaningless.
If one accepts the notion that objective reality is an intersubjective phenomenon, the necessity of treating technology as a form of humanly constructed and maintained knowledge then becomes more clear. Through the process of objectivation, technology becomes removed (i.e., reified) from the realm of human construction, maintenance, responsibility, and control. Consequently, its objectivated form(s) can then become subjectivated as an external autonomous force with apparently constraining consequences and effects. Such reification can increase the likelihood that consequences will remain latent, that social and psychological impacts might be perceived as negative, and that people might perceive they have no control over or responsibility for these outcomes. The scope of these consequences, impacts, and their potentials is far-reaching. Mayr suggested:

Technology as a fundamental human activity is intimately related to all other human activities and thus is an integral, indispensable part of all human culture and is not, as one often hears, an alien, inhuman force unleashed upon mankind by some external agent. (Mayr, 1986, p. xv)

What is more significant sociologically is that this relationship can be measured and empirically studied for a better understanding of the interrelationship between technology, society, and social change.

The interactive relationship between technology and all other manifestations of human life and culture can be proven, even interactions as intractable and elusive as that between the political, social, economic, or religious ideas dominant in a given society and contemporary preferences and designs of technological hardware. (Mayr, 1986, p. xv)

For the purposes of sociological explanation, it is especially important to make the distinction between technology as human knowledge and its subsequently reified form(s). With this in mind, a very cautious operationalization of the concept of technology must be undertaken.
It is difficult to discuss technology without also referring to machines, inventions, techniques, and engineering. . . . [In] treating these separately and focusing on technology as a type of knowledge system, it is easier to see and understand the intimate character of the relationship between technology and society. (Weinstein, 1982, p. xii)

The operationalization of the concept of technology still remains problematic. Yet without a better understanding of what technology means, a researcher cannot even formulate meaningful hypotheses. The first step in this understanding is making an analytical distinction between technological knowledge and its potentially reified forms, e.g., technical processes, products, and the human experience of them. Any first-order analysis must hypothesize initial cause and effect relationships when choosing a meaningful and logical independent variable for testing. This requires sorting out temporal moments within the larger social dialectic. In addition, without such an analytical distinction concerning the nature of technology, the realities of multiple causation and mutually contradicting yet reciprocally reinforcing dialectical interrelationships tend to lead the researcher down long and spurious paths. A review of the literature indicates that this distinction is absent or distorted throughout much of the sociological treatment of technology. In order to understand the meaning and significance of technology as an explanatory variable for sociological analyses, a more comprehensive examination of the topic must be undertaken.

Scope of the Problem

Based on the above observations and background information, there appears to be a serious misunderstanding concerning the meaning, application, and significance of technology as a variable in sociological investigations. This mandates a more comprehensive examination of the
history of technology throughout the discipline of sociology. Through such an examination one may develop a more comprehensive understanding of technology as it relates to sociological and scientific phenomena and thought. A better and more comprehensive understanding of technology can and should also provide a theoretical framework upon which to build empirical investigations which better explain human behavior and social phenomena.

The scope of this study is focused on the examination of existing literature in the discipline of sociology, particularly from classical and contemporary sociological theory. In addition to this body of literature, an examination of a few of the popular contemporary empirical analyses utilizing technology as a primary variable will be discussed. Finally, a model which synthesizes the various approaches discussed will be used in the development of a research proposal which better addresses the explanatory power of technology as a variable in sociological analyses.

**Theoretical Assumptions and Clarification of Terms**

This thesis and research proposal will operate under the following assumptions:

1. Knowledge, of which technology is a part, is humanly constructed, defined, and maintained.

2. People have the innate capability and desire to both objectivate (i.e., actively create, apply, manifest) and subjectivate (i.e., experience, interpret, evaluate) knowledge such that the relationship between objective and subjective realities becomes inherently dialectical and indivisible.

3. Reification is the process by which objectivated knowledge is realized in "things." In turn, these things becomes subjectivated as inhuman objects outside of their exclusive objectivated origins and, consequently, outside of
direct human controls. Reification is also (especially) applicable to technology as a form of knowledge.

4. Technology is first and foremost a form of knowledge; in this sense technology is inherently neutral—all value attached to technology is dependent exclusively on the experiential context of its objectivated and potentially reified form(s).

5. Intersubjectively, no such thing as social causation in a strict linear sense can exist. Social phenomena exist (i.e., derive meaning) only in a dialectical relationship to all other phenomena and, for the purposes of sociological explanation, are contingent upon our relative positions, interpretations of, and impositions on and within the larger social-material context.

6. It is also assumed that any larger social reality dialectically encompasses all possible variables within the potentially infinite variety of objective and subjective phenomena. In addition, one must include the complex array of social phenomena involving human action and experience. Thus, any adequate explanatory model must take into account the range, scope, and dialectical interrelationships of this larger reality, including the intersubjective micro and macro social-material context, human action, and human experience.

Given the above analytical assumptions, technology can now be operationalized as follows: An explanatory model using "technological knowledge" as an independent variable must first consider the subjective and objective dimensions of technology, for example, the interrelationships between technological knowledge, technological processes, products, and social consequences. One must then develop indicators from the realm of human
action and experience to facilitate measurement and explanation of the relationships between the phenomena. The more general context of technology places it in a dialectical and macro-historical relationship with other forms of knowledge, most specifically, scientific knowledge and social thought. Historically, these interrelationships have been poorly conceptualized and operationalized. A dialectical model can be constructed to better illustrate these concepts (see Figure 1). Note that the categories as illustrated are neither mutually exclusive nor logically exhaustive of all potential variables in the social-dialectical moment; there is an implicit overlap between and within the component categories of the model.

Figure 1. The Social Dialectic with Technology as a Variable
The model and the assumptions herein draw heavily from dialectic and conflict theory, the sociology of knowledge, and the Critical School of sociology. A social dialectic is illustrated in the model which encompasses the objective and subjective components of social reality. This dichotomy has been well developed throughout the German philosophical tradition, particularly in the works of Kant, Hegel, Marx and, more recently, the attempts of the Critical School. In addition, the model includes the essential human processes of objectivation and subjectivation, i.e., human action and experience. This dichotomy also is part of the German philosophical tradition and has been conceptually addressed by Hegel, Marx, Mannheim, and, more recently, Berger and Luckmann (1967) in their treatise on the sociology of knowledge. The model identifies several overlapping areas of thought, action, structures, and experiences, i.e., technological, sociological, and natural/scientific. It is asserted herein that changes in any one of these areas changes the interrelationships throughout the rest of the model and the nature of the whole itself.

Through the construction of such a model, a more comprehensive analytical reference point upon which to build a better understanding of the complex interrelationships of the social world (in this case, technology as an explanatory variable within the social world) may be facilitated. The model was initially constructed to resolve the several criticisms made herein of the inadequate treatment of technology throughout the history of social thought and to offer a more comprehensive and synthesized analytical alternative. The utility of the model will be further developed and illustrated through the following analysis, critique, and review.
The review of the literature and research proposal operate under the analytical framework and assumptions presented herein, utilizing the model presented in Figure 1, with implicit debt to its exemplars as credited throughout. The purpose of this endeavor then becomes twofold: (a) to apply this model and method of analysis for the purpose of explaining, using technological phenomena as empirical examples, the relationships between subjective knowledge, human action and experience, and the objective world, and (b) to offer a better understanding of the importance of technological knowledge as an explanatory variable in a larger social and scientific milieu.

**Research Questions**

The question posed herein specifically involves the reification of technological knowledge and the consequences of this reification. More specifically, a research proposal is constructed which would test the hypothesis that the reification of technological knowledge results in perceptions that technology is oppressive, autonomous, and uncontrollable. The administration of the study and instrument are described. Various indicators are developed, based on previous research, which address technology as knowledge, process, products, and components of human experience. Attitudinal scales are then developed which utilize these indicators. In addition to measurement of attitudes, experiential and demographic variables are also addressed. Suggestions are made for statistical analyses. It is suggested that through the construction and utilization of the proposed research, it would become more apparent that an analytical distinction must be made between technological knowledge and its reified forms if meaningful sociological explanations are to be pursued.
Technology as an institutionalized concept began to emerge parallel to the scientific and industrial revolutions, generally from the mid-eighteenth to the mid-twentieth centuries (Weinstein, 1982, p. 3). However, technology as a form of knowledge has been a defining part of cultures, societies, and civilizations throughout history. "It is knowledge designed to extend the capabilities of humans in dealing with their environment, to overcome constitutional and environmental limitations" (Weinstein, 1982, p. xi). R. J. Forbes explained:

Man did not seek to understand nature merely to satisfy his curiosity. He had to survive in a strange, hostile world. He had to come to grips with nature using as his main weapon the intellect [i.e. capacity for knowledge] that distinguished him from the animals. The primary thing he had to do was to find and collect food, and food was not always in plentiful supply. All his long life on earth man has had to use his intelligence, to observe nature around him, to remember the facts he perceives, and to try to apply them in a way that will increase his security and comfort. (Forbes, 1958, p. 4)

Forbes thus pointed out the inevitable necessity of constructing and maintaining technological knowledge, but Marx pointed out the necessity of sociologically studying it:

Technology reveals the active relation of man to nature, the direct [dialectical] process of the production of his life, and thereby it also lays bare the process of the production of the social relations of his life, and of the mental conceptions that flow from these relations. (Marx, 1977/1867, p. 493)

Some contemporary sociologists also accorded technology a central role in social development and "sociocultural evolution." One of those is Gerhard Lenski.
We reviewed the basic trends in human societies to determine what type of cultural information has been most important in sociocultural evolution. The answer is clear. Technological information [i.e. knowledge]—information about the utilization of the material resources of the environment to satisfy human needs—has been far more important than any other in shaping the most basic processes of development and change in human societies. Had there been no technological innovations during the last 10,000 years, all societies would be small, nomadic populations of hunters and gatherers, living much the way our Stone Age ancestors did. Instead technological advance has propelled us rapidly (by evolutionary standards) from Stone Age to Atomic Age. Thus we must define sociocultural evolution as the process of development and change that results from the acquisition and use of new cultural information, especially technological information. (Lenski & Lenski, 1978, p. 67)

Having identified the necessity of treating technology as a body of knowledge, and subsequently, having laid out the sociological necessity of studying technology as such, we now turn to a historical-comparative analysis of technology and sociology within the history of social thought.

**Technology and Sociology in Early Great Britain**

During the late seventeenth and early eighteenth centuries there occurred drastic social, scientific, and material changes which were conducive to the development of an institutionalized concept of technology, but such a conceptualization of technology was not yet separate nor distinct from scientific and social philosophy. These changes most significantly included social and economic development combined with a transformation in thought from fatalism to positivism (Weinstein, 1982). At that time scientific and technological knowledge were not considered as separate fields of human knowledge and endeavor. Many of the enlightened philosophers were also scientists, inventors, and social innovators (Jeremy Bentham, Condorcet, Ben Franklin, Adam Smith, Auguste Comte, etc.).
This new conception of development allowed the amateur intellectuals of the Enlightenment to view man as an active and effective agent of change, and encouraged people to seek to understand and improve upon the remarkable transformations taking place around them. For many, this search led to inventions of new machines and processes. For others, it led to inventions of social systems, new constitutions, and the formulation of theories whereby social systems and constitutions could be studied and changed. For most, this search led to an intense interest in both machines and social innovation. (Weinstein, 1982, p. 8)

Social philosophy and social innovation during the post-enlightenment time period went hand in hand with scientific and technological innovation. During this time period there was also a realization that these areas of thought were indelibly intertwined, i.e., changes in one area might and often did precipitate change in another. Literature after this time period tended to treat the areas of social, scientific, and technological innovation as separate and discrete bodies of knowledge. A similar developmental path occurred in early post-enlightenment France.

**Sociology and Technology in Early France**

Early post-enlightenment France was considered the intellectual center of Europe. However, while England experienced the "industrial" side of the "twin revolutions," the driving intellectual force in France was "political" revolution and order as opposed to "industrial" in England.

In part because of the country's lack of economic development and its sudden rise to prominence in intellectual realms, the key social and technological issues of revolutionary France were not directly related to industrialization; by the late eighteenth century, it was no longer meaningful to ask if the country should industrialize but only how to do so and how to deal with related social impacts... [The] revolutionary era that extended from before 1789 to about 1830 was a struggle not to initiate but to institutionalize development, and thus establish a place in the social order for technology and social science. (Weinstein, 1982, p. 14)
The early French enlightened philosophy of Descartes, Pascal, Bayle, Voltaire, Montesquieu, Condorcet, Turgot, and Rousseau, along with the British political philosophy and positivism of Thomas Hobbes, John Locke, Adam Ferguson, and Adam Smith dominated the intellectual atmosphere of early France. This was the intellectual context which served as the foundation for the philosophy of sociology's "grandfather," Saint-Simon (Ashley & Orenstein, 1985; Bronowski & Mazlish, 1960; Weinstein, 1982). Saint-Simon, as the mentor of sociology's "founding father," Auguste Comte, began a project intended to "employ science and technology to reorganize postrevolutionary France" (Weinstein, 1982, p. 14).

Saint-Simon's main idea was that industrialism was a new era in history. Progress was not a matter of science alone, but affected all the conditions of life. This new society, growing out of a declining feudalism, would provide the basis for solving all the old problems. Saint-Simon was the first to discern the new order emerging, and he took on the role of prophet concerning how it should operate. (Collins & Makowsky, 1984, p. 23)

Saint-Simon realized that scientific knowledge, technology, and social thought were all complexly intertwined. He proposed the reconstruction of society based on scientific and technological knowledge. In reality, he proposed a technocratic meritocracy.

What Saint-Simon developed turned out to be the characteristic ideology of industrialism. It is found all over the world today, among the technocrats of the modern French state, in the British civil service, and in the great American bureaucracies from the universities to the RAND Corporation. It is a belief that progress is based on science and that new societies are created out of the old (in the developing nations as well as the more advanced countries of the East and West), without revolution or conflict, simply by putting the scientists and industrialists in charge. (Collins & Makowsky, 1984, p. 25)
Saint-Simon saw science and technology (then an undifferentiated body of knowledge) as the "answer to all problems." The concept was undoubtedly value-laden. Saint-Simon, in the context of postrevolutionary France, saw a dire need for a more stable and directed reorganization of society based on positivistic empirical knowledge and immutable scientific laws.

Saint-Simon envisioned a highly socialized economic order, democratically [technocratically] governed—politically and morally—by men of learning dedicated to positivist principles. This system, while ancient in concept, is one of the first modern models of technocracy, government by scientists and engineers. With it, the pursuit of social and nonsocial science was linked to the application of technology for the improvement of [human conditions]. This doctrine was issued in response to the unprecedented development then occurring. It was meant to provide a structure for making progress in the economy, science, and technology a regular part of the ongoing business of the state. (Weinstein, 1982, p. 15)

Comte followed in Saint-Simon's footsteps. However, "Saint-Simon was a thoroughgoing atheist [sic] and materialist, a believer in science and industry, whereas Comte felt that society could not be held together by reason alone, but demanded faith" (Collins & Makowsky, 1984, p. 28). Comte tended to focus more on the ideational side of social evolution while Saint-Simon was concerned with more substantive means and ends. Even so, Saint-Simon did not tend to reify the concepts of scientific and technological knowledge, though these concepts were distorted by various social values and political motives inherent in the context in which he lived. "Comte's approach sought to view truth itself as an appropriate object of scientific study, subject to the same causes and conditions that affect any other aspect of human behavior" (Weinstein, 1982, p. 15). Comte's answer to the material and ideational contradictions of that socio-historical context was to formulate a new institutionalized discipline which he called "social physics," later changed to
sociology. However, being born out of the "twin revolutions" (i.e. industrial and political),

[the field of sociology] was formulated not merely as a formal discipline whose own development was foremost (although Saint-Simon, Comte, and the others appreciated the purer orientation in science), but as a knowledge system inextricably tied to technology and government. (Weinstein, 1982, p. 17)

In France the concepts of sociology, science, and technology became institutionalized; however, they became institutionalized as separate bodies of knowledge within the French university system. Science as an institutionalized form of knowledge began to isolate its premises and exemplars into the disciplines of the natural sciences, e.g. astronomy, physics, biology, anatomy, etc. Technology became the object and subject of engineering and, in its emerging reified form, also became the defining basis and central means of a growing industrial social-political-economic base. Sociology, on the other hand, was tied to "education" in general, and at the hands of Emile Durkheim, became an intellectualized, institutionalized, and separate body of knowledge in itself. Thus, in France, as well as in Great Britain, science, technology, and [industrial] society were the central (yet increasingly separate) themes of social thought, and technology often became understood as either the "answer to all our problems" or as the "source of all our problems."

Clearly, the segmentation and institutionalization of knowledge into artificially exclusive disciplines would have latent consequences for the further development of social, scientific, and technological thought. Once the bodies of knowledge now called science, technology, and sociology were separated and institutionalized, it follows that the "substance" of the knowledge also would become more reified—i.e. astronomy "became" stars and planets; anatomy
became organs and tissue; society became institutions such as the family or church, with "social facts" such as norms, laws, and collectivities, and technology became machines, inventions, and revolutionary products and processes, all apparently independent of the knowledge by which they are objectivated and understood. The institutionalization and segmentation of knowledge separated the object of knowledge from the subject, both within and between the disciplines of concern herein. This rationalization and bureaucratization of knowledge, particularly in the fields of science, technology, and society, is a central theme (and proposition) around which this thesis revolves, as well having been a primary theme at the other emerging geographic center of European social thought: Germany.

Sociology and Technology in Early Germany

Social thought in 19th century Germany was inspired by 300 years of the Western intellectual tradition flourishing in Western Europe.

The ideas of the French Revolution were influential; the English Utilitarians were working out a reasoned system, and the American thinkers had actually had the chance to begin a new society. At the same time, the small German states reentered the intellectual ferment of the West, which Martin Luther had once so strongly provoked; and their contribution had a subtle influence on the course of history. (Bronowski & Mazlish, 1960, p. 472)

In Germany, as in France and England, sociological, scientific, and technological knowledge were not initially separate and distinct bodies of knowledge. In Germany, the intellectual revolution was ignited by the classic poets, of whom Johann Wolfgang von Goethe was the most renowned and influential.

Goethe was a scientist as well as a poet, and a highly individual scientist. He was interested particularly in the growth and form of plants, in which (like Erasmus Darwin in England) he sensed the underlying unity in the
development of nature which Charles Darwin later expressed in the theory of evolution. Goethe also rediscovered the Renaissance and the antiquities of Rome; he was a successful public servant, particularly in education; and his wide and vivid interests fired the minds of men far beyond Germany. (Bronowski & Mazlish, 1960, p. 472)

Science and technology in early Germany were thought of as ways of understanding nature, the environment, and the natural (dialectical) interrelationship of humans and nature. Thus, in Germany, as well as in France and England,

[philosophy and social thought were] an attempt to find foundations for the new science [in fact, science was a natural outgrowth of philosophy], and many philosophers were scientists. Kant was among these, and his philosophy was such an attempt to close a gap in the foundations of science which had been opened unexpectedly in his boyhood. (Bronowski & Mazlish, 1960, p. 473)

Kant argued that science, as subject and object (which also subsumes technology), was dialectically inseparable from both experience and a priori knowledge.

Hume had shown that there is no empirical evidence for causality; and Kant concluded from this that empiricism is not enough, and that nature can only be understood if we see that under empirical experience lies a framework of a priori knowledge. . . . [Some] knowledge must be a priori to make empirical science possible at all. (Bronowski & Mazlish, 1960, p. 477)

Kant pointed out that people are simultaneously both objects and subjects of nature, and that to change either inevitably changes the other. "Kant had given a new sense of dignity to men, in which the limitations of nature were not obstacles but the natural conditions for human freedom" (Bronowski & Mazlish, 1960, p. 479). In Kant's time, understanding nature (and its limits) was the aim of scientific knowledge; technology, as a part of scientific knowledge, was the mechanism by which the limitations of nature were continually redefined and
refined. Only through creative action, experience, and understanding could an empirical reality (and empirical knowledge) become possible.

We can postulate the real world only because we know it, and the part that our senses play has to be analyzed with care. Man is not simply a passive receiver on whom the outside world prints a set of impressions. The knower and what he knows influence one another; what is known is in part imposed by the knower; so that the knower is active, is creative [emphasis added], and thereby becomes what Kant called a self or ego.

(Bronowski & Mazlish, 1960, p. 483)

People create the world by objectivating knowledge. This, in turn, and simultaneously, is experienced (subjectivated) by the observer, expanding and recreating the knowledge by which the objectivation is maintained and realized. These ideas would later be picked up by Hegel and Marx.

With Hegel, one sees philosophy and social thought start to become removed from active scientific objectivation and experience. Hegel was not a scientist and innovator, at least in the sense that many of the great thinkers of France and England were. Hegel was an academician, and from the age of five he pursued the world of the classics and the philosophy of early French, English, and German writers as opposed to tinkering with the "nuts and bolts" of the empirical world. Hegel, as opposed to Kant, saw knowledge (Weltgeist), or "reason," as the "given" in society, and man's primary objective was simply to realize the nature of consciousness itself. Moreover, Hegel asserted that knowledge and subject, apparently even in the absence of the object, could change the nature of reality.

Thus, before Marx was born, Hegel had concluded that the whole point of philosophy—or of any kind of social theorizing—was to change the world. As far as he was concerned, however, merely to understand the world in new ways and in a new form is already to have changed it.

(Ashley & Orenstein, 1985, p. 129)
In terms of science and technology, Hegel questioned the impacts of technology and the "new science" much as other enlightened philosophers did. The trend in modern societies, according to Hegel, was the separation of the subject from the "whole" or "totality" of universal reason (i.e. reality; existence).

