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The Computerization Crisis within the Educational System

by

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Abstract

This study identifies current societal trends initiated within the economic sector which have resulted in the computerization crisis predominant in the North American educational system (specifically, Canada and the United States). This study includes an analysis of the transformations shaped by advancements in computer communication technology exemplified through changes in the focus, process, structure and values within the economic sector. An exploration of the resulting changes within the social and political sectors is included as well. Together these provide a basis for understanding the sources, ideologies and mechanisms that are responsible for promoting change as we move into the Global Age.

The inability of the educational system to adapt to this dynamic situation has placed it in a state of crisis. The persistence of this 'computer crisis' is due to the inadequate mind-set and mode of inquiry currently used by educators, thus, limiting the perspective and adaptability of this institution.

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Dedication

To my extraordinary parents:

may this thesis be a reflection of the wonderful examples I have had growing up.

You.

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> Obviously we can not plan for the future in a vacuum. We must grasp certain clues in the concepts and practices of today in order to imagine those of tomorrow...School planners can prepare themselves for the task of planning for the unforeseeable by carefully analyzing present trends in educational innovations, their types and objectives....Indeed, school planners should consider both national and international developments in their review of existing trends.

Harold E. Coffey, *Guidelines for Planning Future Public School Facilities: A Trends Orientated Approach*, 1992.

CHAPTER ONE: A NEW SOCIETY IS EMERGING

Major Transition Marks the Beginning of a New Era

Fundamental to the discussion of the technology crisis within the educational system is an analysis of changes that have occurred in other aspects of society. Key to this examination is the realization that the economic sector has endured and continues to survive a transition of phenomenal magnitude and significance. Consequently, this paper will begin with a discussion of the changes that have occurred within the economic sector, why this is important to other areas of society and the impact this change has had on various facets of our nation.

Society is in a Transformation of Evolutionary Significance

The discussion of cultural transformation was pioneered by Pitirim A. Sorokin in his 1937 book, entitled Social and Cultural Dynamics. As summarized by Capra, in The Turning Point, "Sorokin's analysis suggests very forcefully that the crisis we are facing today is no ordinary crisis but one of the great transition phases that have occurred in previous cycles of human history." Sorokin explains that three basic patterns of human cultural expression have produced identifiable cycles in Western civilizations and he has plotted -- on dozens of charts for belief systems -- wars and internal conflicts, scientific

and technological developments, laws and various other social institutions. In Sorokin's model, the current paradigm shift and revolutionary processes associated with the decline of the Industrial Age are another period of societal maturation. Although Sorokin made his predictions prior to the onset of the Technology Revolution, his study emphasizes the fundamental, transitory impact of the changes that our society has recently experienced. The importance of Sorokin's work lies in the realization that the magnitude of these changes has not been matched since the Industrial Revolution. The impact of our current revolution is extensive, irreversible and has caused changes within the economic, political and social realms of our society. Wilbur Schramm in his book, The Beginnings of Communication Study in America, predicts this impact:

> The new world brought by the development of an advanced information society ... is expected to generate major transformations comparable to those caused by the Industrial Revolution and will completely change the world as we know it. In particular the basic value system that guides society will shift from one based on goods to one where information is the dynamic that propels society.

Many terms have been coined to describe this recent revolution: *Technology Revolution*, *Computer Revolution*, *Information Age*, *Communication Age* and *Global Age* are just a few that appear extensively in the literature. The variety of labels used to describe this era is not an indication of falsities in the media, but rather reflects the swiftly evolving nature of this particular revolution. Some argue that the dynamics of change that we are currently experiencing have been unmatched, and Capra (1982) supports this by

stating, "The transformation we are experiencing now may well be more dramatic than any of the preceding ones, because the rate of change in our age is faster than ever before, because the changes are more extensive, involving the entire globe, and because several major transitions are coinciding." Given the rapidly dynamic nature of this revolution, each label is inherently correct in that it represents an ideology, technology, process or structure that is, or once was, an initiator of this revolution. In providing a current framework, most literature suggests that we are leaving the *Information Age* and entering the *Communication* or *Global Age*. (These latter terms can be used synonymously but the remainder of this thesis will utilize Global Age in reference to this era.)