Hegel believed that human society becomes most reasonable and most just when social institutions do not divide and fragment subjects who subsequently must experience [realize] themselves as incomplete. . . . Factory workers might have total control over some small part of the environment through the use of technology. By objectifying themselves as cogs in an impersonal system of production, however, they lose sight of the ends of human striving [i.e. the attainment of pure self-reflexive reason]. The modern organization of work is often too complex and the involvement of the individual worker too specific for workers to be able to see themselves as expressing the totality of anything humanly produced. Thus modern workers are likely to experience themselves as the expression of something that is alien to them. (Ashley & Orenstein, 1985, p. 131)

Hegel saw "primitive" societies and human beings as being incapable of attaining pure reason. However, the other side of the situation is that "Unlike the modern, private individual, the primitive human being does not suffer from the sense of being excluded from the totality of human experience" (Ashley & Orenstein, 1985, p. 131). Hegel posited that pure reason could be attained only through the realization of a sense of community and the self as a part of it. The idea of the autonomous self, or any individually constructed reality, was artificial.

Hegel pointed out that the essence, or nature, of a person's thought lies beyond that particular person; hence the reflective experience of oneself as a particular kind of social object is a product of a social whole, not a product of the individual. (Ashley & Orenstein, 1985, p. 134)

Here is where Hegel's idealist philosophy loses its utility in explaining scientific and technological knowledge. Pure reason, or any implication of an inherent
"order" in objective and/or subjective reality, is the very essence of science as a body of knowledge. However, in true dialectical form, scientific knowledge only derives human meaning from its objective manifestations. Technology is understood as knowledge only in relation to its potentially reified forms. Hegel tried to circumvent this sophist's trap by asserting that the "external" world was both objective and subjective. In addition,

[Hegel] denied that there is any thing-in-itself. To Hegel, there is no reality until we know it. We exist by virtue of knowing the outside world—but the world also exists only [emphasis added] by virtue of our knowing it. "The real is the rational and the rational is real," [said Hegel]. (Bronowski & Mazlish, 1960, p. 483)

Hegel's dialectic was decidedly teleological. It assumed some end-state of pure reason, and then explained knowledge and (removed it from) action by way of a rational, reflexive, means to this somewhat metaphysical end. It tried to rationalize away non-rational action, and teleologically, confused the non-rational (absence of means-ends calculations) with the irrational (means-ends calculations which are not complementary). It reified knowledge as an end-in-itself and ignored the (more sociologically important) process of world-building and social construction, which would later become the foundation for Marx's dialectic. More significantly, the true "objective vs. subjective" dialectic not only addresses the objective and subjective components of the external world, but does so on different levels, i.e., objective and subjective aspects of knowledge, in addition to things like culture and social relationships, on and between the levels of the individual, organization, and society, in space and time. Marx sought to bring Hegel's philosophy back down to earth or, in other words, "turn Hegel on his head." Using the dialectic as an analytical tool, Marx, the realist,
approached the sociological world-building process from a materialist perspective.

In place of Hegel's "spirit" as the prime mover of history, Marx inserted the forces of production, as Smith and Saint-Simon had suggested. In doing so, technology was once again made a major subject of what we now call sociological inquiry. (Weinstein, 1982, p. 19)

Marx, true to his own biography, failed to conform to the trend toward the institutionalization of knowledge, science, technology, and social thought. He actively sought political and economic reforms, spent time in the factories of London, and, with Engels, may have been one of the first "technology assessors" (Weinstein, 1982, p. 18). Marx made no explicit distinction between scientific and technological knowledge, but he did speak of them as separate, and also of their specific reified forms. However, in doing so, he intended to point out the necessity of their interrelationships in the objective world. "Marx made no sharp distinctions between social scientific theory, technology, and political praxis; rather he made their connection essential" (Weinstein, 1982, p. 19). He rightly pointed out that the value and any evaluation of those products of science and technology is exclusively contingent upon the context in which they are applied.

The alienating potential of the reified forms of science, technology, economy, and government was one of Marx's central concerns. "Like the other founders of social science, Marx was certain that the industrial revolution had secularized the human prospect" (Weinstein, 1982, p. 19). Like Hegel, Marx saw a growing gap between the self (i.e., species being as he called it) and the means by which the self is formed and maintained (i.e., through objectified knowledge in the form of labor, subjectivated as an extension of the self through the use-value of human material and non-material products). Marx's
all-encompassing dialectic was one of man to nature. Man, as an active and creative force in and of nature, alters the physical and natural environment and, in the process, alters and recreates himself (Marx, 1977/1867). By definition, the knowledge of the means to modify and alter nature for human ends is called technology. In this sense, technology was a primary integrating theme throughout all of Marx's work.

Historically, the separation of social thought, science, and technology, in addition to the institutionalization of each of these (artificially separated) bodies of knowledge, resulted in man's alienation from himself and from the processes, products, and rewards of his labors. If the goal of existence is to realize one's human potential through human action (i.e., labor), then any gap in the social dialectic inevitably results in the experience of alienation from one's own humanness (i.e., species-being, to use Marx's term). This apparent gap in the social dialectic creates the necessary preconditions for negative impacts and latent social consequences outside of human controls; specifically, at least for Marx, the contradictions of capitalism which inevitably deteriorate the foundations of "modern" capitalist society.

While the concept of development remained central to Marx's thought, it was demystified. By 1848, it was clear that development would not inevitably proceed in an orderly, rational fashion merely because Europe had entered the age of science and technology. For Marx, the dialectical nature of productive forces, marked principally by the perennial struggle between the means of production, assured that the development spurred by modern technology must occur in a conflictual and uneven manner. ... [Like] the Scots, he focused on the unintended and ironic side of progress, on the "darker side" of the enlightenment. But like the French Fathers, he also believed in the power of man, aided by technology, eventually to mitigate negative impacts. (Weinstein, 1982, p. 19)
Marx saw technology as a two-edged sword. This knowledge could be used to better the lot of mankind, or, exclusively in the wrong hands, could ultimately oppress the multitude of persons and lay the foundation for the eventual destruction of society and life as we know it. In either case, it was a necessary means to the material development and evolution of individuals, cultures, and societies. Being both a progressive philosopher and positivist, Marx saw technology, its processes, products, and impacts, as a pivotal point in the future development of society. These ideas are seen most clearly in Marx's theory of social stratification and the stratification and control of knowledge and power:

Stratification, as Marx knew, has crucial bearing not only on sociological theory and research, but also affects the way in which technological innovation is conducted: Who conducts it, in whose interests, and for what purposes. These considerations identify an important way in which social factors shape technology. Yet at this point, perhaps more than any other in Marx's work, the current social science disciplines—some of which have embraced the stress on stratification—diverge from one another and from engineering and other technical fields—which have generally ignored it. In the 1848 era, there was a third [i.e. Marx's] attempt [following the explicit one in England and the other in France] to formulate a systematic, scientific, explanation of the moral and social consequences of industrialization. By this time the economic and political effects of the industrial revolution had spread to the masses. The results were, by Marx's account, less than entirely progressive, liberating, or enlightening. (Weinstein, 1982, p. 20)

In effect, technology, science, and society had become institutionalized past the point of return and, inevitably, past the point of accountability. In terms of liberating and emancipating the human condition, we had taken a giant step backward on the socio-evolutionary ladder. Man had created structures he could not escape and which he was forced to bow down to and worship as deities. Science, technology, economy, government, etc., all
became reified forms of objectivated knowledge, taking on ever-more rationalized forms. Marx could not believe that people would continue to tolerate the contradictions of such an oppressive and ambiguous social order.

However, not all the social commentors in Germany were as optimistic as Marx that human technology, innovation, and necessity would overcome. A pervading disenchantment of the enlightened world was becoming apparent. One of the most important figures in this trend was Max Weber.

Sociology and Technology in Late Nineteenth Century Europe

Weber, Sociology, and Technology

In Germany, and throughout late 19th century Western Europe, society was characterized by a growing trend toward increased rationality, specialization, professionalization, and bureaucratization.

By the turn of the twentieth century the West had grasped the lesson of the industrial revolution and had institutionalized development. This achievement was not based on a Smithian model of the perfectly competitive market, nor on a Marxist model in which a disenfranchised working class would seize power and institute socialism, nor even on a Saint-Simonian vision of technocracy. Instead, an R&D approach to development was initiated in which producers, sellers, buyers, and even the working class were transformed into highly trained specialists. In the universities, schools, and professions, functions were defined and graded in terms of the services they rendered to the development of industrial, and frequently this meant military, technology. (Weinstein, 1982, p. 25)

Rationality was a central theme in Max Weber's works. He saw the rationality of technology as a dependent variable in relation to the market economy and its supporting rationale, and as an independent variable in the social relationships surrounding bureaucratic organizations and modern culture. He illustrated this by comparing the traditional "vocational ethic" of the Hindu caste system to the economic rationality of the modern West:
[This] vocational ethic of a caste system is—at least as far as the crafts are concerned—notably traditionalistic, rather than rational. It finds its fulfillment and confirmation in the absolutely qualitative perfection of the product fashioned by the craft. Very alien to its mode of thinking is the possibility of rationalizing the method of production, which is basic to all modern rational technology, or the possibility of systematically organizing a commercial enterprise along the lines of a rational business economy, which is the foundation of modern capitalism. (Weber, 1978/1921, p. 436)

Weber saw "technique" as the means by which ends are accomplished. However, he interchangeably used "technology" and "technique" in the same discussion. In the discussion, he claimed to distinguish between "economy" and "technology." To complicate matters more, he then equated "rational technique" with the term "scientific knowledge." Even so, the analysis is useful in illustrating the importance of the relationship between knowledge and technology, technique as an objectivation process, and the reified forms of technology, all with potentially negative consequences.

[Not] every action which is rational in its choice of means will be called "rational economic action," or even "economic action" in any sense; in particular, the term "economy" will be distinguished from that of "technology." The "technique" of an action refers to the means employed as opposed to the meaning or end to which the action is, in the last analysis, oriented. "Rational" technique is a choice of means which is consciously and systematically oriented to the experience and reflection of the actor, which consists, at the highest level of rationality, in scientific knowledge. What is concretely to be treated as a technique [i.e. treated as scientific knowledge in its reified form] is thus variable. The ultimate meaning of a concrete act may, seen in the total context of action, be of a "technical" order; that is, it may be significant only as a means in this broader context. Then the "meaning" of the concrete act (viewed from the larger context) lies in its technical function; and, conversely, the means which are applied to accomplish this are its "techniques." In this sense there are techniques of every conceivable type of action, techniques of prayer, of asceticism, of thought and research, of memorizing, of education, of exercising political or hierocratic domination, of administration, of making love, of making war,
of musical performances, of sculpture and painting, of arriving at legal decisions. All these are capable of the widest variation in degree of rationality. The presence of a "technical question" always means there is some doubt over the choice of the most rational means to an end. (Weber, 1978/1921, p. 65)

So Weber subtly hinted at the distinction between the rational-scientific knowledge of techniques, i.e., technology, and the concrete forms of technique, i.e., technological processes, products, and means. He then pointed out that "technical rationality," as a means to an anticipated end, has the potential to achieve ends which are also unanticipated: "In the present terminology we can conceive of a rational technique for achieving ends which no one desires.... [The] procedure under normal circumstances would be clearly irrational because there would be no demand for the product" (Weber, 1978/1921, p. 67). Weber asserted that "rational technology" is largely determined by perceived economic ends.

The fact that what is called the technological development of modern times has been so largely oriented economically to profit-making is one of the fundamental facts of the history of technology. But however fundamental it has been, the economic orientation has by no means stood alone in shaping the development of technology. In addition, a part has been played by other-worldly interests and all sorts of fantasies [non-rational elements], a part by preoccupation with artistic problems, and by various other non-economic motives. None the less, the main emphasis at all times, and especially the present, has lain in the economic determination of technological development. Had not rational calculation formed the basis of economic activity, had there not been very particular conditions in its economic background, rational technology could have never come into existence. (Weber, 1978/1921, p. 67)

Herein lie the contradictions of modern technology. Once the bureaucratic institutionalization of technology as a form of knowledge is in place; once the reified forms of this knowledge, i.e. machines, process,
products, etc., become the means to another reified end, i.e., money-making (as opposed to explicity productive and creative ends), technology becomes decidedly irrational (producing non-complementary means and ends), as Weber pointed out. "Rational technology," at it is highest level of rationality, is part of "scientific knowledge." Scientific knowledge, according to Weber, "[first] arose in connection with practical considerations. Its most immediate and often sole purpose was the attainment of value-judgements concerning measures of State economic policy" (Weber, 1949/1904, p. 51). Technology, as a part of scientific knowledge, then becomes objectivated as a (reified) means, i.e., the technique, of maximizing economic production and profit. Randall Collins explicated:

[In] Weber's scheme, technology [meaning technique] is essentially a dependent variable. The key economic characteristic of mechanization is that it is feasible only with mass production. (Collins, 1986, p. 25)

Weber does not elaborate a systematic theory of technological innovation, but it would be possible to construct one along these lines. He does note that all crucial inventions of the period of industrial takeoff were the result of deliberate efforts to cheapen the costs of production. These efforts took place because previous conditions had intensified the capitalist pursuit of profits. The same argument could be made, although Weber did not make it, in regard to the search for methods to improve agricultural production that took place in the seventeenth and eighteenth centuries. The "green revolution" which preceded (and made possible) the industrial revolution was not a process of mechanization (agricultural mechanization took place only in the late nineteenth century) but was, more simply, the application of capitalist methods of cost accounting to hitherto traditional agriculture. Thus, it was the shift to the calculating practices of the capitalist market economy which makes technological innovation itself predictable, rather than, as previously, an accidental factor in economic life. (Collins, 1986, pp. 25-26)
Weber, and Collins' interpretation of Weber, tends to reify technological knowledge and mistakenly treat it solely as technique, innovation, and the processes and products of industrial production. Weinstein pointed out

[In Weber's approach] technology, like stratification and religion, was at most to be treated as one phenomenon among the many in bureaucratic society: to be studied, to be accurately related to its true causes and effects, and viewed as a variable factor in history and across cultures. This type of treatment continues to be important in social science; it defines the distinctly sociological way of looking at technology. At the same time, it allows the questions of technology's impact to remain academic: technology is viewed as an object [i.e. reified] but not as a vehicle [of knowledge] in which the "wisdom" of social science, as opposed to the prevailing social "ignorance," might be incorporated. . . .

As the social and technical fields are discovering today, this approach, though it may have been appropriate for the academic era, is now more of an impediment than an aid to understanding. (Weinstein, 1982, pp. 36-37)

One must conclude that Weber's analysis falls short of the mark. By his failure to adequately distinguish between technology and technique, he failed to adequately distinguish between knowledge, motivation, and action. Had Weber realized technology is first and foremost a form of knowledge—different, yet inseparable, from its objectivated and subsequently reified forms—the idea might have been very instrumental to the development of his thesis that ideas and culture, in addition to the Marxian notion of material goods and conditions, affect the socio-historical development of the Western world.

The theories of Weber, in Germany, as well as Durkheim, in France, illustrate how the institutionalization of knowledge results in the artificial separation of social philosophy, science, and technology as bodies of knowledge, in addition to how these bodies of knowledge tend to become reified as the concepts are operationalized. While Weber saw technology as a result of increasing economic rationality, in France, Durkheim saw it as a
process by which the "social organism" became more specialized and differentiated.

**Durkheim, Sociology, and Technology**

Durkheim did not make explicit references to "technology" as Weber did, nor did he follow Saint-Simon's footsteps in promoting a democratic technocracy. Durkheim's sociology was primarily concerned with differentiating "social" phenomena from less significant individual actions, thus according Sociology (as a discipline) a pristine place in the academic social sciences. An ex-post-facto analysis of technology in Durkheim's sociology places him on the positivist side of technological development. Pre-modern societies were characterized by mechanical solidarity in which knowledge of nature and its manipulation were undifferentiated and evenly distributed throughout the population. Increasing specialization and differentiation—as a socio-evolutionary process—precipitates the transition from mechanical solidarity to organic solidarity. Organic solidarity is the predominant form of the division of labor in modern societies and is characterized by high degrees of specialization, differentiation, and interdependence. Durkheim saw this increased interdependence as a very positive development in terms of what he (and Spencer) fondly referred to as "social evolution." However, he recognized that these increasingly interdependent relationships and emerging complex social structures require a parallel evolution of legitimizing normative trust, beliefs, and values in order to maintain their operation. Durkheim preferred to speak of the social division of labor, thus differentiating it from the concept of the same name to which economists refer. "The division of labor Durkheim is talking about is a structure of the society as a whole, of which technical or economic division of labor is merely and expression" (Aron, 1969/1965, p. 18).
Durkheim, like Weber, lost track of the one fundamental social relationship that is the operative defining characteristic of social life: All knowledge is socially acquired and maintained, and consequently inseparable from the objective and subjective experience of it (Berger & Luckmann, 1967, p. 3). As both Durkheim and Weber pointed out, "things" such as the division of labor, or a rational economic order, can only continue to exist due to the fact that they are legitimized and maintained through a normative belief and value system. Such linear models of social change fail to address the reciprocal and dialectical relationship of humankind to nature. The separation and institutionalization of social philosophy, science, and technology exacerbates the problem. The "positivism" of the early European social philosophers and innovators became distorted within the institution. The enlightened philosophy of a social order founded on scientific knowledge and principles became fragmented in the face of institutional autonomy.

The institutionalization of disciplinary sociology in the universities of Europe contributed to a general estrangement between social science and institutionalized technology. The efforts of early sociology's proponents helped the discipline achieve a certain degree of acceptance as an academic field. But the fact that it was so specialized and segregated from the other social sciences, its ambiguity concerning objectivity, and—especially as the academic era continued—the ever-present pessimism about technology's inevitable effects on human relations, made it difficult for European sociologists to communicate about or share in the general social commitment to development via the innovation of capital-intensive technologies. (Weinstein, 1982, p. 37)

Especially by the turn of the 20th century, the subject and object of knowledge—social, scientific, and technological knowledge—were separated. With the means and machinery of technological change in place, and the social-scientific knowledge of social and technological ends removed and fragmented, the reification of technology was inevitable, accompanied by
unanticipated and latent consequences which individuals did not attempt to accept responsibility for or comprehend.

Sociology and Technology in the Early Twentieth Century United States Background and Development

Sociology did not begin to become institutionalized as a readily accepted separate academic discipline in the United States until 1892, when Albion Small set up the Department of Sociology at Chicago, although the University of Kansas had a department of Sociology in 1889, and various courses in different departments have been taught under the name of "sociology" (or its equivalent) throughout the United States from 1854 on (Ritzer, 1988, pp. 165-166). As was the case in Europe, early reformers in the United States were also scientists, inventors, and social innovators (e.g., Benjamin Franklin, Thomas Edison, Alexander Graham Bell). However, the institutionalization of science, technology, and sociology in the United States took a somewhat different direction than that of Europe. The early founders of sociology in the United States were heavily influenced by Spencer's idea of evolutionary progress (Ritzer, 1988). The group had an unusual range of backgrounds, drawing from positivism, populism, progressivism, and the social gospel (Weinstein, 1982, p. 45). On the other hand, science and technology merged in the United States and were institutionalized in institutes of technology such as MIT and also in large elite universities such as Columbia and Yale. The autonomy of pure research in science and technology is illustrated by the negative reactions to John Desmond Bernal's book The Social Function of Science published just before World War II.

Bernal argued that the central government should be the source of funds for scientific research, and that these funds should be granted on
the basis of the expected social and political benefits. Most scientists were horrified by Bernal's proposals, which were contradictory to their cherished ideals. Scientists were committed to designing their own research without any regard to its immediate usefulness [i.e. consequences]. As late as 1937, the great physicist Ernest Rutherford could state that the work he and his colleagues were doing at Cambridge University in nuclear physics had no conceivable practical value for anyone and he expressed delight that such was the case. Nor did university scientists drool over government grants, since many had independent incomes to help finance their still-inexpensive equipment and experiments. (McKay, Hill, & Buckler, 1983, p. 1108)

Clearly, in the United States, sociology as a knowledge-based discipline was institutionalized well outside of scientific and technological knowledge, in spite of the fact that American sociology was decidedly "scientific" in the positivistic sense and well aware of the potentials of industrialization and technology, be they positive or negative. The influences of British sociology, particularly the social-evolutionary and progressive ideas of Spencer, predisposed American sociology to take on a traditional-liberal bent.

Liberalism, taken to its extreme, comes very close to conservatism. The belief in social progress—in reform or a laissez-faire doctrine—and the belief in the importance of the individual both lead to positions supportive of the system as a whole. The overriding belief is that the social system works or can be reformed to work. There is little criticism of the system as a whole; in the American case this means, in particular, that there is little question of capitalism. Instead of immanent class struggle, the early sociologists saw a future of class harmony and class cooperation. Ultimately this meant that early American sociological theory helped to rationalize exploitation, domestic and international imperialism, and social inequality. (Schwendinger & Schwendinger, 1974, in Ritzer, 1988, p. 167)

Ritzer concluded that "In the end, the political liberalism of the early sociologists had enormously conservative implications" (Ritzer, 1988, p. 167).