The Global Age is characterized by increasingly complex computer communication technology essential to the exchange of information. Information has become the valued resource of our new society. The actual storage and processing of data began with the beginning of recorded time (i.e. cave men counting on their fingers or carving notches in stone), and evolved into an industry in the 1890's with the development of the electro-mechanical punch-card equipment (Sapre & Perritt, 1976). Since then the industry of data processing, manipulation and storage has become one of the largest and fastest-growing industries in the United States and, in recent years, the entire world (International Business Machines Corporation, 1976). The potential of this industry was realized with the advent of the first electronic computer; and its capabilities for large-scale business applications was acknowledged. Technological advances in this industry grew, exponentially, from

1951 to 1976, shaping the era commonly referred to as the *Computer Age*. With the continuing advancement of computer technology, digitization of all information became prevalent, resulting in an unprecedented growth of available information (often referred to as the 'information explosion') and an increased interest in gaining access to it. Thus, the 1980's are known as the *Information Age* (Brightman & Dimsdale, 1988). Inevitably, the focus changed again and it now revolves around the exchange and manipulation of information by utilizing new computer communication technology (Mandell, 1982). Thus, this era has been labeled the *Communication* or *Global Age* (International Business Machines Corporation, 1976).

Indications of the Global Age

Two indications that we are becoming submerged in the Global Age were outlined at the *Information Industry Annual Convention and Exhibition* on October 7, 1996. According to the keynote speaker, the first sign will be the appearance of an 'electronic community' which, simply stated, means that everyone and everything will be effortlessly and seamlessly 'wired' together. Businesses, homes, schools, hospitals and multitudes of other institutions will be linked together, manipulated by people and their tools, interacting independently of distance and time. The second harbinger of this revolution will be the development of a fully 'networked' economy. This economy is not concerned with electronic commerce such as the automation of ordinary household transactions -- home

banking and home shopping -- but rather will present the rationalization of the supply chain in business and the potential for transforming how we educate our children and train our workforce. Although this phase has just begun, both of these 'red flags' are increasingly visible.

Two Key Elements of a Transition

Historical analysis of previous revolutionary phases has revealed that two elements are inherent in a revolution with these dynamics. Lorraine Mitchell (1996) has outlined these elements in terms of the two key lessons learned from the last economic revolution (i.e., Agrarian to Industrial). The first lesson was that some underlying technology provide the catalyst for transition. For example, the steam engine was refined to the internal combustion engine which gave way to the turbo jet engine which provided the means for the factory structure and perpetuation. Analogous to this evolution is the integration of computing and communication technology which drove the transition into this Information Age. As communication technology becomes increasingly networked, globally, it is propelling us into the Global Age. The second lesson was that productivity required incorporating the new technology and changing the organizational structure for doing work. This was easily observed during the Industrial Revolution when great numbers of people relocated from the country to cities and congregated every day in factories that housed the production technology around which their jobs revolved.

The need to integrate the new technology and the inherent changes that must occur to allow this integration is fundamental to understanding why changes during a revolution require transformation, but also inclusion, of the previous system. Technological change creates new opportunities for societies, but it also generates new problems (Lowenthal, 1990). This change creates a bi-polar effect in which both positive and negative affects occur simultaneously and in virtue of each other. The usual sequence is that a technological advancement creates new opportunity to achieve some desired goal, which then requires alterations in social organization if advantage is to be taken of the new opportunity. This means interference with the function of existing societal structures and goals, served by the older structures, will be attained inadequately (Lowenthal, 1990). To promote the benefits of the new, technologically-advanced society, old institutions must adopt new organization, structure, ideologies and values facilitated by a transformed mind-set.

Revolutions Are Marked By Some Technology

Technological Advancements Create Change

Inseparable from the word 'transformation' is 'change.' Change has become an inherent characteristic of life in the twentieth century: new technology is rapidly and continuously developing new equipment, new processes and methods, new relationships and new work assignments in our society (Wright, 1993). Today, with the introduction of

new technology, the need to change quickly is highly valued and technology underlies the constituents of being competitive. Petrella (1997) explains that "[Technology] is the most effective and efficient weapon for being competitive in the global market." An Internet article released by Industry Canada (Manley, 1997) also points out the impact that new technology has upon the continued success of various industries:

> Technological change is creating new industries and transforming old ones. For example, biotechnology creates new products and competitive advantages for firms in such diverse industries as agriculture, waste treatment, health care and forestry.

Definition of Technology

Although technology is seen as the fundamental catalyst for all major economic revolutions, the definition of what technology encompasses has not remained static but rather changes with each revolution, reflecting the values of that era. Before the Industrial Revolution 'technology' referred mainly to the scientific study of practical matters. Technology was not machinery but rather the result of the confluence of streams, such as cybernetics and systems theory (Lowenthal, 1990). During the Industrial Revolution the definition of technology reflected the new focus of creating product-intensive machinery, thus the meaning of technology became synonymous with scientific discoveries to meet industrial or commercial objectives. Now, with the increase in the information and service sectors of society, the definition of technology is reverting to include the ideas and processes behind developing something. "Technology is a system which involves

organization, procedures, symbols, new words, equations, and most of all, a mindset" (Franklin, 1990).

Technology Creates New Means of Communication

Technological Revolution Enabled Communication Technology

The introduction of communication technology via computers is of additional significance to the change associated with this era because it has altered the way in which we communicate. Computers are no longer glorified for facilitating calculations, word-processing and storing large amounts of data; they have become a means of communicating (Wright, 1993). Just as the Gutenberg Press marked the beginning of mass-production of printed ideas, computer communication technology has marked the beginning of instantaneous editing and delivery of electronic text, worldwide. The predominant theme embraced by this technology is that our world is becoming increasingly small: everything has become global.

The following indicates the evolution of communication technology within the educational system, to date. This table, from James and Mary Eisele's book, Educational Technology – A Planning Resource Guide Supporting Curriculum, outlines the evolution of technological stages of communication as we have advanced through time.

Table 1: Evolving Stages of Communication and Facilitating Technology

Communication Technique	Technology Exemplifying Type of Communication
Primitive Communications	Cave drawings Symbols Simple hand signals
Written Language	Distribution of spoken language Conservation of language
Invention of Gutenberg Printing Machine	Widespread use of textbooks
Use of Electronics	Calculators Tape recorders
Communication Technology	Television (e.g. Sesame Street) Computers Networking Computers

This evolution is of extreme significance because our mode of communication inherently changes human consciousness. As Ong (1982) observes, literacy (or literate society) is a recent development:

> Human society first formed itself with the aid of oral speech, becoming literate very late in its history, and at first only in certain groups. *Homo Sapiens* have been in existence for between 30,000 and 50,000 years. The earliest scripts date from only 6000 years ago.

New methods of communication have developed at an unmatched rate over the last century. Telecommunications, in the form of television, radio, and telephone, developed in 1920, 1895, and 1876 respectively, are recent inventions that changed our lives by allowing us to communicate with anyone, anywhere, or receive worldwide news in our homes (Ardley, 1994). Computer networking, which has advanced significantly

within the last 30 years, introduced a new means of communication. Differing from telecommunications, communication technology via computers allows a simultaneous exchange of electronic written language in which both parties are *active participants* in a two-way exchange of information. Essentially, oral culture provided the means for a literate culture which peaked when printed literature appeared. The electronic culture builds upon both writing and print, creating a simultaneous act in which the two are often indistinguishable (Ong, 1982). This process provides a new means of self-expression and reflection. As Schramm (1997) states, "The more fundamental insights in human communication since the invention of writing have probably been in the way humans have learned to talk about themselves and their world." Electronic communication alters the exchange of information and thus, has affected the way we think, work and interact.

CHAPTER TWO: ECONOMIC SECTOR GREATLY AFFECTS EVERY ASPECT OF SOCIETY

To get a proper perspective of the Global Age it is necessary to review changes that have occurred within the economic sector since this sector not only constitutes how we define ourselves as a nation, but is the most influential force shaping all areas of our daily lives.

How Economic Sector is Linked to Formulation of Society

Definition of Economics

Three groupings define the influences and pressures of a society: the economic, the political and the social. This is not to say that these elements exist independently of each other, nor does it say that they are of equal importance. Rather, these sectors can be thought of as intersecting circles, each constituting a unique area while simultaneously acting against, and being acted upon, by the other two. See Appendix, Figure 1. Within this mesh of circles formulating society, the economic sector is predominant. The economic sector is the most dominant in the confluence of circles for the simple reason that it formulates how we structure our society, what we value as a society and the current ideologies which we accept.

The source of this sector's heightened influence is more easily seen by utilizing the definition of economics set out by Capra in The Turning Point, "Economics is defined as the discipline dealing with the production, distribution, and consumption of wealth. It attempts to determine what is valuable at a given time by studying the relative exchange values of goods and services." Thus, economics provides the monetary means by which a society sustains itself, while also indicating the mind-set of that society (i.e., what is valuable). The other two sectors play supportive roles; the political circle is that agent which controls and maintains the sustenance of the society, while the social realm incorporates all that needs to be sustained (i.e., the people). See Appendix, Figure 2. The fact of the dominance of the economic sector is extremely important because any transformation that occurs in the economic sector will consequentially alter the other two sectors, and ultimately change that society.