The separate institutionalization of science and technology with their laissez-faire autonomy, combined with the economic liberalism which formed
the foundation for early American institutionalized sociology were antithetical to an academic unity of American social thought, scientific knowledge, and technological knowledge. Unlike the earlier social philosophers, who treated social, scientific, and technological knowledge as an analytical whole, American academicians were specialists, bound to means-ends calculations and observations within their own limited pseudo-scientific paradigms. To question this institutional system and separation of knowledge would mean to question what was paradigmatically defined as "progress," which formed a large segment of American ideology and nationalism (and also posed a threat to those people whose interests financed the growth of the institutions themselves). "Although these early sociologists were attracted to the ideas about dealing with the dangers of industrialization generated by the labor movement and socialist groups, they were not in favor of radically overhauling society" (Ritzer, 1988, p. 167). This allowed for the growth of institutionalized sociology in the United States, but also hampered the acceptance of sociology as a viable "scientific" discipline. Science and technology, in early twentieth century America, were enjoying a position of high academic, social, and political status and esteem. The growth, differentiation, and specialization of American industry and the economy which, according to Spencerian theory, were characteristics of mature progressive social organisms, were credited to the advances of science and technology and to their operation outside of governmental interventions and controls. The ideal society, then, was one which was left alone to operate and evolve on its own outside of social, political, and economic controls, constraints, and reforms.

In comparison to the non-social sciences, the technical fields, and even the better established social sciences such as economics and
psychology—which had no concern with criticizing the morality of the times, sociology was often identified as a reformist, "concerned," but impotent fringe of the academic community. (Weinstein, 1982, p. 46)

While sociology remained on the fringes of, if not separated from, mainstream institutional scientific and technological knowledge with its high regard and prestige, mainstream sociology also had its own "fringes." On this fringe was the eccentric yet brilliant son of poor Norwegian immigrants, Thorstein Bunde Veblen. Like Marx, Veblen, due in part to his unique situation in larger society, escaped the reins and limitations of the segmented and institutionalized academic disciplines. Consequently, Veblen set out to develop his own theory of technology and society.

**Veblen's Sociology of Technology**

Veblen was a scholar, scientist, positivist, and progressive thinker. One of his central themes was **instincts**, and one of the instincts he formed his theories around was the "instinct of workmanship." In the *Instinct of Workmanship* (1914) Veblen contended that the most important impulse, and most general impulse, in human nature is

[the] drive to manipulate the world creatively with productive labor. Veblen maintained that its supreme importance lies in the fact that it is the instinct that facilitates the achievement of all the other adaptive instinctual drives. Its ends or goals are thus the survival of the human species. Thus the instinct of workmanship serves as a general drive for the achievement of goals that maintain life and permit social advance. For Veblen, as in the critical theories of Marx and Hegel, labor serves both adaptation and self-creation of categories of thought through which the world is understood, reflected on, and eventually changed. (Ashley & Orenstein, 1985, pp. 377-378)

Another instinct, inevitably linked to technological knowledge and its objectivation, is **idle curiosity**. He linked this not only to the objectivation of
technology, but also to the segmentation, institutionalization, and stratification of knowledge itself.

In essence, idle curiosity involves the insatiable desire for knowledge apart from any ulterior end and independent of any pragmatic or utilitarian motive. This human drive for knowledge leads to a constant disturbance of the habitual body of knowledge in any society. Thus, though "idle" (nonutilitarian) in origin, the instinct leads to an advance in knowledge, which provides the basis for technological improvement that ultimately underlies social evolutionary development. In The Higher Learning in America (1918), Veblen defended the independence of university faculty members from immediate applied or vocational endeavors forced on them by university administration. He did so by arguing that, by following the instinct of idle curiosity, the scholar will produce more of a benefit for society in the long run than by any other approach. Again, as with Hegel and Marx, true knowledge arises from an interrational drive, and the passion for knowledge is undermined when it is made subservient to external instrumental logic. (Ashley & Orenstein, 1985, p. 378)

Veblen developed a class dichotomy between business interests and the free dissemination of technological knowledge by engineers and technicians. Veblen proposed a technocracy, not unlike the one envisioned by Saint-Simon in France a century earlier. He also foresaw an inevitable political struggle for the control of technological knowledge in which, left in the hands of business and monetary interests, could destroy the humanitarian foundations upon which progress was built and directed.

The distinction between technical versus business classes is a radical one. It is a distinction that had been partly obscured by industrial society's [tendency] to equate development with capital accumulation. With the understanding that technological progress and the growth of business do not necessarily coincide, Veblen struck the core of the "problem with" technology in the modern era: that its practice and practitioners had been subordinated to the will of the business enterprise. Veblen was not prepared to believe that the shape and effects of technological innovation must inevitably be tied to the accumulation of capital, even if the effects of such a relationship in prosperous time is good; nor, like Weber, did he believe that technology
inevitably contributes to increasing bureaucratization. On the contrary, he was concerned with freeing technology, with elevating it to a position where it would direct changes in industry and society as a whole. Anticipating later social critics of the Frankfurt School by nearly one-half century, Veblen envisioned a contemporary political struggle for control of technology in which a great deal is at stake. This is a struggle not between workers and owners but between the "Engineers" driven by a creative, scientific instinct and the "Price System" driven by the need to accumulate wealth. Veblen's understanding of technology led him to pose a choice between reason and greed as alternative stimulants to development. (Weinstein, 1982, p. 47)

Veblen had several other important insights which still influence our contemporary understandings of technology. In his *Theory of the Leisure Class* (1899) he

[Veblen] illustrates how social customs and economic pressures had perverted technology: how a supposedly rational technological system can be organized to produce waste; how modern industrial technology can be employed not for the benefit of all but as the weapon of a "predatory" class in competition for booty; and how the establishment of a society-wide R&D system has served not to satisfy human needs, but to supply a decades-long round of potlatches among the ruling classes. (Weinstein, 1982, pp. 48-49)

Veblen proposed that social evolution is contingent upon the impartial accumulation and free dissemination of social, scientific, and technological knowledge. In fact, it is the combination of the human tendency toward sociability and the need to act on and experience the world based on the accumulation of human knowledge which makes society possible.

Thus Veblen rejected the principle that humans are basically asocial or self-centered beings. In the course of biological evolution, in the long stage of savagery, humans developed basic instinctual drives to create, to identify with and benefit others, and to accumulate knowledge that provides for technological and social advance. Veblen maintained that these instincts, mediated by cultural norms and conscious intelligence, provide the foundation for both social organization and social evolution. (Ashley & Orenstein, 1985, p. 378)
His ideas about the relationship between science, technology, and society combined with his scathing criticisms of the institutionalization, segmentation, and bastardization (i.e., failure to recognize the origins) of knowledge form a solid and enlightening theory of technology and society with many contemporary applications.

The Chicago School began to wane circa the 1920s and 1930s as the primary representatives of institutionalized sociology. The discipline later (via the representatives of the Harvard School and conservative social thought) experienced a movement to reunite itself with scientific knowledge, especially with scientific methods. This did not mean a reunification of science, technology, and social thought, but for one member of the Chicago school, William F. Ogburn, it did inspire a theory about technology and society.

Ogburn and Technology as the Impetus of Social Change

In his presidential address before the American Sociology Society in 1929, the Chicago sociologist William F. Ogburn announced sociology's scientific coming-of-age and its exclusion of mere social do-gooders. This was also a personal confession for Ogburn, who had begun his career as a socialist and had gradually shifted to an emphasis on detached quantitative research and technological trends. (Collins & Makowsky, 1984, p. 193)

Ogburn (1955) proposed that, as an independent variable, technology, i.e., material culture, changes faster than non-material culture; Ogburn is often criticized for being a "technological determinist."

Other thinkers [besides Marx] have emphasized material factors as causes of change. William Ogburn in the 1930s wrote extensively about the technological causes of social change in America. He argued that the advent of the automobile had changed American society in many ways: by increasing geographic mobility, by accelerating the growth of the suburbs, and by changing courtship customs (by removing them from the supervision of adults). In general, Ogburn's argument is that material culture (technology) changes more rapidly than
nonmaterial aspects of culture (ideas, values, norms, ideologies). As a generalization I think it is debatable, but it is true that humans are often more willing to adopt new techniques and tools than to change their cultural values and traditions. He argues that there is often a "cultural lag" between the nonmaterial culture and the material culture, which is a source of tension. (Harper, 1989, p. 57)

Ogburn, and Harper's assessment of Ogburn's theory, illustrates how technology in twentieth century America becomes almost indelibly reified into its material products and processes. Ogburn's theory confused technology with its material products, and mistakenly treated the products as independent variables. In fact, technology as knowledge is a cultural phenomenon, and acts in a dialectical as opposed to a unilinear force in the process of social change. This was essentially Marx's theory of technology, and though Marx was rightfully labelled a materialist—specifically in terms of initiating social change—by Harper and others, the issue of being a determinist is not as readily defended. Ogburn's theory failed in that it hopelessly reified technology, i.e. confused it with its products, processes, and consequences, and ignored the aspects of technology's relationship to science and social philosophy [and its consequential explanatory potentials] as interwoven, interrelated, and interdependent bodies of knowledge.

This reification of technological knowledge pervaded American sociology well through the conservative era of the Harvard School and Ivy League, into the radical revivalism started by C. W. Mills in the 1950s and maturing in the 1960s, up through the "creative sociologies" of the sixties and seventies (see Ritzer, 1988, for a more detailed discussion of these developments). Science and technology were then increasing in social importance and support with the advent of World War II, the development of the atomic bomb, and "space race" which pumped millions of dollars into applied scientific and technological
pursuits. This was done at the expense of the social sciences and served, for the most part, to entrench the "technology as applied science and engineering" mentality still characteristic of American academia and modern society (Whyte, 1956). Within the institution, the rekindling of Marxist perspectives by C. W. Mills moved the topic of technology and its impacts into the sociological subdiscipline often called the Sociology of Work (see Mills, 1951). That discussion will be pursued in a later section. It is now necessary to return to Europe and examine how technology, particularly within the Frankfurt School, became a significant concern in the sociology of knowledge.

Technology and the Sociology of Knowledge: Twentieth Century Europe

Mannheim and the Growth of Critical Sociology

Any discussion of the sociology of knowledge is ultimately grounded in the works and ideas of Karl Mannheim (Berger & Luckmann, 1967, p. 11). Mannheim's primary concern was with ideology as a form of knowledge and the consequences of ideology as a form of knowledge in terms of the members of a given society.

He [Mannheim] insisted that a sociology of knowledge was possible, that there was an association between the forms of knowledge and social structure, and that membership of particular groups conditioned belief. (Abercrombie, Hill, & Turner, 1988, p. 144)

Mannheim sought to "detach" knowledge from its ideological and institutionalized constraints. He asserted that education of technicians, engineers, and social planners must include social prerogatives—a "sense of the extensive and often dissimulated outcomes of innovation" (Weinstein, 1982, p. 73). Mannheim proposed that civilization has entered a new technological era which necessitates social planning—the era of the stage of planning.
Earliest human societies are in the "stage of chance discovery." Their methods of dealing with the world consist of traditions, accidentally adopted and maintained because they work. . . . On this level of society, freedom means spontaneous physical action—the freedom to go where one pleases, to do what one wants when one wants to do it. The limitations of this freedom come primarily from the environment—wild animals, the weather, diseases, lack of food—which may keep human beings from being able to do everything they want. (Collins & Makowsky, 1984, p. 226)

Herein one can observe how the knowledge of altering the environment to meet human needs, i.e., technology, can be considered as an independent variable in the development of societies. This becomes more clear in Collins and Makowsky's explication of Mannheim's stage of invention and stage of planning.

More advanced civilization has reached the "stage of invention." People have learned to reflect on their world, to develop tools, crafts, machines, businesses, factories, and organizations. The new techniques and organizations free us from the hardships of nature, but in return we must give up much of our physical spontaneity. The self-discipline of work with tools and in cooperation with others gives us much control over the physical environment, but it forces us to change our concept of freedom: It is no longer physical freedom to make one's own fortune by using tools and building one's business. It is the freedom of the inventor and intrepeneur.

But if the stage of inventions gives us control over the physical environment, it puts us at the mercy of the social environment. What good is formal freedom to choose one's own work, says Mannheim, to a worker who is at the mercy of the shifting trends of the labor market? Accordingly, we find ourselves at the dawn of the "stage of planning," in which we give up the free activity of each entrepreneur and inventor to go his or her own way regardless of the consequences for others in return for a new sort of freedom: the freedom to control our social world instead of being controlled by it. Democracy can be preserved in planning by incorporating the safeguards and procedures of democracy into the plan itself. At least, such was Mannheim's hope. He had to be optimistic about planning, for he felt there was no other acceptable choice. (Collins & Makowsky, 1984, pp. 226-227)
What Mannheim appears to propose is a reactionary response to material and ideological "progress" in the technical sense: A return to the time when science, technology, and social thought were a unified body of knowledge free from institutional and ideological constraints yet rich with emancipatory intentions. Mannheim clearly identified the consequences of the separation and institutionalization of these bodies of knowledge.

[The] contradiction [is] between the Enlightenment intention to use technology to set people free from bondage to tradition and nature and the current situation in fascist, communist, and mass societies alike in which technology serves to keep most people in bondage to the few political and technical elites. (Weinstein, 1982, p. 72)

The sociology of knowledge approach to technology—identifying technology as a basis for ideological manipulation—became the central theme of the Frankfurt School, founded in Frankfurt, Germany, February 23, 1923 (Ritzer, 1988, pp. 250-251). To the critical theorists of the Frankfurt school, technology embodied the formal rationalization of human objectified action. "To the critical theorists, formal rationality is concerned unreflectively with the question of the most effective means for achieving any purpose" (Tar, 1977, cited in Ritzer, 1988, p. 250). The rationalization of technological knowledge in absence of scientific and traditional emancipatory social guidelines then becomes technocratic thinking.

[In technocratic thinking] the objective is to serve the forces of domination, not to emancipate people from domination. The goal is simply to find the most efficient means to whatever ends are defined as important by those in power. Technocratic thinking is contrasted to reason, which is, in the minds of the critical theorists, the hope for society. Reason involves the assessment of means in terms of the ultimate human values of justice, peace, and happiness. (Ritzer, 1988, p. 250)
Technology, in critical terms, is the most predominant form of formal rationality (Ritzer, 1988, p. 251). Formal rationality, in contemporary society, takes on an irrational form due to the fact that it is devoid of its "substantial" components. "The model of substantial rationality is a person thinking realistically, calculating so that his or her actions reach their intended goals" (Collins & Makowsky, 1984, p. 225). Formal rationality is also devoid of those nonrational components (i.e., phenomena not based on means-ends calculations at all) such as values, trust, or "precontractual solidarity" which form the bases for all rational action (Collins, 1982). Thus, technological knowledge in the absence of directive social and scientific knowledge can become decidedly irrational (i.e., following a means-ends path in which the means and ends are decidedly not complementary). In this sense, technology could be a very significant independent variable in the development of modern society. Of all the critical theorists, Herbert Marcuse most directly addressed the significance of technology as an important variable in social development (Marcuse, 1964; Ritzer, 1988, p. 251).

Marcuse: A Critique of Technology, Knowledge, and Society

In absence of his dialectical roots, Marcuse almost comes off as a technological determinist, although the rationale is considerably more sophisticated than that of, for example, Saint-Simon, or Ogburn. Given that man is in dialectical relation to nature—in fact an acting part of nature—Marcuse asserted that technology, as a form of knowledge, takes on an a priori dimension through its objectivation.

The technological a priori is a political a priori inasmuch as the transformation of nature involves that of man, and in as much as the "man-made creations" issue from and re-enter a social ensemble. One may still insist that the machinery of the technological universe is "as
such" indifferent towards political ends—it can revolutionize or retard a society. An electronic computer can serve equally a capitalist or social administration; a cyclotron can be an equally efficient tool for a war party or a peace party. This neutrality is contested in Marx's controversial statement that the "hand-mill gives you society with the feudal lord; the steam-mill society with the industrial capitalist." And this statement is further modified in Marxian theory itself: the social mode of production, not technics, is the basic historical factor. However, when technics becomes the universal form of material production, it circumscribes an entire culture; it projects a historical totality—a "world". (Marcuse, 1964, p. 154)

Marcuse pointed out the necessity of a technology which is "indifferent" and simultaneously pointed out, that due to the objectivated nature of technological products and processes, the impossibility of such a "neutral" form of knowledge. As Marx purported, technology can be emancipating as well as oppressive, but one can envision that such an emancipatory endeavor would, based on the analyses herein, involve the de-institutionalization of technology, the loosening of its ideological reins, and its reintegration with social-scientific humanitarian means and ends. It, according to Marcuse (1964), involves the explicit redirection of technological knowledge into conscious social-scientific efforts to create a better and less oppressive society.

[Marcuse] saw technology in modern society as leading to totalitarianism. In fact, he viewed it as leading to new, more effective, and even more "pleasant" methods of external control over individuals. The prime example is the use of television to socialize and pacify the population (other examples are mass sports and sex). He rejected the idea that technology [in its objectivated form] is neutral in the modern world and saw it instead as a means to dominate people. It is effective because it is made to seem neutral when it is in fact enslaving. It serves to suppress individuality. The actor's inner freedom has been "invaded and whittled down" by modern technology. The result is what Marcuse called "one-dimensional society" in which individuals lose the ability to think critically and negatively about society. Marcuse did not see technology per se [i.e., technological knowledge] as the enemy, but rather technology as it is employed [i.e., objectivated] in modern
capitalist society. . . . Marcuse retained Marx's original view that technology is not inherently a problem and that it can be used to develop a "better" society. (Ritzer, 1988, p. 251)

Habermas: A New Critical Direction?

Jurgen Habermas, the new leader of the Frankfurt School, interpreted the situation differently. In an analysis of Marx's theory of historical materialism, Habermas (1979/1976) asserted that, in addition to innovations in productive techniques and refinements in technological knowledge, social evolution must ultimately be driven by refinements in normative integration, more precisely, in integrative communicative action.

The postulated learning mechanism [in Marx's theory of the development of evolutionary innovations] explains the growth of a cognitive potential [i.e., knowledge] and perhaps its conversion into technologies and strategies that heighten productivity. It can explain the emergence of system problems that, when the structural dissimilarities between forces of production become too great, threaten the continued existence of the mode of production. But this learning mechanism does not explain how the problems that arise can be solved. The introduction of new forms of social integration—for example, the replacement of the kinship system with the state—requires knowledge of a moral-practical sort and not technically useful knowledge that can be implemented in rules of instrumental and strategic action. It requires not an expansion of our control over external nature but knowledge that can be embodied in structures of interaction—in a word, an extension of the autonomy of society in relation to our own, internal nature. (Habermas, 1979/1976, pp. 145-146)

Habermas asserted that social evolution is ultimately contingent upon emerging social structures and relations which are ultimately grounded in social communicative discourse. This thesis downplays the significance of technological knowledge in the social evolutionary process and negates the proposition that technology, in the form of knowledge, can be useful as an
independent variable in explaining social change and social relationships.

Habermas' point is well taken—increased cognitive potentials and

[the] endogenous growth of knowledge [are] thus a necessary condition of social evolution. But only when a new institutional framework has emerged can the as-yet unresolved system problems be treated with the help of the accumulated cognitive potential; from this there results an increase in productive forces. (Habermas, 1979/1976, p. 147)

Habermas, then, appears to give primacy to cultural forces (i.e., in Marx's terminology, the superstructure) in instigating social change.

Habermas' mode of analysis is similar to Marx's in that he sees social evolution as a result of crises or "contradictions" inherent in a given system. These create "steering problems," which eventually make the system untenable. However, like other critical theorists, Habermas emphasizes the role played by people's ideas and consciousness. Underlying structural changes and contradictions manifest themselves in the breakdown of shared values or "normative structures"; and the old social system disintegrates because such changes threaten people's feeling of social identity (and therefore social integration). (Wallace & Wolf, 1986, p. 104)

Habermas' focus on ideas as the mechanism of social change makes his treatment very different from that of Marx, who treats the development of modern industry as a deus ex machina that catapulted mankind from feudal into capitalist society. (Wallace & Wolf, 1986, p. 105)

Additional Critique and Analysis

The debate Habermas constructed resembles an antithesis to the one Marx undertook with Hegel concerning the nature of dialectic reasoning and the consequential origins of social change. However, such debate is nothing more than an exercise in futility and a negation of the dialectic method itself (Ollman, 1976). It appears quite clear that changes in both objective and subjective social phenomena are prerequisite to all large scale social change. Within the theoretical framework and assumptions herein, supported by more
modern attempts (e.g. Ollman, 1976; Ritzer, 1988) to understand the dialectic method, the necessary focus of analysis is on the reciprocal nature of opposing social phenomena, thus minimalizing the need (and opportunity) to make assertions about linear causation. What is sought herein is to explain the occurrence of latent socio-technological consequences; not to speculate as to the origin of all technological knowledge. For this purpose, the objective-subjective dialectical debate is pointless; what matters is the process by which people mistake or give primacy to one or the other, i.e., the process of reification. The process of objectivation and the subsequent reification of technological knowledge into its own products and processes does not significantly differ from the process by which normative ideas become objectivated into language and symbols. The issue at hand is how these objectivations become "things in themselves" which apparently operate outside of human understanding and controls, inevitably producing negative social outcomes. In the sense of what should be, Habermas proposed a promising solution—the free and open exchange of knowledge outside of political and ideological constraints. However, as Marcuse points out, material culture, specifically technological culture, is indelibly and ominously attached to the symbols and meanings people share. John Dewey, perhaps, best pointed out the real necessity of the integration of scientific, social, and technological knowledge through objectivated action and experience:

Aforetime man employed the results of his prior experience only to form customs that henceforth had to be blindly followed or blindly broken. Now, old experience is used to suggest aims and methods for developing a new and improved experience. Consequently experience becomes in so far constructively self-regulated. . . . The very fact of experience thus includes the process by which it directs itself in its own betterment.
Science, "reason" is not therefore something laid from above upon experience. Suggested and tested in experience, it is also employed through inventions in a thousand ways to expand and enrich experience. Although, as has often been repeated, this self-creation and self-regulation of experience is still largely technological rather than truly artistic or human, yet what has been achieved contains the guaranty [sic] of the possibility of an intelligent administering of experience. The limits are moral and intellectual, due to defects in our good will and knowledge. They are not inherent metaphysically in the very nature of experience. "Reason" as a faculty separate from experience, introducing us to a superior region of universal truths begins now to strike us as remote, uninteresting and unimportant. Reason, as a Kantian faculty that introduces generality and regularity into experience, strikes us more and more as superfluous—the unnecessary creation of men addicted to traditional formalism and to elaborate terminology. Concrete suggestions arising from past experiences, developed and matured in the light of the [material and ideational] needs and deficiencies of the present, employed as aims and methods of reconstruction and tested by success or failure in accomplishing this task of readjustment, suffice. To such empirical suggestions used in constructive fashion for new ends the name intelligence is given. (Dewey, 1968/1920, pp. 95-96)

The Frankfurt School maintains an emancipatory agenda and is concerned with the ways in which knowledge itself is manipulated, stratified, and used as means of oppression by socio-political elites. In Italy, Antonio Gramsci, somewhat prior to Habermas, also criticized Marx for his economic and materialist tendencies, asserting the importance of ideological considerations. However, Gramsci also accorded significance to the objectivated experiences of the oppressed.

The stability of capitalist societies was mostly dependent on the ideological domination of the working class [i.e., hegemony]. Gramsci suggested that this domination could not be complete, however, for the working class has a dual consciousness, one part of which is imposed by the capitalist class while the other part is a commonsense knowledge derived from the workers' everyday experience of the world. (Abercrombie, Hill, & Turner, 1988, p. 107)
In France, Louis Althusser took Gramsci's notion of ideology a step further, proposing that it forms an inherently objective material condition which mechanically reproduces the social relations of production, specifically through the institutions of education and mass media (Abercrombie, Hill, & Turner, 1988, p. 10). Thus, European sociology, either through the sociology of knowledge, critical sociology, or the subject-object dialectic was concerned with technology, its impacts, and implications within the larger social milieu. However, with few exceptions (e.g. Marcuse), the distinction between technology as a form of knowledge, its institutionalized, segmented, and reified forms, its processes, products, and explanatory potentials, are not sufficiently developed such that one can use the concept in empirical sociological analyses or explanation. Some of the concepts, however, kindled an interest in these issues for an American sociologist in the post-war era, namely, C. W. Mills. Mills examined technological products, processes, and relationships in the workplace and sought to demonstrate their oppressive implications. This analytical focus has become a popular approach in sociology since the post-war period of the United States, particularly since the "radical revolution" precipitated by Mills in the 1960s.

The Treatment of Technology in Contemporary American Sociology

C. W. Mills, Technology, Alienation, and Deskilling

C. W. Mills saw technological rationality as a core variable in "modern occupational change" (Mills, 1951, p. 66). Technological rationality, according to Mills, is visible in three trends. These include (a) the increase of productivity through mass-production processes and techniques, (b) an increased focus on marketing and the necessity of artificially increasing demand, and (c) consequential shifts in the social relations of production such that the
proportion of white-collar to manual laborers increases while the autonomy of white collar work and workers decreases (Mills, 1951). Mills pointed out that technological "know-how," occupational skills, and the social relations of production are interrelated.

Technology has thus narrowed the stratum of workers needed for given volumes of output; it has also altered the types and proportions of skill needed in the production process. Know-how, once an attribute of the mass of workers, is now in the machine and the engineering elite who design it. Machines displace unskilled workmen, make craft skills unnecessary, push up front the automatic motions of the machine operative. (Mills, 1951, p. 67)

One issue that Mills introduced to his audience is the question of deskillling. The deskillling assertion contends that the degree of manual skill required to perform most jobs has decreased with the introduction of new technologies and increased managerial controls. The debate on this question still continues today. What Mills contributed most to the debate is the realization that skills are inextricably contingent upon knowledge, most specifically, technological knowledge. Technological rationality since the Civil War has altered the nature of skills such that the know-how of production has become increasingly invested in machinery, abstract technological processes, and rational bureaucratic organizations. This results in a labor force in which "fewer individuals manipulate things, more handle people and symbols" (Mills, 1951, p. 65). As workers deal with increasingly abstract products, the potential for alienation from these products appears to increase, as does the reification of the associated technological knowledge by which the products and processes are made possible. Skill as know-how tends to become abstracted from the worker and invested in the organization. Mills pointed out that
deskilling, per se, is not the issue; it is the control of the technological knowledge itself that determines the social character of work in modern industrial societies.

Mills concluded that technological rationality, with its accompanying oppressive manipulations, makes possible the centralization and sedimentation of power in an elite economic few. To Mills, it was not technological processes and products that determined the social relations of production, nor was it technological know-how and knowledge that accorded power to the individual. Power is derived from the stratification of this technological knowledge, such that the outcomes of the technological process, product, and experience are removed from the worker and reinvested in the rationalized organizational power structure itself. This structure then can become a reified piece of machinery outside of perceived individual rationality, responsibility, and control. This is accomplished through a hierarchical control over the dissemination of technological knowledge, the manipulation of technical processes, and the removal of the worker from the product and other meaningful organizational affiliations.

The detailed division of labor means, of course, that the individual does not carry through the whole process of work to its final product; but it also means that under many modern conditions the process itself is invisible to him. The product as the goal of his work is legally and psychologically detached from him, and this detachment cuts the nerve of meaning which work might otherwise gain from its technical processes. Even on the professional levels of white-collar work, not to speak of wage-work and the lower white-collar tasks, the chance to develop and use individual rationality is often destroyed by the centralization of decision and the formal rationality that bureaucracy entails. The expropriation that modern work organization has carried through thus goes far beyond the expropriation of ownership; rationality itself has been expropriated from work and any total view and understanding of its process. No longer free to plan his work, much
less to modify the plan to which he is subordinated, the individual is to a great extent managed and subordinated in his work. . . . [The] enterprise is an impersonal and alien Name, and the more that is placed in it, the less is placed in man. (Mills, 1951, pp. 225-226)

Technological rationality and knowledge then, according to Mills, are intentionally removed from the work process and workers by an elite minority of owners and managers. The result is worker alienation and the removal of individually-guided rational action from the process and product of work. In this scenario, technological knowledge is used to oppress workers and to maintain a stratified social division of labor to the benefit of an elitist few.

In an impersonalized and more anonymous system of control, explicit responses are not so possible: anxiety is likely to replace fear; insecurity to replace worry. The problem is who really has power, for often the tangled and hidden system seems a complex yet organized irresponsibility. When power is delegated from a distant center, the one immediately over the individual is not so different from the individual himself; he does not decide either, he too is part of the network by means of which individuals are controlled. (Mills, 1951, p. 349)

Mills offered a comprehensive analysis of the dimensions of this problem, yet he was somewhat deficient in proposing solutions. He pointed out that technological and social knowledge are stratified by elitists who use various dimensions of the technological process to separate social and technological bodies of knowledge for the purpose of altering the social relations of production to their own benefit. This results in a gap between the objective and subjective conditions of social reality for most individuals: First, individual action can no longer be rationally self-directed, and second, the experience of one's own character is no longer consistent with or complementary to the imposed social structure in which it must exist. This inevitably results in alienation and fragmentation of the social self.
Mills hurdled an intellectual milestone in identifying important sociological variables such as technological rationality (i.e. knowledge), technical process, human directed action, relations of production, objective conditions, and human experiences such as alienation. Unfortunately, in this particular effort, the complex interrelationships are not as well-developed as they could be. Mills' greatest contribution to American sociology may have been the very fact that he challenged the right wing conservative bent sociology had taken during the forties and fifties (Ritzer, 1988). This laid the foundation for the spread of critical sociology in the United States and suggested that the sociological agenda should include a questioning and critique of traditional American institutions and ideology. Particularly in the areas of alienation and on the question of deskilling, Mills spurred a growing interest in the relationship between social organization, work, and self.

Technology, Alienation, and Freedom: Robert Blauner

Robert Blauner wrote what may still be the landmark study of technology and its effects on the modern worker. Blauner sought "[to bring together] two modes of inquiry that have usually stayed somewhat apart—the abstract, even philosophical, speculation of the alienation concept, and empirical research, with its sensitivity to concrete social life and scientific procedures" (Blauner, 1964, p. vii). Blauner acknowledged an intellectual debt to Marx, but suggested that it may be overly simplistic to conclude that the capitalist mode of production inevitably leads to alienation. Upon examination of various empirical sources, including a 1947 Roper-Fortune Survey on worker satisfaction, combined with his own collected data, Blauner observed a relationship between the context of work performed and respondents'
perceptions of satisfaction. According to Blauner, the primary variable influencing this relationship was technology.

The most important single factor that gives an industry a distinctive character is its technology. Technology refers to the complex of physical objects and technical operations (both manual and machine) regularly employed in turning out the goods and services produced by an industry. Technology signifies primarily the machine system, the level and type of mechanization, but it also includes the technical "know how" and mechanical skills involved in production. (Blauner, 1964, p. 6)

Using this rather limited definition of technology, Blauner then proceeded to correlate technology with alienation. An important distinction made is that alienation has both objective and subjective components. This treatment of alienation may have been Blauner's strongest argument.

Alienation is a general syndrome made up of a number of different objective conditions and subjective feeling-states which emerge from certain relationships between workers and the sociotechnical settings of employment. Alienation exists when workers are unable to control their immediate work processes, to develop a sense of purpose and function which connects their jobs to the overall organization of production, to belong to integrated industrial communities, and when they fail to become involved in the activity of work as a mode of personal self-expression. In modern industrial employment, control, purpose, social integration, and self-involvement are all problematic. (Blauner, 1964, p. 15)

"Sociotechnical settings" appears to have included subjective feeling-states of social actors, technological processes, technological products, and the experience of the self through these settings. A potential for alienation hypothetically exists at each social moment of the sociotechnical setting which is unique to each industry. Blauner then conceptualized alienation as having four dimensions. These include (a) powerlessness, (b) meaninglessness, (c) social alienation, and (d) self-estrangement. Apparently unknowingly, Blauner identified reification of technological knowledge as a source of this alienation.
Thus the four modes of alienation reflect different "splits" in the organic relationship between man and his existential experience: the subject-object, the part-whole, the individual-social, and the present-future dichotomies. Each makes it more possible to use people as a means rather than as ends. Since "things" rather than human beings are normally used as means, alienation tends to turn people into things: thus thingness, in addition to fragmentation, is another common denominator of the various meanings of alienation. (Blauner, 1964, p. 33)

By definition, reification means to "make something thing-like" (Abercrombie, Hill, & Turner, 1988, p. 205). What Blauner attempted to infer was that the objective components of human action and experience tended to become removed (i.e., reified) from the subjective components. This treatment of alienation, then, also took on a decidedly dialectical characteristic, utilizing traditional dichotomies (i.e., subject-object, part-whole) common to the writings of Kant, Hegel, Marx, etc. The passage also can illustrate the trend toward ever-more rational-technical thought in its reference to means-ends calculations. Of course, Blauner's message was that such rationality is dialectically contingent upon the technology which supports it. However, he insightfully pointed out that the by-product of such rationality is the fragmentation of individual experience. "The result of being a means for the ends of others is that for himself, his (own) activity becomes only a means rather than a fulfilling end" (Blauner, 1964, p. 33).

The core of Blauner's empirical work was to explicate the differences in alienation from one form of technology to the next. This was done through the empirical examination of four different industries including (a) printing and craft industries, (b) textile and machine-tending industries, (c) automobile and assembly-line industries, and finally, (d) chemical plant and continuous-process industries. Simply put, Blauner concluded that perceived alienation was
greatest in those industries that located skill, control, and knowledge outside of the individual, namely, the textile (machine-tending) and automobile (assembly line) industries. Workers felt least alienated in industries where they perceived they had adequate control over the work and product, i.e., craft and continuous process industries.

Inherent in the techniques of modern manufacturing and the principles of bureaucratic industrial organization are generally alienating tendencies. But in some cases the distinctive technology, division of labor, economic structure, and social organization—in other words, the factors that differentiate individual industries—intensify these general tendencies, producing a high degree of alienation; in other cases they minimize and counteract them, resulting instead in [feelings of] control, meaning, and integration. (Blauner, 1964, pp. 166-167)

Blauner identified several variables to consider when conducting empirical investigations about the nature of work and alienation in modern industrial societies. These included technological processes, products, the division of labor, and the social relations of production inherent to any particular industry. Blauner did not develop these relationships very extensively nor offer any clear analytical framework for understanding how these variables affect one another. Furthermore, technological, scientific, and social structures also exist and must be understood outside of the workplace. Blauner, for the most part, ignored the alienating potential and implications of larger industrial society itself. However, this formed the foundation for his call for further empirical research:

Finally, I have also attempted to demonstrate the usefulness of the alienation perspective in clarifying our understanding of the complexities of the modern social world. The idea, developed by Marx in his early writings, can be expressed in systematic concepts and propositions that raise important analytical, as well as sociopolitical, questions. I hope to have shown that these questions can be partially answered through empirical research (especially of a comparative nature) without eliminating the humane value orientation that has informed the historic usage of this body of thought, for the moral power
inherent in the alienation tradition has been its view of man as potentiality. A social scientist must emphasize a sober, non-romantic understanding of man as he is, in terms of present levels of aspirations and achievements. But we cannot assume that men are only what they are at present or what they themselves desire to become. There is a need to fuse an empirical, realistic approach with the valuable humanistic tradition of alienation theory that views all human beings as being potentially capable of exercising freedom and control, achieving meaning, integration, social connection, and self-realization. There is always a strain between empirical tough-mindedness and human relevance in social research, and in such areas as the study of alienation in work it is especially essential that this conflict be overcome. (Blauner, 1964, p. 187)

One might conclude, as Blauner did, that the social implications and context of rapid technological change mandate further empirical research for the purpose of better understanding "the complexities of the modern social world" (Blauner, 1964, p. 187). One might also conclude that additional analytical questions and problems still remain. One final criticism of Blauner is that this social world he spoke of is much broader than the world of industrial production—the question arises whether these variables have any implications for everyday social existence. Even so, Blauner built a firm intellectual foundation upon which the task of empirical and analytical clarification can be further pursued. This thesis continues on that path.

Technocracy Revisited: Bell's Post-industrial Society

Daniel Bell saw technology as the underpinning of a new social-political order. The crux of Bell's thesis is that the axes of stratification in contemporary post-industrial society will be based more on knowledge and less on property (Bell, 1976, p. 374). He identified four estates which will compete for political power in this society, specifically, (a) scientific, (b) technological, (c) administrative, and (d) cultural.
While [these] estates, as a whole, are bound by a common ethos, there is no intrinsic interest that binds one to the other, except for a common defense of the idea of learning, in fact there are large disjunctions between them. The scientific estate is concerned with the pursuit of basic knowledge and seeks, legitimately, to defend the conditions of such pursuit, untrammeled by political or extraneous influence. The technologists, whether engineers, economists, or physicians, base their work on a codified body of knowledge, but in the application of that knowledge to social or economic purposes they are constrained by the policies of the different situses they are obedient to. The administrative estate is concerned with the management of organizations and is bound by the self-interest of the organization itself (its perpetuation and aggrandizement) as well as the implementation of social purposes, and may come into conflict with one or another of the estates. The cultural estate—artistic and religious—is involved with the expressive symbolism (plastic or ideational) of forms and meanings, but to the extent that it is extensively concerned with meanings, it may find itself increasingly hostile to the technological and administrative estates. . . . Thus in the post-industrial society one finds increasingly a disjunction between [technical-rational] social structure and [antinomian and anti-institutional] culture which inevitably affects the cohesiveness if not the corporate consciousness of the four estates. (Bell, 1976, p. 376)

Bell identified a growing technical-rational trend in industrial societies, culminating in the supremacy of scientific and technical occupations which would constitute a new class. Bell refuted Saint-Simon's conception of technocracy, and instead substituted a vision of a society in which scientific and technological knowledge laid the foundation for a "true" meritocracy. In spite of citing several problems with such a knowledge-based social hierarchy (e.g., bureaucratization of science, antinomian dissent, increasing difficulty maintaining consensus) Bell painted an optimistic picture of the post industrial society. Particularly, the aspect of humankind's release from the limitations of nature and materialism.

For most of human history, reality was nature, and in poetry and imagination men sought to relate the self to the natural world. Then reality became technics, tools and things made by men yet given an
independent existence outside himself, the reified world. Now reality is primarily the social world—neither nature nor things, only men—experienced through the reciprocal consciousness of self and other. Society itself becomes a web of consciousness, a form of imagination to be realized as a social construction. Inevitably, a post-industrial society gives rise to a new Utopianism, both engineering and psychedelic. Men can be remade or released, their behavior conditioned or their consciousness altered. The constraints of the past vanish with the end of nature and things. (Bell, 1976, p. 488)

Bell's utopian forecast is reminiscent of Hegel's Weltgeist, or that of universal reason or consciousness. However, such a conclusion, as critiqued earlier, is a teleological fallacy. Dialectically, reason and knowledge are inseparable from the subject-object interfaces of human action and experience. Granted, people inevitably construct social reality, but not independently of the larger social context diagrammed earlier in this manuscript. Bell identified technological knowledge as an important variable in sociological analyses, but failed to explain the process by which this knowledge operates to generate social consequences. In fact, Bell's vision appears very similar to the elitist ideology of Saint-Simon which he took such care to critique. Harry Braverman suggested that Bell is typical of most academic sociologists "[who write about] occupations, work, skills, etc. without even bare familiarity" (Braverman, 1974, p. 106). Bell tended to reify all forms of knowledge and ignore the objective conditions and social relations which create and maintain human knowledge and experience. Braverman, in the Marxian tradition, asserted that technological and scientific knowledge can also be utilized by economic elites to maintain control and power over workers. In addition, this knowledge is not then experienced by workers as Utopian freedom, but instead, as alienation and oppression.
Braverman, Technology, and the Social Relations of Production

Harry Braverman, like many of the contemporary sociologists examining the social implications and conditions of work, credited Marx as a primary reference in his theoretical foundation. Braverman was specifically concerned with the relationship between technological processes and ownership and control of the means of production. His primary campaign was one in opposition to crass technological determinism, of which he saw Bell as a proponent.

[The] tendency of modern social science is to accept all that is real as necessary, all that exists as inevitable, and thus the present mode of production as eternal. In its most complete form, this view appears as a veritable technological determinism: the attributes of modern society are seen as issuing directly from smokestacks, machine tools, and computers. We are, as a result, presented with a theory of a societas ex machina, not only a determinism, but a despotism of the machine. (Braverman, 1974, p. 16)

Note that although Braverman claimed to make a distinction between technological processes and products, this distinction was not well developed. However, in terms of process, he did offer an analysis of how people come to see machines as independent and separate from their makers, owners, and operators. Braverman again drew from Marx in his analysis of how this phenomena comes about.

It has become fashionable, however, to attribute to machinery the powers over humanity which arise in fact from social relations. Society, in this view, is nothing but an extrapolation of science and technology, and the machine itself is the enemy. The machine, the mere product of human labor [processes] and ingenuity [i.e., knowledge], designed and constructed by humans and alterable by them at will, is viewed as an independent participant in human social arrangements. It is given life, enters into the "relations" with the workers, relations fixed by its own nature, is endowed with the power to shape the life of mankind, and is sometimes even invested with designs upon the human race. This is the
reification of a social relation; it is . . . nothing but a fetishism, in Marx's sense of the term. (Braverman, 1974, p. 229)

Unfortunately, Braverman left these rich insights behind and pursued a treatise on how technological processes are primarily a function of the capitalist mode of production with the implicit goal of exerting control over work and workers. This, according to Braverman, is accomplished through the deskilling of jobs and intentional alienation and subordination of workers. The majority of Braverman's analysis involved how the objective conditions of work serve to maintain capitalist domination over the worker. Braverman concluded that technological knowledge and control must be restored to the worker if social democracy and freedom are to be maintained; recent attempts at "workplace democracies" cannot substitute for the larger social democratic reality.

Without the return of requisite technical knowledge to the mass of workers and the reshaping of the organization of labor—without, in a word, a new and truly collective mode of production—balloting within factories and offices does not alter the fact that the workers remain as dependent as before upon "experts," and can only choose among them, or vote for alternatives presented by them. Thus genuine workers' control has as its prerequisite the demystifying of technology and the reorganization of the mode of production. (Braverman, 1974, p. 445)

Braverman correctly concluded that social and technological knowledge and processes are indelibly intertwined. Most enlightening, though poorly developed, is the idea that this knowledge becomes reified and becomes fetishisms, i.e., abstract social relations which mistakenly (though possibly intentionally) come to be seen as separate from human knowledge and action, and subsequently become experienced as part of the objective material world. This is particularly problematic for workers in a monopoly capitalist economy where it is to the benefit of the capitalist to support and maintain such
reifications and fetishisms for their own benefit. In light of Braverman's analyses, Bell's technological meritocracy seems only an oxymoron phrase.

Even given Braverman's strong analytical foundation upon which to build further analyses, the same criticisms made of Blauner can be made of Braverman. Monopoly capitalism is not a social relation limited to workers and laborers. The range and scope of technological, social, and scientific knowledge exceeds that of the common workplace. Can the concepts of alienation, reification, and fetishisms extend to the individual, family, or other social institutions? In a world where knowledge grows exponentially, particularly technological knowledge, what then becomes the larger social implications and impacts of these phenomena? Braverman rightfully suggested that a more comprehensive analysis of the relationship between social, scientific, and technological knowledge, process, products, and experiences be undertaken.

Edwards and the Transformation of the Workplace

Richard Edwards also asserted that control over work and workers is the primary function of technology in a monopoly capitalist society. He initially proposed, like Braverman, that alienation in the workplace results from a long history of capitalist social relations and the mode of production.

The change [in the workplace] does not reflect inevitable consequences of modern technology or of industrial society, but rather . . . the transformation occurred because continuing capital accumulation has propelled workers and their employers into virtually perpetual conflict. And while both technology and the requirements of modern social production play a part in the story . . . the roots of this conflict lie in the basic arrangements of capitalist production. (Edwards, 1979, p. 10)

Edwards outlined two broad types of emerging workplace structural controls which superseded the "simple" oppressive controls of the early small
entrepreneurs. The first is technical control, which involves designing control mechanisms into the technological process of production. The second is bureaucratic control, which brings the social structure into play by creating and enforcing hierarchical knowledge and decision structures. This bureaucratic control inevitably evolves into an institutionalized social structure of workplace relations (Edwards, 1979, pp. 20-21).

The typology of control embodies both the patterns of historical evolution and the array of contemporary methods of organizing work. On the one hand, each form of control corresponds to a definite stage in the development of the representative or most important firms; in this sense structural control succeeded simple control and bureaucratic control succeeded technical control, and the systems of control correspond to or characterize stages of capitalism. On the other hand, capitalist production has developed unevenly, with some sectors pushing far in advance of other sectors, and so each type of control represents an alternative method of organizing work; so long as uneven development produces disparate circumstances, alternate methods will exist. (Edwards, 1979, p. 21)

Edwards went to great lengths to describe the transition of the western economy into monopoly capitalism. Most important, according to Edwards, was the Marxian notion that labor must become and remain a commodity, subject only to the profitability of the controlling capitalists. Edwards reasserted, after Braverman, that the social relations of production inevitably influence, if not dictate, the types of control employed, particularly technical controls.

How something is produced is in large part dictated, of course, by the nature of the product and by the known and available technologies for producing [it]. It is well known that most industries confront a variety of possible techniques, and that relative costs of required inputs will influence which is [chosen]. What is less well known is that there is also an important social element in the development and choice of technique. Firms confront a
range of techniques that differ not only with respect to required inputs, but also in the possibilities for control over their workforce. A superior technology may be one that facilitates the transformation of the firm’s labor power into useful labor, even if that technology entails a larger bill for other inputs or even a larger wage bill per hour of operation. (Edwards, 1979, pp. 111-112)

Put more simply, Edwards proposed that the technique (technological process) most often chosen is the one that consistently elicits the greatest amount of work out of each worker. This is what Edwards called technical control and, following Marx, was described as "designing machinery and planning the flow of work to minimize the problem of transforming labor power into [commodified] labor as well as to maximize the purely physically based possibilities for achieving efficiencies" (Edwards, 1979, p. 112). Often, this involves removing the knowledge and control of the technical process from the worker and embedding them in the structure of the organization and work process itself.

Technical control emerges only when the entire production process of the plant or large segments of it are based on a technology that paces and directs the labor process. When that happens, the pacing and direction of work transcend the individual workplace and are thus beyond the power of even the immediate boss; control becomes truly structural. (Edwards, 1979, p. 113)

Not only does this restructuring of work and workplace controls create gaps between a worker's knowledge, action, and experience, but the situation tends to result in what Edwards called the "mystification" of technology. In other words, the workers tend to "fight the line" or "beat the clock" and lose track of the fact that the technology is first and foremost a product and process of directed human knowledge.

In this dazzle of new technology the workers are almost lost from sight. With their activities and productivity constantly being directed and
monitored by the computer hierarchy, workers find even less opportunity to exercise and control over their work lives. Their immediate oppressor becomes the programmed control device, the programming department, the printout—in short, the technology of production. In this environment, the human hierarchy and the capitalist organization of production that has produced the technology appear to recede. Control becomes truly structural, embedded in that hoary old mystification, technology. (Edwards, 1979, p. 125)

One might be quick to criticize Edwards in the same fashion as Blauner and Braverman—the analysis is useful in understanding workplace relationships, but what of the larger social milieu? Edwards was also willing to extend his arguments to more general arenas.

The rise of technical and bureaucratic control inside the core corporations altered the way in which core firms recruit, direct, evaluate, motivate, and discipline their workforces. These two forms of control, and the residual simple control in forms of the competitive periphery, all give rise to distinct labor market processes; indeed, when combined with the economic manifestations of racism and sexism, these forces have led historically to the segmentation of labor markets. The institutionalization of these various forces in the operation of segmented labor markets has in turn created the material basis for enduring divisions or fractions within the working class. This process has created, as distinct elements [sic], the working poor, the traditional proletariat, and the middle layers. Enduring divisions by race and sex create further and overlapping fractions of black workers and female workers. Each of these groups remains subject to the yoke of capitalist employment, yet each also experiences that employment under different concrete conditions. Since these differences have been institutionalized in the economic structure of society, and more fundamentally since they serve the needs of capital accumulation, they persist. (Edwards, 1979, p. 197)

Edwards saw technology (i.e., technique) as a means by which economic elites maintain control over the rest of the workforce, and subsequently, over the lower echelons of the economic population. Although he addressed the "mystification" of technology, i.e., the aspect of the reification of technology, he did not really develop how technological knowledge differed
from technique or product. Unlike Mannheim and Marcuse, Edwards did not address how the stratification of technological knowledge acts to create and maintain power and authority structures. Unlike Weber and Marx, Edwards did not develop the concept that power (and authority) are dialectically contingent upon legitimation and belief structures upheld by the oppressed themselves. Such a distinction is necessary if technical and bureaucratic control structures are to be studied as part of a larger intersubjective social structure. Nonetheless, Edwards offers yet another insight into how technology can be utilized to effect other social and scientific ends, often resulting in the latent experience of alienation by other individuals. Edwards analyzed the transformation of the workplace in terms of technical and bureaucratic controls. Harley Shaiken (1986, p. xi) raises the next question: "The technical potential of this transformation in production—higher productivity, better quality, and increased flexibility—is far reaching and widely heralded. But, what about the social implications?"

Shaiken and the Technological Transformation of Work and Society

Harley Shaiken witnessed technological changes in the workplace firsthand as a skilled machinist. Now an associate professor and well-recognized analyst of trends in the automobile industry, he offered a very insightful challenge to the "neutrality and inevitability" of the "hidden ways in which technology shapes our lives" (Shaiken, 1986, p. ix). Though his primary focus was on computer technology in the workplace, he also was sensitive to the effects of technology on the human condition in general.

[Far reaching] technological changeover raises some pivotal questions that affect the entire society. Since any advanced industrial economy is heavily dependent on manufacturing, changes of this significance in the technology of production are bound to have repercussions far beyond
the factory walls. For example, will these new technologies spur economic growth and the creation of new jobs or will they be introduced in a way that decimates employment? Will automation free workers from soul-destroying work or will it lay the basis for subordinating people to machines in a new and degrading way? Will computerization be used to rebuild the nation's industrial base or will it facilitate the ability of multinational corporations to operate independently of any given country? (Shaiken, 1986, p. 3)

Shaiken's thesis is that technology is both a human choice and, simultaneously, an antecedent for new choices. What becomes problematic, according to Shaiken, is when the control of these choices is removed from the people which they affect. In the workplace, this is done through two processes. These processes are (a) complete automation, which removes physical human input from the technical process of work and, (b) deskilling, or the removal of knowledge and decision making from the technical process of work (Shaiken, 1986, p. 5). The real strength of Shaiken's argument is in his treatment of sociological and technological choices. "Unfortunately, technical possibilities and social purposes do not come in neatly labeled packages but are often intertwined in a complex and rapidly changing environment. . . . Moreover, the development of technology is a dynamic process that changes in response to the environment" (Shaiken, 1986, pp. 10-11). This is as good a statement as any other so far in outlining the interrelationships of technology and society.

Shaiken saw and clearly delineated human knowledge, choices, action, and experience, from both a technological and sociological vantage point. "Computer-based automation is not found in nature. These new machines and manufacturing systems are designed by human beings who have certain purposes in mind, both technical and social" (Shaiken, 1986, p. 45). The
contradiction, according to Shaiken, is that increases in "technical productivity" often result in decreased social productivity. The social impacts of these technologies include (a) a degradation of work and self, (b) a quantifiable loss in other areas of productivity, for example, maintenance, (c) a loss of individual knowledge and skills and, (d) the loss of human creative potential (Shaiken, 1986, p. 5).

Developing automation in this direction [i.e., the elimination of human inputs] carries with it some long-term costs for society. In fact, there is a fundamental contradiction between the potential of computerization to enrich working life and increase productivity and the development of the technology in the pursuit of authoritarian social goals. The moral cost is that people's lives become diminished through the degrading their work. The productivity loss stems from the inability of systems that reduce the input of workers to fully utilize the skill, talent, experience, and creativity that only human beings can provide. Moreover, in seeking to bypass human input at almost any price, new systems often achieve a breathtaking complexity that is prone to breakdown and consequently requires even greater human input [e.g. installation, maintenance, upgrades]. (Shaiken, 1986, p. 5)

What Shaiken feared most is a society in which knowledge and practice are politically and economically separated. In fact, he pointed out the inevitable dangers of artificially separating social, scientific, and technological knowledge and action.

Could human intelligence have arisen independently of the practical needs it served? The answer is undoubtedly no. Could modern science have developed in a society where craftsmanship and manual work were regarded as unbefitting to the thinker? Again the answer must be no: a Greek philosopher could in principle have carried on experimental science through the agency of a slave; but those questions which could be answered only with a slave's assistance would have appeared unworthy of the philosopher's attention. So if, in an industrial society, intellectual and manual work come to be finally and completely divorced, there must be a doubt whether this will not destroy the basis on which science and industrial development have themselves been able to flourish. There can, at a more personal level, be no doubt
at all that to deny the experience of interaction between theory and practice is damaging to the individual. (Shaiken, 1986, pp. 223-224)

Shaiken's substantive work involved description of changes on the machine shop floor, particularly robotics, NC machining, CAM, and the shift of decision making, "skill," and control from the skilled machinist to technocrats such as engineers and managers. His response was to propose a more democratic workplace and an elimination of the stratification of knowledge, skills, and decision making within the socio-technical enterprise.

The process of technological change does not take place in a vacuum. Without a more democratic control of the enterprise as a whole, the social control of technology will remain an illusion. . . . Ultimately, the issues transcend collective bargaining and their political character becomes apparent. At stake is a more democratic structure of economic as well as political decision-making. (Shaiken, 1986, p. 277)

The antecedent to a more democratic political and economic participation is a more democratic distribution of knowledge and opportunity. According to Shaiken, technology as it is applied today tends to remove knowledge and opportunity from the worker and inevitably reduces the quality of work life. The question remains as to how one brings about such a change.

One essential force is a revitalized labor movement willing and able to take on these larger challenges. While the risks are significant, labor is unlikely to hold on to its traditional gains unless they are taken. But the issues raised by this technological transformation [i.e., the elimination of direct human inputs] affect more than labor: They are issues of central concern to the entire society. When work is electronically demeaned in the office or the factory, the repercussions carry far beyond the workplace. Work remains a central part of life; diminishing the human contribution on the job diminishes the quality of life off the job. And, a more authoritarian workplace could have a corrosive effect on democratic values throughout society. Whether we like it or not, the design of machines reflects social values as well as technical needs. The ideas and experience of those who are affected by new designs can help ensure that computerization will be a force that aids in liberating
people rather than a vehicle for increased authority and control. (Shaiken, 1986, pp. 277-278)

Shaiken concludes with a Technology Bill of Rights. His approach was based on six assumptions (Shaiken, 1986, pp. 271-272).

1. A community has to produce in order to live. As a result, it is the obligation of an economy to organize people to work.

2. The well-being of people and their communities must be given the highest priority in determining the way in which production is carried out.

3. Basing technological and production decisions on narrow economic grounds of [short-range] profitability has made working people and communities the victims rather than the beneficiaries of change.

4. Given the widespread scope and rapid rate of introduction of new technologies, society requires a democratically determined institutional, rather than individual, response to changes taking place. Otherwise, the social cost of technological change will be borne by those least able to pay it: Unemployed workers and shattered communities.

5. Those that work have a right to participate in the decisions that govern their work and shape their lives.

6. The new automation technologies and the sciences that underlie them are the product of a worldwide, centuries-long accumulation of knowledge. Accordingly, working people and their communities have a right to share in the decisions about, and the gains from, new technology.

Shaiken's proposal involves a unity of social, scientific, and technological means and ends. He acknowledged that technology is historically, first and foremost, a body of knowledge. People act upon that knowledge which results in various technical and social consequences. Often these consequences are negative, individually, and/or socially. Shaiken suggested this is due to the fact that some people monopolize control over some technological means and
ends which often adversely affect others who lack those controls. Shaiken asserted that such a situation is not only undemocratic, but potentially tragic.

The choice should not be new technology or no technology but the development of technology with social responsibility. Therefore, the precondition for technological change must be the compliance with a program that defines and insures the well being of working people and the community. (Shaiken, 1986, p. 272)

Such a guarantee, according to Shaiken, involves three things (Shaiken, 1986, pp. 272-273).

1. New technology must be used in a way that creates or maintains jobs.
2. New technology must be used to improve the conditions of work.
3. New technology must be used to develop the industrial base and improve the environment.

Shaiken offered a very substantive analysis of the relationship between technological and sociological means and ends. It was not his intention to detail the actual reification process by which people come to separate these bodies of knowledge and their respective processes and products. He did point out, however, that to do so inevitably results in the experience of alienation and a reduction in the quality of life of individuals and other social groups. More importantly, Shaiken offered the insight that technology can and should be a vehicle for the liberation of people. Other writers have also focused on the potentially constraining and oppressive effects of computer technologies. One such author is Barbara Garson.

Deskilling and the Degradation of Work: Barbara Garson

Barbara Garson may be best known as a journalist, playwright, and author. However, her extensive use of ethnographic research methods and
concern with the social aspects of work warrants the inclusion of her findings in this thesis. Her book *The Electronic Sweatshop* (1988) empirically addressed cases in which technology was used as a specific means of controlling work and workers, with the result being that the quality and meaning of work was diminished. Her thesis is clear:

Right now a combination of twentieth-century technology and nineteenth-century management is turning the Office of the Future into the factory of the past. At first this affected clerks and switchboard operators, then secretaries, bank tellers and service workers. The primary targets now are professionals and managers. . . . [The] effect is to centralize control and make decision making higher up in the organization. (Garson, 1988, pp. 10-11)

This was the goal that guided nineteenth-century industrial management. The same principles that transformed craftsmen into factory hands are now being applied to make white-collar workers cheaper to train, easier to replace, less skilled, less expensive and less special. (Garson, 1988, pp. 10-11)

Garson treated technology as an aspect of the work process. However, her thesis suggested that the important factor which influences this process is the technical knowledge behind the design of the work itself.

I started this research with definite ideas about the industrialization of office work. I was continually surprised, however, at how much further the process had gone than I'd imagined. Extraordinary human ingenuity has been used to eliminate the need for human ingenuity. I can't help but convey admiration for the automaters when I describe the machines and systems they've developed.

I was also repeatedly surprised by the wit and acumen of the people being automated. Of course human intelligence is something I expected to [find].

The one thing I didn't anticipate was the underlying motive. I had assumed that employers automate in order to cut costs. And indeed, cost cutting is often the result. But I discovered in the course of this research that neither the designers nor the users of the highly centralized technology I was seeing knew much about its costs and benefits, its bottom-line efficiency. The specific form that automation is
taking seems to be based less on a rational desire for profit than on an irrational prejudice against people. (Garson, 1988, pp. 12-13)

Garson expressed this argument in Weberian terms. The technology of the modern office, according to Garson, is one of bureaucratic means-ends calculations. However, the means are legitimized in terms of efficiency and profit, whereas the ends are experienced as control and the degradation of work. Garson called this techno-bureaucratic trend the "second industrial revolution" (1988, p. 11). It is characterized by technologies and workplace designs that maximize controls over work and workers, at the expense of human input, responsiveness, and flexibility. One result, according to Garson, is that "service" jobs can no longer provide service. An example of this phenomena is the McDonald's corporation.

By combining twentieth-century computer technology with nineteenth-century time-and-motion studies, the McDonald's corporation has broken the jobs of griddleman, waitress, cashier and even store manager down into small, simple steps. Historically these have been service jobs involving a lot of flexibility and personal flair. But the corporation has systematically extracted the decision-making elements from filling french fry boxes or scheduling staff. They've siphoned the know-how [i.e. technical knowledge] from the employees into the programs. They relentlessly weed out all variables that might make it necessary to make a decision at the store level, whether on pickles or on cleaning procedures. (Garson, 1988, p. 37)

This control over the work process was achieved through rational technical designs including computerized fry vats, bell timers, work scheduling by national normative standards, and even cash registers without numbers so clerks could not make mathematical entry mistakes. Like Shaiken, Garson pointed to a larger trend of deskilling and the removal of decision making from the shop floor to the bureaucratic organization. McDonald's store managers were turned into "operators" in much the same way skilled craftsmen were
transformed into operators through the use of numerical controls and computer technologies. Garson interviewed a McDonald's store operator:

"Jon," I said. "This has been fantastic. You are fantastic. I don't think anyone could explain the computers to me the way you do. But I want to talk to someone who's happy and moving up in the McDonald's system. Do you think you could introduce me to a manager who . . ." "You won't be able to."

"How come?"

"First of all, there's the media hotline. If any press comes around or anyone is writing a book I'm supposed to call the regional office immediately and they will provide someone to talk to you. So you can't speak to a real corporation person except by arrangement with the corporation.

[Second], you can't talk to a happy McDonald's manager because 98 percent are miserable.

[Third of all], there is no such thing as a McDonald's manager. The computer manages the store." (Garson, 1988, pp. 38-39)

The net effect is that you have computers managing people instead of the other way around. Garson pursued and confirmed her thesis through the examination of several occupations and individual workers. Computers, according to Garson, were irrefutably removing human knowledge, decision making, and controls from work and workers and subsequently locating them in the technical process and minds of the bureaucratic corporate representatives. What is even more problematic, according to Garson, is the fact that this type of technology can be self-regulating and self-correcting. The issue of covert monitoring of work and workers also threaded through Garson's studies. The computers could not only direct the work, but log all deviations from standard operating procedures. Such was the case with ticket agents in the airline industry, social workers in the human services arena, and even stock brokers on Wall Street. All expressed a general degradation of their jobs as computers were introduced into the respective industries. All expressed
frustration with the inflexibility of the automated systems and the lack of human inputs and controls. All related their fears and frustrations concerning the covert monitoring and statistical evaluations of their performance—performance over which they felt they had little or no individual control.

At the heart of Garson's thesis is human knowledge—the bureaucrat's and technocrat's distrust of it. "The underlying premise of modern automation is a profound distrust of the thinking of human beings. More than any particular technology, this unanalyzed prejudice against people determines the way work is organized" (Garson, 1988, p. 261). However, the removal of this knowledge from human experience only exacerbates the problem; mindless jobs produce mindless people with limited individual and social expectations. "It's a vicious circle, eventually producing a labor force fit [only] for McDonald's" (Garson, 1988, p. 40).

Eventually, the stratification and control of the knowledge becomes justified, i.e., legitimized, in the psyche of the workers and owners. Garson hinted at how this operates and becomes reified in the larger social dialectic.

Computers may be used in many ways. Like the sewing machine, the computer is just a tool. A sewing machine can be used by one person to make an entire dress. It can also be used in a sweatshop to sew zippers or right cuffs so fast and such small, repetitious motions that the result is eye strain, neck ache and damage to the wrists.

During the first industrial revolution, manual workers like weavers, iron molders, and sewing machine operators were systematically de-skilled, separated from decision making and frequently displaced or discarded. It was a horrible hundred years, justified in the name of progress. In the place of "progress" a similar abstraction [i.e., reification], "the economy," is used today to justify sacrifices made by working people. Through a peculiar inverse anthropomorphism, "the economy" can somehow be doing well while the majority of people are doing poorly. (Garson, 1988, p. 262)
Garson pointed to gaps in the social dialectic. Those gaps were created and maintained through the separation of knowledge and decision making from human action. The result, again, was the experience of alienation by workers and the eventual degradation and stratification of the workforce as a whole.

Garson ends on a Marxian note.

Hierarchical automation is arranged on the assumption that most people are lazy, stupid or hostile. All over the world, technology is controlled undemocratically by people who scorn, fear or simply want to use their fellow human beings.

But it seems clear to me that people want and need to work. The joy we feel in planning and carrying out a task is probably biological [note the similarity here with Marx's concept of species being]. Any system that expends so much money and energy on limiting instead of using human creativity has got to be inefficient. Yet the individuals now making basic decisions about white-collar automation assume that the best way to run things is to further centralize control—with themselves in command. (Garson, 1988, pp. 262-263)

It is important to note that such decision making capabilities concerning automation are a result of the stratification of technical knowledge—know-how. It also reflects the undemocratic nature of such stratification. It is accompanied by the real possibility that human skills, knowledge, and abilities may become vestigial, and the technocracies envisioned by Saint-Simon and Bell may be close at hand. Like Blauner, Edwards, and Shaiken, Garson insisted that workers must regain control over the knowledge and process of their work.

There are many ways to combine the efficiency of computers with the skills and talents of human beings. Frankly, though, I doubt that our workplaces will change simply because we start dropping pro-people ideas into the suggestion box. The pull in the other direction is very powerful. Still, if we insist forcefully enough, perhaps it's not too late to say, "We want the computer but not the sweatshop." (Garson, 1988, p. 263)
Even though Garson's primary focus was on popular culture, she still addressed the functions and implications of technology in the larger social dialectic. However, like many other writers from an ethnographic "sociology of work" approach (e.g., Blauner, Shaiken, etc.), she failed to extend the argument to human experience outside of the workplace. There are a few good examples of popular writers who have tried to extend the social impacts of technology into everyday life and the larger sociocultural realm. One such writer is O.B. Hardison, Jr.

On Technology, Culture, and Knowing: O. B. Hardison, Jr.

When compared with the ethnographic substance of Garson, or Blauner, for example, Hardison's work seems exceedingly esoteric. At the same time, it typifies the problem Hardison described: Technology is a product of human knowledge and at the same time shapes human knowledge. In intersubjective terms, technology can and does alter the very meaning structures by which we interpret and impose order on the world. In addition, new technologies may impose experiences on us which we have neither the language to interpret nor the reference frame by which to understand those experiences. Hardison's own analytical frame of reference has been influenced heavily by the science of chaos (see Gleick, 1987). Hardison appeared to say that human culture represents a continuing history of human constructions and impositions of order on random patterns in nature. Kant's dilemma concerning the origins of knowledge and limits of knowing also haunted Hardison.

Today, nature has slipped, perhaps finally, beyond our field of vision. We can imitate it in mathematics—we can even produce convincing images of it—but we can never know it. We can only know our creations. (Hardison, 1989, p. 1)
Our creations and the experience of them was the main focus of Hardison's work. He identified five areas which technology has changed our fundamental cultural references: (a) ideas about nature, (b) our understanding of history, (c) language itself, (d) art, and finally, (e) our understanding of human evolution. Technology has extended the realm of experience outside of the human ability to know, understand, and express. Examples of this phenomena include the study of sub-atomic particles, deep space, the fossil record, etc.

The framing assumption Hardison based his work on is a realization that the largest part of what we believe to be "objective" reality is in fact subject to the human objectivation process. This realization, though debated for centuries in philosophical and scientific circles, was only verified after computer programs were written which simulated the "unfolding" of natural phenomena. What was found in these simulations is the fact that natural phenomena are decidedly random in occurrence. However, in this randomness, patterns can be discerned. What we cannot know, can never know, is the real nature of this phenomena, i.e., to what extent the patterns are contingent upon the human desire to impose such order on a fundamentally random world. The dilemma is exacerbated if the line of thought is pursued. If people do in fact impose the concept of order on random natural phenomena, what might be the alternative? Wouldn't it also be true that disorder would be a human imposition on nature? Indeed, computer technology allows people to simulate nature. It still cannot provide the framework of understanding needed to arrive at any more substantive conclusions about the nature of reality. In fact, it invariably moves empirical observation outside of the realm of the senses and back into forces unseen and exceedingly mystical.
Having put this fundamental query aside, Hardison then asserted that technology is making nature itself "invisible." It challenges the historical categories and patterns we have constructed to interpret, understand, and express the "real" world.

In its fearless exploration of inner and outer worlds, modern culture has evidently reached a turning point—a kind of phase transition from one set of values to another. Crossing the barrier that separates the phases is another kind of disappearance.

The nature of that barrier is nicely characterized in a phrase developed by science in connection with the search for extraterrestrial life: "Horizon of invisibility."

A horizon of invisibility cuts across the geography of modern culture. Those who have passed through it cannot put their experiences into familiar words and images because the languages they have inherited are inadequate to the new worlds they inhabit today. They therefore express themselves in metaphors, paradoxes, contradictions, and abstractions rather than languages that "mean" in a traditional way—in assertions that are apparently incoherent or collages using fragments of the old to create enigmatic symbols of the new. (Hardison, 1989, p. 5)

The human capacity to understand and interpret is invariably dependent on language and symbols. Hardison proposed that modern technologies have extended the scope of human experience beyond the human capacity to express and understand them.

The most obvious case in point is modern physics, which confronts so many paradoxes that physicists like Paul Dirac and Werner Heisenberg have concluded that traditional languages are, for better or worse, simply unable to represent the world that science has forced on them. (Hardison, 1989, p. 6)

However, the question remains as to whether Hardison sees science as an imposition on culture, or, instead, whether culture ultimately imposes science on the rest of the world. Nevertheless, given that people have now proven that random patterns (or patterned randomness) is the real state of
nature, the problem becomes constructing patterns of thinking and acting (i.e., culture) which are in harmony with such a nature. This problem has historically been addressed by the imposition of references, assurances, and verities on the material world such as science, history, language, etc. These, according to Hardison, are "necessary fictions."

The mind cannot get along with them, but it cannot get along without them either. They organize experience just as religion, mythology, and tradition organize it. They are the preconditions of knowledge. . . . [The] world is a fiction, but perhaps we will eventually discover that the fiction makes sense. (Hardison, 1989, p. 47)

Hardison asserted that science and culture are becoming more and more abstract as a result of technologies that access the invisible and inexplicable random patterns of nature. Proportionally, our need to understand and construct appropriate cultural artifacts and references increases.

Quantum theory shows that nature cannot be separated from the person observing it. Quark theory suggests the existence of entities that can never be observed. By proposing that everything in the universe comes from nothing, the inflationary theory makes the disappearance of nature official. (Hardison, 1989, p. 56)

To many people, the world of quarks and black holes is an affront. Humanity seems to have leaked out of it. To others it is a playful world—a world of games and necessary fictions, although some of the fictions are more necessary than others. The choice of fictions may be decided by the throw of a die, but perhaps not. The question is probably being asked in terms of a past that no longer exists rather than a present that may not exist but is as good a bet as any when you're playing against the house. (Hardison, 1989, p. 57)

The point Hardison made is that technology inevitably shapes, reshapes, and is shaped by these necessary fictions which, taken collectively, are called culture. Technology has resulted in the experience of an unseen reality of subatomic particles like quarks, muons, gluons, and anti-quarks. On the other end of the reality spectrum, people have been subjected to black holes, warped space,
and the birth of the universe as accurately as to within $10^{-43}$ second. Such things negate the historical scientific conceptions of reality—that reality is hard, impenetrable, measurable, massive and, above all, empirically observable (Hardison, 1989, p. 58). Ironically, while science becomes more and more to resemble a human abstraction, art, through technology, takes on ever-more "natural" forms. Witness fractal geometry and computerized art. Contrary to Bacon and the crass positivists, Mandelbroit "is not out to reproduce nature but to make convincing models of it" (Hardison, 1989, p. 60). The result is a wedding of technology, science, mathematics, and aesthetic culture. Technology, as suggested by Hardison, has turned science and nature on their heads. Science and nature are limited human constructions while art, particularly in its computerized self-generating forms, can truly represent "nature" in a pristine state.

The science of the late 20th century asks man to understand himself in light of his own reason detached by his history, geography, nature, and also from myth, religion, tradition, the idols of the tribe, and the dogmas of the fathers. It offers likenesses of nature, not nature, and suggests further that nature is a project created in part by man. Culture is an artifact and probably a game, and what happens in it is the result of human rather than divine will.

Objectifying this understanding of things requires new languages [i.e., significations; see Berger & Luckmann, 1967, for an extended discussion]. (Hardison, 1989, pp. 70-71)

If science is a human creation, we have caught the mind in the very act of swallowing up the world, which is another way of saying that we have witnessed nature in the process of disappearing. The steps are neatly defined by the figures of Charles Darwin [progressive evolution], D'Arcy Thompson [geometric forms and shapes], and Benoit Mandelbroit [fractal geometry]. They take us from a nature that is alien and into which human motives are poured, to a nature that is number—but number authenticated by an absolute order—to an imitation of nature by means of a number that is also a form of art. (Hardison, 1989, p. 71)
A fundamentally different understanding and experience of science—a fundamentally different nature—derives from the modern technological objectivation of knowledge. Accordingly, a different perspective on the world is called for. Hardison pointed out that as the scope of scientific knowledge and experience increased, the homogeneity of culture and cultural artifacts also increased. The result, according to Hardison, is the disappearance of progress and history.

Science is committed to the universal. . . . [As] the corollary of science [sic], technology also exhibits the universalizing tendency. This is why the spread of technology makes the world look ever more homogeneous. Architectural styles, dress styles, musical styles—even eating styles—tend increasingly to be world styles. The world looks more homogeneous because it is more homogeneous. Children who grow up in this world therefore experience it as a sameness rather than a diversity, and because their identities are shaped by this sameness, their sense of differences among cultures and individuals diminishes. As buildings become more alike, the people who inhabit the buildings become more alike. The result is described precisely in a phrase that is already familiar: the disappearance of history. (Hardison, 1989, pp. 142-143)

Indeed, Hardison saw technology at the core of a long-term trend toward cultural homogeneity. However, such a trend must be accompanied by the ability of individuals to know, understand, and express themselves in meaningful and culturally relevant ways.

Cultural evolution should not be understood, any more than biological evolution, in terms of movement from bad to good or good to better. Its absolute direction is best symbolized by an arrow pointing down a dark corridor.

There is, however, a unifying theme. Every advance in culture has been an advance in communications and has encouraged ever-larger organizations of the human beings who produced it. . . . The movement has its downs and ups but the direction is continuous. . . . With every day that passes it becomes a little more impossible for us to act or think otherwise than collectively. (Hardison, 1989, p. 288)
Even so, a collective identity can come no closer to a more comprehensive understanding of science, technology, and culture than an individual can. The possibility always remains that all the birds are flying in the wrong direction. The risk, according to Hardison, is that we may lose sight of what it means to be human. With artificial intelligence, expert systems, self-generating art, science, and material culture, a growing gap is created between rational action, human experience, and knowledge itself.

People have tried to create machines in their own image, only to find that the act itself inevitably alters the human image, making necessary a reassessment of meaning. Thus, a potential gap in the social dialectic is constructed. To exacerbate the problem, technological products have been given the power to create and manipulate new information apparently independent of their human counterparts. Hardison suggested that technology has brought us closer to an intersubjective understanding of reality, but at the same time brought into question what it really means to be human.

In the preceding pages, we have reviewed the disappearance of fundamental verities in several of the major areas of modern culture: science, history, language, art. Consideration of intelligent machines suggests that the idea of humanity is changing so rapidly that it, too, can legitimately and without exaggeration be said to be disappearing. (Hardison, 1989, p. 347)

These changes have been made possible by new technologies which have extended the realm of the senses, even beyond traditional empirical possibilities. As people create and recreate their material world through the objectivation of technological knowledge, culture and other ideas must also be recreated which complement new contexts of experience. Hardison suggested that many of our traditional notions about science, art, nature, history, language, and human evolution have been inevitably transformed in the
process. Transformed, possibly, past the point of our ability to create appropriate symbols of understanding, even to the point of total transparency, i.e., invisibility.

Hardison offered a profound and fascinating treatise on how new technologies have changed the way we express ourselves through language and in the arts, as well as how we understand the world by creating sciences, nature, and historical records. The analysis lacks substance. However, it is a representative example of modern literary attempts to better understand the relationship of science, technology, and society. One other example from current contemporary literature will be examined: Richard Saul Wurman’s discussion of Information Anxiety.

Wurman and the Impacts of Information Technology

Richard Saul Wurman was concerned with how the exponential growth of information affects individuals. Wurman proposed that the recent information explosion creates anxiety in many people. This is due to the fact that people feel a compelling need to understand their experiences and derive meaning and knowledge directly from their immediate environment. However, according to Wurman, people are now exposed to more information than they can process and understand. The result, as coined by Wurman, is information anxiety.

Information anxiety is produced by the ever-widening gap between what we understand and what we think we should understand. Information anxiety is the black hole between data and knowledge. It happens when information doesn’t tell us what we need to know. (Wurman, 1989, p. 34)

Almost everyone suffers from information anxiety to some degree. We read without comprehending, see without perceiving, hear without listening. It can be experienced as moments of frustration with a manual
that refuses to divulge the secret to operating a video recorder or a map that bears no relation to reality. It can happen at a cocktail party when someone mentions the name Allan Bloom and the only person you know by that name is your dentist. It can also be manifested as a chronic malaise, a pervasive fear that we are about to be overwhelmed by the very material we need to master in order to function in this world. (Wurman, 1989, p. 34)

Wurman suggested that the term "information explosion" is a misnomer. What we really have, according to Wurman, is a "non-information explosion" (Wurman, 1989, p. 38). Information can only "inform" if it conveys meaning. Meaning is a prerequisite to the accumulation of knowledge. The information (or non-information) explosion is really a data explosion. People have the technical capabilities to churn out endless streams of data in absence of any meaning or interpretation whatsoever. One of the defining characteristics of homo sapiens is a capacity for knowledge, i.e., knowing. The success of the species itself is often attributed to the accumulation and dissemination of knowledge. Wurman's thesis was that the sheer volume of information or data available creates anxiety resulting from the insatiable human "need to know" and parallel need to construct and express meaning.

Information anxiety can afflict us at any level and is as likely to result from too much as too little information.

There are several situations likely to induce information anxiety: not understanding information; feeling overwhelmed by the amount of information to be understood; not knowing if certain information exists; not knowing where to find information; and, perhaps the most frustrating, knowing exactly where to find the information, but not having the key to access it. (Wurman, 1989, p. 44)

The information overload concept is not new. Alvin Toffler discussed the implications in the book Future Shock (1970). In terms of the psychological dimensions of the impacts of information technology, Toffler may have best outlined the process.
Rational behavior, in particular, depends upon a ceaseless flow of data from the environment. It depends upon the power of the individual to predict, with at least fair success, the outcome of his own actions. To do this, he must be able to predict how the environment will respond to his acts. Sanity, itself, thus hinges on man's ability to predict his immediate, personal future on the basis of information fed him by the environment.

When the individual is plunged into a fast and irregularly changing situation, or a novelty-loaded context, his predictive accuracy plummets. He can no longer make the reasonably correct assessments on which rational behavior is dependent.

To compensate for this, to bring accuracy up to the normal level again, he must scoop up and process far more information than before. And he must do this at extremely high rates of speed. In short, the more rapidly changing and novel the environment, the more information the individual needs to process in order to make effective, rational decisions. (Toffler, 1970, pp. 350-351)

Nearly two decades after Toffler, Wurman proposed that the nature of information now requires more than just the ability to "scoop up and process more." Overcoming information anxiety, according to Wurman, requires a different type of knowledge—the knowledge of information dissemination—the ability to identify pertinent information, disregard non-pertinent information, and finally, transform it into meaningful knowledge.

The old formulas and systems of data processing are impotent against the complexity of information we must assimilate today. We need to develop new formulas for understanding. We need to treat understanding as a business in itself, not only as a component of all other business. (Wurman, 1989, p. 52)

To comprehend new information of any kind—be it financial reports, appliance manuals, or a new recipe—you must go through certain processes and meet certain conditions before understanding can take place. You must have some interest in receiving the information; you must uncover the structure or framework by which it is or should be organized; you must relate the information to ideas that you already understand; and you must test the information against those ideas and examine it from different vantage points in order to "possess" or know it. (Wurman, 1989, p. 53)
Wurman expanded on all these concepts and offered a "cookbook" approach to overcoming information anxiety. The brilliance of Wurman's work is not in the conceptualization but in the operationalization of the ideas. He constructed several psychological indicators which allow for testing and measurement of the variable "information anxiety." These indicators (Wurman, 1989, pp. 35-36) include:

1. Chronically talking about not keeping up with what's going on around you.

2. Feeling guilty about that ever higher stack of periodicals waiting to be read.

3. Nodding your head knowingly when someone mentions a book, an artist, or a news story that you have never heard of before.

4. Finding that you are unable to explain something that you thought you understood.

5. Blaming yourself for not being able to follow the instructions for putting a bike [or anything else] together.

6. Refusing to buy a new appliance or piece of equipment because you are afraid you won't be able to operate it.

7. Feeling depressed because you don't know what all the buttons are for on your VCR.

8. Buying hi-tech electronics because you feel that through osmosis you'll become more technologically knowledgeable.

9. Calling The Society of Mind "prophetic" even though you couldn't even understand the book review, which is all you read.

10. Looking down at your digital watch to sign in the exact time in an office building logbook even though you know no one really cares.

11. Giving time and attention to news that has no cultural, economic, or scientific impact on your life.

12. Filling out a form and feeling compelled to fill in each and every blank.
13. Reacting emotionally to information you don't understand—like not knowing what the Dow Jones really is, but panicking when you hear that it has dropped 500 points.

14. Thinking that the person next to you understands everything that you don't.

15. Being to afraid or too embarrassed to say "I don't know."

16. Or worse, calling something information that you don't understand

Though some of these indicators may appear humorous, they all adequately depict the psychological dilemma information technology—and technology in general—places individuals in. This dilemma is characterized by a need to know, explain, and express one's own everyday experiences. It is also a technological crisis in at least one respect: Technology is first and foremost a form of knowledge.

There is indeed a knowledge crisis. The recurring theme in Wurman, Toffler, and other contemporary writers on the impacts of technological change is that there exists a gap between rational action, human experience, and human knowledge and understanding. For whatever reason—the stratification of knowledge (power and control issues); an institutional separation of scientific, social, and technological knowledge, means, and ends; or even individual lack of understanding—there is a growing gap between human objectivations, experience, and an understanding of the social-dialectical process and its consequences. It takes different names and forms, e.g. reification, technocratic thinking, alienation, future shock, information anxiety, technophobia. What is needed is a more comprehensive analytical framework within which to better understand the place and process of each of these similar, yet still different, phenomena. The most comprehensive and
enlightening attempt yet, though still focused primarily in the sociology of work, is Harvard Business Professor Shoshana Zuboff's study and review, titled *In the Age of the Smart Machine: The Future of Work and Power*.  

Zuboff, Technological Knowledge, and a Social Dialectic

Shoshana Zuboff synthesized many of the important findings from the literature on technological and social change. The result was a comprehensive analysis of the social and psychological impacts of technology based on an empirical ethnographic study of several workers and workplaces. Having demonstrated a remarkable command of the existing literature, she expressed a dissatisfaction with the limited scope and depth of those previous analyses:

Through this [review of the literature], I tried to grasp how everyday life had been altered by the profound material change in those means and methods of production. . . . In many cases it provided rich detail about behavior, or the interpretation of behavior by human observers, but offered inadequate insight into the subtleties of human experience. (Zuboff, 1988, p. xi)

Zuboff began her treatise with the assumption that any measurement and assessment of human experience must also involve the process of how people construct their own realities. She explained, "As my work progressed, I was ever more fascinated with the very different social constructions of reality that characterized workers then and now" (Zuboff, 1988, p. xi). She was aware that human action and experience is ultimately intertwined with human knowledge and corresponding assumptions about reality. Zuboff's thesis was that once objective experience (which she refers to as sentience) becomes separated from knowledge and understanding, distress, alienation, and confusion invariably arise (Zuboff, 1988, p. xii).

Zuboff tended to treat the advent of information-based social relations as a major historical transformation.
I realized that the people I had been interviewing were on the edge of a historical transformation of immense proportions, as important as that which has been experienced by the eighteenth- and nineteenth-century workers about whom I had read so much and imagined even more. (Zuboff, 1988, p. xiii)

She was influenced by Bell's concept of a post-industrial society, but found the analysis little more than a "sociological abstraction" (Zuboff, 1988, p. xiv).

I wanted to discover the flesh and blood behind the concepts, the interior texture rather than the external form. I wanted to understand the practical problems that would have to be confronted in order to manage the new computerized workplace in ways that would fulfill the lofty premise of a knowledge-based society and to generate knowledge that would be instructive to those charged with managerial responsibility. (Zuboff, 1988, p. xiv)

Zuboff outlined her project and assumptions as such:

The approach would combine participant observations with semiclinical interviews and small group discussions. I intended to use my clinical skills to help people articulate their still-implicit experiences in the new work settings. With such data it would be possible to identify generic patterns of psychological and organizational experience associated with the emerging technological conditions of work. . . . [It] seemed likely that in the apparently maladaptive responses of workers to computer-based technology (what many called "resistance to change"), it would be possible to trace a lineage of ordinary assumptions that referred back to the realities of the past and their points of disjuncture with the future. (Zuboff, 1988, p. xiv)

What Zuboff appeared to be doing was identifying gaps in the social dialectic—gaps between existing knowledge and assumptions, rational action, and the ability to assimilate ongoing experience with existing social and psychological structures. The goal, according to Zuboff, is to derive meaning from this experience. The problem is that many information-based technologies are designed to remove knowledge and control from individuals and locate it in exterior processes and products. The result is alienation and the loss of meaning.
As more tasks must be accomplished through the medium of information technology (I call this "computer-mediated work"), the sentient body loses its salience as a source of knowledge, resulting in profound disorientation and loss of meaning. (Zuboff, 1988, pp. 5-6)

To better understanding the process by which alienation and meaninglessness becomes possible, an important distinction must be made between automation and information technologies. Like many of the other authors reviewed herein, Zuboff identified the sociological importance of the computer's ability to generate new information in the absence of any meaning and interpretation.

What is it, then, that distinguishes information technology from earlier generations of machine technology? As information technology is used to reproduce, extend, and improve on the process of substituting machines for human agency, it simultaneously accomplishes something quite different. The devices that automate by translating information into action also register data about those automated activities, thus generating new streams of information. (Zuboff, 1988, p. 9)

Automation- and information-based technologies are not necessarily the same thing. Information technology produces additional data outside of direct human inputs. The result of this is that people are subject to the experience of this data in absence of their own rational action, intention, and understanding. This does not, however, inevitably result in a loss of meaning. Zuboff asserted that this information can also provide the means for a broader and deeper understanding of the social dialectical process. She referred to this capacity as "informating."

In its capacity as an automating technology, information technology has a vast potential to displace the human presence. Its implications as an informating technology, on the other hand, are not well understood. The distinction between automate and informate provides one way to understand how this technology represents both continuities and discontinuities with the traditions of industrial history. As long as the technology is treated narrowly in its automating function, it
perpetrates the logic of the industrial machine that, over the course of this century, has made it possible to rationalize work while decreasing the dependence on human skills. However, when the technology also informates the processes to which it is applied, it increases the explicit information context of tasks and sets into motion a series of dynamics that will ultimately reconfigure the nature of work and the social relationships that organize productive activity.

Because this duality of intelligent technology has not been clearly recognized, the consequences of the technology's informating capacity are often regarded as unintended. Its effects are not planned, and the potential that it lays open remains relatively unexploited. Because the informating process is poorly defined, it often evades the conventional categories of description that are used to gauge the effects of industrial technology. (Zuboff, 1988, pp. 10-11)

This concept of informating is similar to Wurman's concept of information anxiety and the process of overcoming it. In order to derive meaning from experience, one must have an antecedent frame of reference upon which to accommodate and/or assimilate the information. Human choices in terms of organizational design can either supply and enhance, or remove and distort, this reference frame. Zuboff insightfully suggested that control and stratification of this knowledge-based frame of reference provides new power and authority structures in modern industries. Not only do managers choose whether or not to automate, they also choose whether or not to informate. Most importantly, according to Zuboff, informating is the important variable in determining the social relations of the modern workplace (1988, p. 11). In effect, Zuboff suggested that the informating power of information technology, and the stratification of that knowledge, will invariably determine the future of work and power in industrial society.

[It] has been second nature for managers to use technology to delimit worker discretion and, in this process, to concentrate knowledge within the managerial domain. The special dilemmas raised by information technology require managers to reconsider these assumptions. When
information and control technology is used to turn the worker into "just another mechanical variable," one immediate result is the withdrawal of the worker's commitment and accountability for the work. This lack of care requires additional managerial vigilance and leads to a need for increased automatic control. As this dynamic unfolds, it no longer seems shocking to contemplate an image of work laced with stupefaction and passivity, in which the human being is a hapless bystander at the margins of productive activity. (Zuboff, 1988, p. 69)

Zuboff's fears are reminiscent of those of Harley Shaiken's—that the relative knowledge base of the human species as a whole may be deteriorated as the control and stratification of knowledge and meaning are increasingly invested in managerial and technical machinery. As Garson pointed out (1988), we may be approaching a workforce fit only for McDonalds. Zuboff was able to identify individual and social-structural impacts of information technology including individual alienation, loss of productivity, and a social milieu in which the creative and productive potential of the workforce as a whole was diminished. This bridge of the objective and subjective dimensions of technology is but one of the strengths of her thesis.

Having outlined the process by which people become alienated from their jobs and selves in modern information-based workplaces, Zuboff suggested ways in which workers can be reunited with their work, selves, and others. The first step is to recognize the importance and interrelationship of skills and knowledge. Traditionally, Zuboff explained, skills were "action-centered." Zuboff identified four defining characteristics of action-centered skills: (a) sentience, or being derived from immediate physical cues, (b) action-dependence, i.e., contingent upon an objectivation process involving direct action, (c) context-dependence, i.e., bound to a specific and immediate frame of reference and, (d) personalism, or the interiority of knowledge and
understanding. Action-centered skills are tied directly to immediate experience. The computer, according to Zuboff, removes the sentience from knowledge. "It is as if one's job had vanished into a two-dimensional space of abstractions, where digital symbols replace concrete reality" (Zuboff, 1988, p. 63). The abstraction process necessitated by computers removed the action context from work.

Yet even as managers argued over the essentiality of action-centered skill, technology was irreversibly altering the context in which the operators performed. The opportunities to develop such skills were becoming increasingly rare as the action context was paved over by the data highway. (Zuboff, 1988, p. 67)

Zuboff's assessment was that, for the majority of those workers she examined, the concrete frame of reference needed to understand their jobs and derive meaning from their own actions was lost—abstracted into a process, machine, and experiential context over which they had little control or understanding. This also changed the nature of social interaction itself.

Another distinction in Zuboff's analysis was how social interaction becomes transformed by the computer. The nature of digitized information removes it from any human inter-communicative context. People who were accustomed to "acting with" now were forced to "act on" information—more problematically, acting on abstracted information in absence of concrete materials and contexts. Since people are social beings by nature and require a consistent flow of social interaction to develop and maintain their identities, the isolation from interaction, i.e., the inability to "act with," invariably produced discomfort in Zuboff's subjects.

Automation meant that jobs which once allowed them to use their bodily presence in the service of personal exchange and collaboration now required their bodily presence in the service of routine interaction with a
machine. Jobs that had once required their voices now insisted they be mute. Jobs that had been able to utilize at least some small measure of their personhood now emphasized their least individually differentiated and most starkly animal capabilities. They had been disinherited from the management process, and driven into the confines of their individual body space. As a result, the employees in each office became increasingly engulfed in the immediate sensations of physical discomfort. (Zuboff, 1988, p. 141)

Zuboff contended that this also represented the shift from action-centered skills.

Action-centered skills then are limited to the time frame of events and the presence of actors in the context where those events can occur. In other words, action-centered skills are a part of oral culture. They demand present-tense arrangement in the immediate world of objects and people. (Zuboff, 1988, p.175)

The written word can abstract from the human experience, but orality relies upon situational and operational frames of reference that remain close to real human activity. (Zuboff, 1988, p.176)

In a substantive fashion, Zuboff has outlined the actual process by which, as a result of a new type of technology, people become alienated from their work, themselves, and other people. This process includes the stratification of knowledge through managerial and technical machinery, and the removal of knowledge and understanding from action and experience.

Zuboff contended that the trend toward information-based technologies is irreversible (1988, p. 67). Consequently, Zuboff proposed that management undertake a reskilling process, beginning with an organizational design which cultivates intellective skills to replace the action-centered skills and frames of reference which previously linked action, experience, and knowledge. More significantly, the informating capacity of information technology can be the basis for this endeavor.
The automating capacity of the technology can free the human being for a more comprehensive, explicit, systematic, and abstract knowledge of his or her work made possible by the technology's ability to informate. (Zuboff, 1988, p. 181)

This "informating," according to Zuboff, is contingent upon two things: (a) individual competence and, (b) the ability to use and express that competence. Both these things are directly related to organizational design and the distribution of knowledge and responsibility.

The way in which the technology is deployed is crucial in determining whether intellective skill, once developed, can be utilized. There is a need to create organizational environments that support the quality of effort and the kinds of relationships in which intellectual competence can be demonstrated. (Zuboff, 1988, pp. 183-184)

Zuboff's strongest argument was that the very nature of information technology requires that workers have intellective skills. These skills involve the cognitive construction of implicit meanings, contexts, and frames of reference (Zuboff, 1988, p. 192). It is a mastery of the symbolic medium as opposed to the action medium. Such skills, however, cannot be developed in an organizational setting where workers are denied access and control to the very information they must manipulate and understand.

The construction of meaning from the electronic text that now represents the production process is likely to require more deliberative, controlled, aware, cognitive effort than earlier action-centered context-dependent routines. (Zuboff, 1988, p. 191)

What might this imply for the human being at the data interface? Over the long term, intellective mastery will depend on being able to develop a tacit knowledge that facilitates the recognition of decision alternatives and frees the mind for the kind of insight that could result in innovation and improvement. Such tacit recognition depends on first being able to explicitly construct the significance of patterns and relationships in the data. Such meanings cannot be achieved without a level of intellective skill development that allows the worker to solve the problem of reference, engage in reasoning that is both inductive and
deductive, and apply a conceptual framework to the information at hand. Meaning must be constructed explicitly in order to become implicit later. Intellective skill is necessary for the creation of meaning, and real mastery begins to emerge when such meanings are consolidated in tacit knowledge. While the development of mastery in the action medium does not require extensive explication, mastery in the symbolic medium depends upon explicitly constructed meaning, and intellective skill is the means by which this is achieved. While this does not solve the problem of attentional commitment, it does imply that attention can be freed for increasingly comprehensive tasks, invention, and experimentation as intellective skill allows the consolidation of lower-order information in the form of tacit knowledge. (Zuboff, 1988, pp. 192-193)

The final conclusion Zuboff arrived at was a call for a redistribution of knowledge within the organization. Such a redistribution inevitably involves a redefinition of power and authority, in addition to a restoration of technical knowledge and controls to the individual worker. Intellective skills are mandated if the productive capacity and motivation of the individual worker is to be maximized.

The organizations described in this book have illustrated how the need to defend and reproduce the legitimacy of managerial authority can channel potential innovation toward a conventional emphasis on automation. In this context, managers emphasize machine intelligence and managerial control over the knowledge base at the expense of developing knowledge in the operating work force. They use the technology as a fail-safe system to increase their sense of certainty and control over both production and organizational functions. Their experiences suggest that the traditional environment of imperative control is fatally flawed in its ability to adequately exploit the informating capacity of the new technology. (Zuboff, 1988, p. 390)

In the absence of a comprehensive strategy, no single organization fully succeeded in exploiting the opportunity to informate.

The interdependence of the three dilemmas of transformation I have described—knowledge, authority, and technique—indicates the necessary comprehensiveness of an informating strategy. The shifting grounds of knowledge invite managers to recognize the emergent demands for intellective skills and develop a learning environment in which such skills can develop. That very recognition contains a threat to
managerial authority, which depends in part on control over the organization's knowledge base. A commitment to intellective skills development is likely to be hampered when an organization's division of labor continuously replenishes the felt necessity of imperative control. Managers who must prove and defend their own legitimacy do not easily share knowledge or engage in inquiry. Workers who feel the requirements of subordination are not enthusiastic learners. (Zuboff, 1988, p. 391)

Zuboff concluded that the division of labor should not be a "division of learning." Such a division of learning promotes gaps in the social dialectic—gaps between the individual and social self, gaps between social classes and groups, and gaps between human potential and experiential reality. Technology need not be a means which exacerbates this process; it can and should be a means to close these gaps and emancipate people from the unjust and unresponsive social relations they have created. Of course, this is a choice we both individually and collectively must all make.

Zuboff's analysis is perhaps the apex of the accessible literature on the relationship between technology, science, and society. It successfully integrated most of the recurrent themes throughout the literature such as alienation, deskilling, power and authority, technical controls, and above all, the stratification and reification of technological knowledge. Her analysis was grounded in a meticulous review of the literature and backed by empirical ethnographic data. In addition to an unsurpassed description of the phenomena, she offered suggestions (if not mandates) for the resolution of the problems she saw and described. The only criticism to be made of Zuboff is one made of other authors herein cited—the impacts of technology are seldom limited in scope to the context of work.
Although Zuboff's synthesis of the literature and analytical approach remain remarkably solid, a similar attempt to integrate the recurrent issues will be made herein. The goal now is to address and integrate the scope and depth of the cited literature for the explicit purpose of providing a firm theoretical foundation from which to continue empirical research on the topic of science, technology, and society.
The accessible literature on the relationship of technology and sociology is a conceptual hodgepodge. Prior to the institutionalization of sociology, science, and technology as academic disciplines, these concepts made up a larger unified body of knowledge and practice. As previously pointed out, many of the enlightenment-era innovators simultaneously dabbled in scientific, technological, and social reforms (Bronowski & Mazlish, 1960; Collins & Makowsky, 1984; McKay, Hill, & Buckler, 1983; Weinstein, 1982). The institutionalization and bureaucratization of this previously unified body of knowledge into separate disciplines provided the initial impetus for reification to occur. Essentially, people began to enthusiastically pursue technological innovation outside of associated social and environmental concerns. On a macro-objective level of analysis, a separation and stratification of the knowledge base was created. The result of this stratification is that some individuals are able to monopolize certain forms of knowledge, e.g. technology, to influence social outcomes, e.g., economic, environmental, ideological, etc. This aspect of technology as a form of knowledge has become a central theme in the Critical School of sociology (Ritzer, 1988). Conceptually, technology can be best approached as a form and body of knowledge (Weinstein, 1982). However, the body of literature on the topic makes no such distinction. The concept still begs for operationalization in light of the divergent approaches to the subject itself.

Several of the authors cited deal with technology in terms of technical process. Some examples of this general tendency are Weber's concept of
"rational technique" and Durkheim's "division of labor." The technological variables in Blauner's study were technical processes, although he claimed technology itself also involved the machine system and accompanying knowledge-based skills (Blauner, 1964, p. 6). Marx to some extent equated technology with a mode of production, but still defined technology as "know-how." The technical process is one way that the concept of technology has historically been operationalized.

Many of the cited works treat technology as objects and products that result from a technical process. Ogburn and Nimkoff (1955) referred to impacts of specific technological products on social relationships. Many writers (e.g., Blauner, Garson, Hardison, Wurman, Zuboff) spoke of technological products such as numerical controls and computers as having specific impacts on individuals, yet made no clear distinctions between technological knowledge, processes, products, and the experience of them. As previously pointed out, it is difficult to address technology without discussing its processes and products. Historically, one way to operationalize technology has been to examine specific technological products and their social effects.

When technology has been addressed empirically (e.g., Blauner, Garson, Shaiken, Zuboff), technology has been operationalized as an interpretive experience. The 1947 Roper Survey (reproduced in Blauner, 1964, pp. 210-214) asked for individuals to respond to several questions concerning their immediate experience with technology at work. Hardison, Wurman, and Toffler have operationalized technology in terms of the volume of information people are able to meaningfully experience and understand. Since all meaning
is derived from experience, the experience of technology must also be an important consideration in the operationalization of technology as a concept.

Finally, several authors have treated technology as a form and body of knowledge (e.g., Berger & Luckmann, Braverman, Mannheim, Marcuse, Marx, Weinstein). As previously asserted, if one is to empirically address the subject of technology, the sociology of knowledge approach is the most useful. This assertion is made under the assumption that all reality is an intersubjective phenomenon in which knowledge is a unifying foundation. A working definition of technology then becomes "Knowledge of how to manipulate the social and natural environment." Technology, accordingly, has social-dialectical moments involving technical processes, objective products and relations, and human interpretive experiences, all requiring measurement and assessment if the nature of social reality is to be adequately explained.

**Technology's Place in the Social Dialectic**

One of the major criticisms of a sociology of knowledge approach is that it lacks empirical referents (Abercrombie, Hill, & Turner, 1988, p. 237). It is asserted herein that the lack of empirical referents in the approach is not a flaw of the approach itself, but a failure of individual researchers to adequately operationalize the concepts under investigation.

To empirically study technology as an explanatory variable in an intersubjective reality, one must analytically separate the social-dialectical moments of the concept. As extrapolated from the review of the literature, these moments categorically include technological knowledge itself, technical processes, technological products, and human experiences. There also exists a macro-social process in which the separation and stratification of technological knowledge provides a context in which reification and the
fetishism of technology can thrive. The operationalization of the concept of technology must include all these moments in the social dialectic if meaningful social explanation is to be pursued.

**Call for Empirical Application and Research**

The critical roots of this thesis assert that to improve society is of equal, if not greater, importance than explaining society. The strength of the sociology of knowledge approach to technology is that it returns the locus of technological control to individuals. The literature is rich with descriptions of gaps introduced into the social dialectic which are technological in origin. These include gaps between understanding and action, intended action and objective outcomes, objective outcomes and interpretive experiences, and finally, interpretive experience and existing knowledge. By critiquing the stratification of knowledge and raising the consciousness of technologically and ideologically oppressed and misguided individuals, a more responsive and democratic society can ensue. For the researcher, effective critique begins with the empirical observation of the existing objective human conditions, actions, experiences, and understandings. A call for such research is made and a proposal for such research follows.
PROPOSAL FOR EMPIRICAL RESEARCH: MEASURING INDICATORS OF SOCIAL AND PSYCHOLOGICAL IMPACTS OF TECHNOLOGY

Summary

Technology can be an important and significant explanatory variable in sociological research. A review of the literature on the topic finds that there is a relative absence of generalizable empirical data in this area. Recent widespread technological changes, e.g., computer technology, communications, micro-electronics, information technology, etc. suggest a more comprehensive study of these impacts on the everyday lives of people be undertaken. This proposal suggests that a random-sample mail survey and subsequent data analysis be utilized to assess how, through a reification process, specific aspects of technology might negatively affect individual perceptions and objective social phenomena.

The proposal briefly outlines problem areas in the literature. Based on an analytical approach which integrates components of Critical theory, the sociology of knowledge, and a new dialectical model, technology is then reconceptualized and operationalized. Indicators are subsequently developed and categorized within this analytical framework. Using these indicators, hypotheses are developed and an appropriate research method, i.e., a mail survey, is outlined. Finally, suggestions for computer data analyses are made.

Problem Statement and Brief Review

A review of the historical treatment of technology in sociological theory and research leads the researcher to the identification of several problems. The first and most serious is the inconsistency of ways which technology has been conceptualized. Many writers (e.g., Blauner, 1964; Edwards, 1979;
Weber, 1978/1921) have treated technology primarily as technique. Others (e.g., Ogburn & Nimkoff, 1955) have talked of technology as products, machines, and materials in the objective sense. Some writers spoke of technology as an experience requiring unique interpretations and adaptations (e.g., Hardison, 1989; Wurman, 1989). Another approach is to treat technology as form of knowledge, or "know-how" (e.g., Weinstein, 1982). Others writers have not made such distinctions and have combined these categories in various ways (e.g., Braverman, 1974; Bell, 1976; Garson, 1988; Zuboff, 1988). Critical theorists (e.g., Mannheim, Marcuse) see technology primarily as form of knowledge. If the understanding and control of technology is considered as a necessary value and goal, the knowledge approach to technology then becomes the most useful. This is due to the fact that a knowledge-based approach locates the knowledge and control of technology in individuals. For the purposes of this proposal, technology will be seen primarily as form of knowledge with subsequent dialectical moments, i.e., technical processes, objectivated products, in addition to human experiences and interpretations (see Figure 1 for an illustration and review of the theoretical model). The proposed research will test the utility and integrity of the model by separating the moments of the social dialectic into different categories of indicators. Such an analytical model is prerequisite to the construction of a statistical multiple regression model which adequately explains the social and psychological impacts of technology. This is necessary if one desires to explain where gaps in the social dialectic actually occur. The problem of past attempts to conceptualize technology is that, without clearly distinguishing between technical knowledge, processes, products, and experience, the explanatory value and power of technology as a variable cannot be fully realized.
Another problem that becomes apparent when examining the literature and recent research is its limited scope and generalizability. The range of existing empirical data is very limited. Those authors who have undertaken an extensive conceptualization of technology have typically failed to provide necessary empirical referents (e.g., Mannheim, Marcuse, Marx, Weinstein). On the other hand, there exist several rich ethnographic accounts of the impacts of technology in the workplace (e.g., Blauner, Garson, Shaiken, Zuboff). However, these accounts, though insightful, are context-bound to specific industries and to the realm of work in general. Many lack adequate conceptualization and operationalization of the topic, resulting in descriptions with little or limited historical and empirical value.

Socio-technical change may have been driven by changes in the nature of work and production, but technological revolutions in the 1990s—a few of the most significant are in personal computers, micro-electronics, and information technology—have brought the impacts of technology out of the workplace and into the everyday secular experiences of social actors. With the proper conceptualization and operationalization, variables such as technology and its impacts can easily be generalized across the larger population. The obvious scope of the phenomenon suggests that such an attempt be undertaken.

In sum, the existing literature lacks adequate and consistent conceptualization and operationalization of the topic. It is limited in scope and generalizability. It is somewhat biased toward ethnographic accounts in the workplace. Finally, it does not adequately address the extent and scope of the technological changes having occurred in recent years.
Conceptualization and Operationalization of Technology

The literature illustrates how technology has historically been conceptualized in various, often divergent, ways. These include technical processes (e.g., assembly lines, numerical controls), technological products or artifacts (e.g., the automobile, computers), experiences of technology (e.g., future shock, information anxiety), and technological knowledge (i.e., know-how). To facilitate explanation of how technology comes to be perceived as having negative impacts, an analytical model integrating these concepts may be constructed (see Figure 1). This dialectical approach treats technology first and foremost as a form of humanly constructed and maintained knowledge. This knowledge has dialectical moments as it becomes objectivated through the technical process and consequently takes the shape of products, materials, and other objective artifacts. When people lose track of the fact that these processes and products are human creations, it is called reification. Hypothetically, they then may tend to experience technology as an external autonomous force with coercive and constraining effects and/or negative consequences. Technology, thus, can be conceptualized as a form of humanly constructed knowledge with specific dialectical moments.

Technology must be operationalized in terms of its dialectical moments. It is herein asserted that to treat technology solely as a process, product, or imposing experience reifies the concept. Thus, indicators must be developed that treat technology first and foremost as a body of knowledge. Such indicators would involve the possession of "know-how" and confidence in interacting with a rapidly changing material world. A person who recognizes that technology is a form of knowledge, for example, might disagree with the statement that "technology is running away with itself." Another category of
indicators would involve human action, i.e., interaction with the technical-material world. Examples of such indicators would be the use of technical products and processes to achieve desired ends. Using an ATM machine might fall under this operational category. The next set of indicators would involve specific products, artifacts, and materials. A material object must be present and recognizable for people to experience its effects and describe those experiences. Owning a personal computer might fall under this group of technological phenomena. The final set of indicators would involve the immediate experience of technical processes and products. Does a person indicate that her needs are met through interacting with technical process and products? Does she feel alienation? Does she perceive that she has no control over the outcome of her actions? Is her life objectively easier, or more complex, as a result of interacting with specific technological processes and products? By operationalizing technology as sets of indicators which reflect each dialectical moment of the concept, it becomes easier to explain the process in which gaps appear in the social dialectic, resulting in perceptions that the impacts of technology are negative and undesirable. This allows the researcher to explain the actual process in which technology yields certain social and psychological impacts.

Given that the understanding, control, and accountability of technology is a desired goal, the value of a technology-as-knowledge approach is that it locates these moments within each individual. An admitted emancipatory agenda accompanies the way in which technology is operationalized herein. Consequently, it is proposed that any other way of operationalizing the concept exacerbates the reification process and ultimately creates gaps in the social dialectic from which negative perceptions of the phenomena might emerge.
Equally important, operationalizing technology as knowledge with specific dialectical moments can provide the necessary theoretical foundation for more meaningful empirical and quantitative models. This research proposal seeks to illustrate how such operationalization can yield meaningful, generalizable, empirical results.

**Hypotheses**

1. People who define technology as knowledge perceive they have greater control over technological processes than people who tend to reify the concept.

2. People who define technology as knowledge perceive they have greater control over technological products than people who tend to reify the concept.

3. People who define technology as knowledge have fewer negative attitudes about technological processes than people who tend to reify the concept.

4. People who define technology as knowledge have fewer negative attitudes about technological products than people who tend to reify the concept.

5. People who define technology as knowledge are more receptive to technological change than people who tend to reify the concept.

**Definition of Terms**

To clarify the preceding hypotheses, certain phrases and terms may require additional operationalization. For the purposes of this proposal, the following terms will be defined and operationalized as such:
1. Technology-as-knowledge: Technology-as-knowledge relates specifically to know-how. A person who sees technology primarily as a form of knowledge will disagree with definitions which relate technology exclusively to technical processes or products.

2. Negative attitudes: This is an umbrella term which will encompass all indicators that involve the perception that some aspect of technology is undesirable, problematic, dysfunctional, etc. People with negative attitudes concerning technology might indicate that "technology is the cause of all our problems" or that "technology has made my life more difficult."

3. Technological processes: In terms of a specific dialectical moment, technological processes refer to any specific human action which utilizes technological knowledge.

4. Technological products: In terms of a specific dialectical moments, technological products will refer to any object or event which is an objective and observable result of a technological process.

5. Reify: As defined in the review of the literature, to reify something is to give something an identity in absence of the human knowledge and actions which create and/or maintain it. Literally, reification means to "make something thing-like," i.e., treat human creations as "things in themselves." People who reify technology see it only as process or product and not as a form of humanly constructed and maintained knowledge.

6. Control: For the purposes of this study, control will refer to the perception that one is intentionally acting, as opposed to only reacting, in a potentially interactive situation. People who perceive they have control over technological processes might disagree with a statement that they are "manipulated by machines at work." People who perceive that they do not
have control over technological products might agree with a statement such as "I have not bought a personal computer because I probably couldn't learn how to run it."

7. Receptive: Being receptive of something means maintaining a positive outlook, having an open mind, and hesitating to pre-judge the outcome of a situation. A person who is receptive to technological change will anticipate and look forward to new experiences with technological processes and products. It is a near-opposite to a negative attitude, and often involves elements of control.

Method

The methods and analyses suggested herein are intended to illustrate how a critical "sociology of knowledge" approach to technology can be the foundation for empirical research. Ideally, these methods and analyses will be tested, refined, and evaluated before a large representative endeavor be undertaken. In light of this qualifier, to maximize generalizability, a national random-sample mail survey is suggested as the primary method of data collection.

For the initial exploratory study a national random-sample mail survey will be administered to a target population of all households in the United States. The sample frame will be predetermined by a professional sampling corporation, e.g., Survey Sampling Inc. A random sample of 2000 households will then be professionally drawn and household addresses will be provided by the firm on computer disk and pre-printed mailing labels. This proposal will outline the method of administering an initial exploratory study of 2000 households for the purpose of establishing a return rate, testing the survey
instrument, measuring indicator and item reliability, and determining the feasibility of a more comprehensive study. Note that alternative sampling methods could be used at the exploratory phase, e.g. stratified samplings of special interest groups, judgement samples, etc.

An initial exploratory random-sample mail survey is suggested due to the fact that established return rates on national random-sample mailings are only 12 to 15 percent. This estimate includes a probable 20 percent mobility rate. Thus, the exploratory study might yield up to 300 completed questionnaires. Proven instruments which target special interests in the general population can yield up to a 30 percent return rate. Pre-screening can also improve return rates and minimize the mobility problem, but cost-benefit ratios would need to be established in the exploratory phase. The exploratory study will test the instrument and identify special interest and population groups to which refined instruments could be administered at a later time with greatly improved return rates. Reliability analyses will be run on each indicator and item. Most importantly, the exploratory study will yield sufficient representative data to make generalizations about those segments of the population which responded to and returned the instrument.

The sample instrument will include a cover letter, 3-page questionnaire, and a prepaid return envelope. The cover letter will identify the researchers, study, and provide necessary written instructions for completing and returning the instrument. The letter will request that a permanent household member, age 18 or over, complete and return the questionnaire.

The questionnaire consists of 3 sections, each designed in an easy to understand self-directive graphical format. The first section deals with technological products with which the respondent might come in contact. The
section also includes a 5-point attitudinal scale for each product, allowing the respondent to rate the perceived quality of his or her experience with each potential product. The second section consists of statements about the respondent's knowledge, actions, experiences, and perceptions concerning various technological issues, processes, and products. Each statement is followed by a standard 5 point Likert scale. The final section requests demographic information from the respondent, thanks him or her for her cooperation, and makes a final plea to return the questionnaire in the prepaid envelope. A draft of the questionnaire may be found in the appendix.

Ideally, a list of 100 or more items would be developed from a wide range of potential indicators of technological knowledge, reification of knowledge, processes, products, experiences, attitudes, etc. This list would be subjected to a panel of reviewers to assess the potential strengths, representativeness, and reliability of each item. The sample questionnaire is intended to illustrate what an instrument utilizing these indicators might look like.

The following tables are constructed to illustrate which variables in the sample questionnaire represent indicators of each dialectical moment of technology. Table 1 refers to specific technological products with which the respondent may have had experience.
Table 1

Sample Survey Items Indicating Utilization of Technological Products

<table>
<thead>
<tr>
<th>ATM (Bank Teller) Machine</th>
<th>Personal Computer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home Shopping by Phone</td>
<td>Phone Calling Card</td>
</tr>
<tr>
<td>FAX Machine</td>
<td>Computer Electronic Mail</td>
</tr>
<tr>
<td>Mainframe Computer/Terminal</td>
<td>Banking by Telephone</td>
</tr>
<tr>
<td>VCR and/or Video Camera</td>
<td>Cellular or Mobile Phone</td>
</tr>
<tr>
<td>Nintendo/Other Game Machine</td>
<td>Computer BBS/Information Service</td>
</tr>
<tr>
<td>CD or Laser Disk Player</td>
<td>Other (written in)</td>
</tr>
</tbody>
</table>

Accompanying the list of products in Table 1 would be scales for the number of times used and a Likert scale requesting the respondent to quantify the "quality of the experience" on a scale from 1 to 5. In one case, given that the assumptions of the statistics have been met, the quality of an experience could become a dependent variable in partial correlation or regression analyses. In another scenario, the use of technological products and the quality of the experience could become partial explanations for larger experiential variables such as perceptions of alienation, control, satisfaction, etc.

Section 2 of the questionnaire also lists items which indicate assessments and attitudes about technological products. To achieve an optimal level of attitudinal measurement, each item would be followed by a standard 5 point Likert scale. Table 2 lists these items.
Table 2

Sample Survey Items Indicating Assessment of Technological Products

Overall, technological products have made my life easier.
I prefer doing business with real bank tellers and not ATM machines.
I trust store clerks more than UPC bar code scanners.
I am offended by telephone answering machines.
Machines are more reliable than people.
I feel helpless when it comes to computers.
I prefer doing business in person as opposed to over the phone.
Life would be better without so many machines.

Another set of indicators refers to technological processes—specifically, human actions, interactions, and assessments of actions—all of which require the utilization of technological knowledge. Inevitably, attitudes toward experiences of these processes become the actual variable being measured. Often these processes utilize or result in specific technological products. Table 3 offers examples from the sample questionnaire which refer specifically to the technological process category of indicators.

Table 3

Sample Survey Items Indicating Assessments of Technological Processes

My hobbies often include using mechanical or electronic gadgets.
It's fun to assemble and set up a new toy, appliance, or device.
The items in Table 3 are examples of indicators of attitudes relating to interaction with specific technological processes and requiring technological knowledge.

Likewise, a Likert scale could be utilized to quantify attitudes and experiences of technology without referring to specific processes and products. These indicators would refer to how people internalize or subjectivate technology as an objective phenomenon. Feelings of alienation, helplessness, and lack of control might be operationalized using these indicators. Table 4 offers examples of these items.

Table 4
Sample Survey Items Indicating Assessments of Experiences of Technology as an Objective Phenomenon

I feel like technology controls my life.
Modern technology has made the world too impersonal.
New technology has given me more control over my work.
New technologies have made the world too complicated.
I don't have to work as hard as a result of new technologies.
I could be replaced by a machine someday.
I feel limited in my abilities and potentials because of new technologies.

The indicators illustrated by Table 4 could be considered as dependent variables in hypotheses testing and statistical model building. Regardless of whether the dependent variables are specific processes, products, or an assessment of the experience of technology in general, the important independent variable must be technological knowledge and its subsequent
potential to be reified. Indicators of the reification of technological knowledge are discussed in the next section.

Suggestions for Data Analyses

Few assumptions about the representativeness of the population or the effective reliability of the indicators and instrument can be made at this time. The tentative nature of the data acquired in the initial exploratory study suggests that simple descriptive measures be run on each variable. These would describe the scope of modern technology and its impacts. Given that the nature of the population and data meet the necessary assumptions, comparisons of sample means such as t-tests and its derivatives could be used to compare groups of responses to specific items. If the nature of the working population does not lend itself to parametric measures, nonparametric measures such as chi-square and the Wilcoxon ranked means test could be utilized to compare group responses to items of interest.

Once the instrument is refined, reliable indicators established, and a true representative sample is acquired, parametric measures could be utilized in constructing other significant measures of association and dependence, e.g., correlations, partial correlations, and multiple linear regression models.

Since the research question suggests that the reification of technology is at the base of negative perceptions about technology, assumptions about independence focus on indicators of the reification of technological knowledge. The operationalization of the variable "reification of technological knowledge" involves developing indicators which clearly demonstrate that respondents identify technology as "a thing in itself" existing outside of the knowledge and actors which create and maintain it. The following statements (see Table 5)
from Section 2 on the exploratory questionnaire are examples of intended indicators of the reification of technological knowledge:

Table 5

Sample Survey Items Indicating the Reification of Technological Knowledge

Technology is running away with itself.
I am sure technology will eventually destroy the world.
If anything can solve the world's problems, technology can.

When linking the indicators in Table 5 to the conceptual model and approach presented in Figure 1, indicators of the reification of technological knowledge might then be thought of as independent variables upon which to build empirical analyses.

For the purposes of quantitative analysis, a dependent variable would be anything which refers to attitudes toward specific technical processes, products, or particular experiences with these processes and products. Section 1 on the exploratory questionnaire deals with several technological products and requests a subjective assessment of the experience with each product. Section 2 also deals with the experience of technological products, in addition to subjective assessments of intended human action and various technical processes (see Appendix for specific examples). Some responses are clearly negative while others are clearly positive. After recoding the data so that all negative (anti-technology) responses reflect low scores and all positive (pro-technology) responses have high scores, multidimensional scaling could
offer insights into the degree that the reification of technology is associated with negative perceptions concerning technology. A t-test would indicate whether the mean scores for each group of indicators are a simple product of chance or not. Once the preconditional assumptions have been met, a statistical multiple linear regression model could be constructed which may or may not complement the analytical model upon which the study is founded. Such a model would explain negative attitudes and experiences with technology using the reification of technology (see Table 5) as an independent variable. The utilization of products and processes (see Tables 1, 2, & 3) could be treated as intervening variables in specific attitudinal outcomes from Table 4. Alternatively, the utilization of processes and products could also be thought of as outcomes in themselves with technological knowledge as the independent variable. Both approaches could be utilized and the groups later compared. Generally, the items in Table 4 can be treated as attitudinal outcomes to be explained.

The purpose of this proposal is to suggest how a more comprehensive operationalization of technology can lead to meaningful empirical research. As a result of these efforts, a better and more comprehensive description of the everyday phenomena of technology can be realized. In addition, technology's relationship to other social phenomena can be explored with the aspiration of better understanding human behavior and social phenomena.
CONCLUSION

Several agendas and layers of analysis have been pursued throughout this thesis. As stated earlier, the two major purposes of the work include (a) the development and application of a more comprehensive socio-technological model (see Figure 1) as a foundation for empirical analysis, and (b) to suggest an empirical direction in exploring the complex interrelationships of technology and society. Antecedent to both of these primary objectives is the need to develop a better understanding of technology as a concept itself. A review of the literature suggests that technology has historically been poorly conceptualized and operationalized, thus negating its empirical and explanatory value. By combining ideas from the Critical School of sociology, the sociology of knowledge, and existing empirical data, a more comprehensive understanding of technology can be developed.

The critical agenda is clear. People appear to be increasingly concerned and disenchanted with the negative impacts of technology. A good deal of the empirical work cited illustrates how technology can be used to oppress people and restructure society to the benefit of an elitist few. The bias herein is the assertion that this technological oppression must be abated. The agenda is that this might be achieved through a better understanding of technology itself—how it becomes reified and people come to blame technology for their problems instead of placing accountability in the hands of the people who are wielding the initial technological knowledge. The advantage of the sociology of knowledge approach is that it locates technology first and foremost in the individual, thus minimizing potential reification and maximizing technological responsibility and accountability.
Another layer of analysis deals with the shortcomings of the sociology of knowledge and social dialectics. Rightfully so, these areas of sociology have been criticized for being "too metaphysical" and "lacking in empirical referents." The method of presentation throughout the thesis was intended to suggest that an empirical approach to the synthesis of the traditional subject-object, action-experience dichotomies is possible and desirable. Technology is a relatively unique phenomenon in that it is irrefutably contingent upon all these dialectical moments. It is a form of knowledge, requires human action to be implemented, takes on specific and identifiable objective forms, and requires the continual reinterpretation and reformulation of knowledge to be maintained. It is a household word, readily identified or experienced, yet often misunderstood. Technology may be the ideal variable to illustrate the utility of the sociology of knowledge and a dialectical approach to social reality. In doing so, these approaches clearly take on more substantive and less metaphysical properties.

The macro-micro rift is indirectly addressed through the method of presentation. The macro aspect of technological phenomena becomes apparent in the institutionalization of knowledge. Science, sociology, and technology became artificially separate, distinct, rationalized, bureaucratized, and commodified bodies of knowledge in the emerging macro social structure of post-enlightenment Europe and the United States. This inevitably affected the outcomes of what was perceived to be large scale social-scientific progress (both Marx and Weber refuted this conception of progress). On the micro level, people came to treat these bodies of knowledge as discrete, thus failing to see how changes in one area inevitably affects change in all the others. In addition, the fact remains that we cannot experience the environment in small rational chunks arbitrarily defined as scientific, technological, social, etc. This
macro-micro rift, involving the bureaucratization and rationalization of knowledge at the macro level, and the fragmentation of knowledge, action, and experience at the micro level, leads to another potential gap in the social dialectic.

Some of the criticisms and shortcomings of critical theory are indirectly addressed. Like the sociology of knowledge, critical theory has been criticized for its lack of empirical referents. If one accepts the assertion that empirically valid and reliable research must be theoretically grounded and interpreted, critical theory can be just as useful as any other approach in providing a framework for research construction, data collection, and subsequent analyses. If technology is the variable under study, critical theory may be even more useful due to the fact that it is the only approach which has extensively addressed the impacts and consequences of technology. Critical theory has empirical applications. This thesis attempts to illustrate one example of such an application.

Finally, as Garson (1988), Mayr (1986), Zuboff (1988), and many others pointed out, information and electronic technology have far reaching effects; the impacts and consequences may be as significant as the coming of the industrial revolution itself. Although the literal concept of the "post-industrial society" may never be actually realized, social and cultural reality definitely take on different shapes and characteristics in light of information and electronic technologies. The rate of social change is increasing exponentially. Technology facilitates, if not precipitates, this rate of change. There is something important going on here that has been largely neglected in past sociological research. It is time that sociological researchers focused more attention on technology as an explanatory variable in sociological studies.
LIST OF REFERENCES


APPENDIX
Section 1.
Instructions:

(1) Place an "X" by each item you have used in the last 12 months.

(2) For each of those items, fill in the blanks with the number of times you have used each item in that time.

(3) Place an "X" by the items you have used at work or in connection with your employment.

(4) Finally, rate the quality of the experience on a scale from 1 to 5 from "1" being a "very bad experience" to a "5" representing a "very good experience." Circle only one number and do not mark between or outside of the boxes.

Experiences with Electronic and Information Technology

<table>
<thead>
<tr>
<th>ITEM</th>
<th>Fill in the number of times you have used the item in the past 12 months.</th>
<th>Mark an &quot;X&quot; if the item is one you use at work.</th>
<th>(Circle only one number)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATM (Bank Teller) Machine</td>
<td>1 2 3 4 5</td>
<td></td>
<td>1 = Very bad experience</td>
</tr>
<tr>
<td>Home Shopping by Phone</td>
<td>1 2 3 4 5</td>
<td></td>
<td>2 = Somewhat bad experience</td>
</tr>
<tr>
<td>FAX Machine</td>
<td>1 2 3 4 5</td>
<td></td>
<td>3 = Neutral</td>
</tr>
<tr>
<td>Mainframe Computer/Terminal</td>
<td>1 2 3 4 5</td>
<td></td>
<td>4 = Somewhat good experience</td>
</tr>
<tr>
<td>VCR and/or Video Camera</td>
<td>1 2 3 4 5</td>
<td></td>
<td>5 = Very good experience</td>
</tr>
<tr>
<td>Nintendo/Other Game Machine</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CD or Laser Disk Player</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal Computer</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phone Calling Card</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer Electronic Mail</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Banking by Telephone</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cellular or Mobile Phone</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer BBS/Information Service</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Write in any other electronic/information/technological device):</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Write in any other electronic/information/technological device):</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Some items have been proportionally reduced or altered to meet thesis margin requirements*
**Questionnaire**

Section 2.
Instructions:

Read each of the following statements and circle the number which best describes your feelings about the statement. Circle only one number for each statement. Do not mark between or outside of the boxes. Do not try to change the statements or possible responses as this will invalidate the item. Use the following number key for your responses:

1 = I Strongly Disagree  
2 = I Somewhat Disagree  
3 = I am Neutral  
4 = I Somewhat Agree  
5 = I Strongly Agree

<table>
<thead>
<tr>
<th>STATEMENTS</th>
<th>Disagree / Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Overall, new technological products have made my life alot easier.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>2. I feel like technology controls my life.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>3. Modern technology has made the world too impersonal.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>4. Technology seems to be running away with itself.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>5. I prefer doing business with real bank tellers and not ATM machines.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>6. I am sure technology will eventually destroy the world.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>7. New technology has given me more control over my work.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>8. New technologies have made the world too complicated.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>9. I trust store clerks more than UPC bar code scanners.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>10. My hobbies often include using mechanical or electronic gadgets.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>11. I am offended by telephone answering machines.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>12. I don't have to work as hard as a result of new technologies.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>13. It's fun to assemble and set up a new toy, appliance, or device.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>14. Machines are more reliable than people.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>15. I feel helpless when it comes to computers.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>16. I prefer doing business in person as opposed to over the phone.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>17. Life would be better without so many machines.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>18. I could be replaced by a machine someday.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>19. I feel limited in my abilities and potential because of new technologies.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>20. If anything can solve the world's problems, technology can.</td>
<td>1 2 3 4 5</td>
</tr>
</tbody>
</table>

*Some items have been proportionally reduced and altered to meet thesis margin requirements*
Questionnaire*

Section 3.

Instructions:

Your household is one of several thousand which has been drawn at random by computer to receive this questionnaire. To guarantee that this study is truly based on a random sample we require demographic information from each household. Your name or address is not associated with this information and you can be assured that any personal information you provide will remain strictly confidential. Please answer the following questions as accurately as possible. Mark an "X" in the box next to the correct answer for each item unless instructed to do otherwise.

Background Information

1. Gender
   (Check one) Female
   Male

2. Ethnic Heritage
   (Check one)
   American Indian
   Asian/Pacific Islands
   Black/Afro-American
   Hispanic
   White
   Other
   (write in)

3. Occupational Status
   (Check one)
   Homemaker
   Student
   Retired
   Unemployed
   Employed
   (write in job title)

4. Place of Residence
   by population
   (check one)
   (less than 1,000) Rural
   (1,000-49,999) Town
   (50,000-99,999) City
   (100,000 +) Urban

5. Your age at your last birthday
   (write in number of years)

6. Highest year of school you have completed
   (write in number of years)

7. Total $ Household Income
   (Check one)
   less than 10,000
   10,000-19,999
   20,000-29,999
   30,000-39,999
   40,000-49,999
   50,000 and up
   (write in)

8. Number of dependents under age 18 in household
   (write in number of children)

9. Number of adults age 18 or over living in household
   (write in number of adults)

10. Please write in your name, phone number, and a time you can be reached if you are willing to consent to a telephone interview.
    (check for a phone interview) Name
    Phone ( )
    Best time to call AM/PM

Thank you for your time and input. Please return this questionnaire in the pre-paid envelope right away. Your responses are greatly appreciated and will remain confidential.

* Some items have been proportionally reduced or altered to meet thesis margin requirements.