Historical Basis of Economic Influence in Society

Historically, society was not always structured in exactly this way. At the end of the nineteenth century the idea that citizens of a nation could share a common economic fate became reality. Before this time the monarchy of a country maintained the national wealth, and the accumulation of riches was utilized to wage wars and enhance power and prestige. It was only in the eighteenth century that England became the first nation to develop patriotism, in which the monarchy became only a symbol of the nation. Implicit in

this foundation was the idea that citizens of the country all bear some responsibility for the economic well-being of their nation. This concept was exemplified during the Industrial Revolution in which the mass-production and ease of selling products worldwide became the means of economic success: the urge toward national competitiveness was foremost. Thus, the new role of economics in the success of a nation was developed and with it the necessity for the populace to understand, promote, and sustain this realm was evidenced.

Recent Changes Within Economic System

The advent of the Information Age, and our movement into the Global Age, has produced many visible changes within the economic sector. By examining changes in the focus, process, structure and values of the economic sector, we can see how communication technology has transformed the economic system.

Transformed Focus of Economy

Movement of Digital Information

The computer technology revolution we are currently experiencing has refocused the primary outcome or end-product desired by the economic sector. The idea of interchangeable parts shaped the Industrial Revolution, leading to economies of scale and the vast, intricate system of customers and suppliers. Ease in moving every factor of production effortlessly across borders diminished the necessity to be fastest at producing

and transporting a material product. Money, technology, factories and equipment are all examples of elements of the Industrial Revolution that link to a nation's success. However, the increasing use of computers as communication tools has provided a practical, usable and inter-operable information infrastructure (Penrod and Dolence, 1992).

The focus of our new economy is selling information and providing services, as opposed to making a product: the emphasis has changed from products to ideas. This movement away from defining our nation by its production strength (i.e., the ability to manufacture) is due to the fundamental transformation of the focus of our economy. The new focus is increasing innovative production and electronic distribution of information. The structures and much of the organization necessary to allow this movement of digital information were developed during previous eras.

Focal to an economy reliant on information is an entire workforce capable of manipulating the current technology as well as promoting new communication technology. The National Commission on Excellence in Education emphasizes this concept in A Nation at Risk (1983):

> History is not kind to idlers. The time is long past when American's destiny was assured simply by an abundance of natural resources and inexhaustible human enthusiasm, and by our relative isolation from the malignant problems of older civilizations. The world is indeed one global village. We live among determined, well-educated and strongly motivated competitors. We compete with them for international standing and markets, not only with products but also with the ideas of our laboratories and neighborhood workshops. America's position in the world

> may once have been reasonably secure with only a few exceptionally well-trained men and women. It is no longer.

Understanding the new economic focus (i.e., the means of and capability to exchange information) and the type of workforce necessary to accomplish this exchange provides the means for maintaining a competitive edge. Staying competitive is a much more complex endeavor today because the economic sector is no longer based on cause and effect. In an industrial society, creating a product is the focus and developing the means to mass-produce a unique product as well as promoting more efficiently-made products is the economic advantage. Both these abilities lower the price of the product and thus increase consumption. This differs from today's global society in which shaping resources into products does not employ the majority of the workers. Today, 60% of the work force is composed of "knowledge workers" who are concerned with the gathering, analyzing, processing, synthesizing, retrieving and storing of data (Coffey, 1992). Thus, to remain competitive, both the means of exchanging information and the type of worker sending and receiving it must advance.

Economic Process Transformed

The shift to an information-based economy leads to a significant change in economic process. Moving matter is completely different from moving digital bits of information since the physical space needed, time limitations and types of consumers have

virtually no resemblance. Thus, the means or process for producing and exchanging these very different products must change to accommodate the differing natures of the 'products.' Two revolutionary changes that have occurred are a globalization of the process and an elimination of time and space limitations (i.e., elimination of boundaries).

Globalization

The economic market has become increasingly global. Countries, companies, resources and people are working together toward the attainment of a common objective, thus bypassing former geographic borders. This process of globalization has altered the market as Riccardo Petrella (1997) observed in a speech given by video-conference at the *Canadian Bureau for International Education Annual Conference*:

> Globalization today is primarily a globalization of economic process in the market. It is the inspiration of three dominant ideological principles and ideological choices - liberalization of all markets, deregulation of the function of the economy, and privatization of all that can possibly be privatized.

The emergence of these three changing ideologies is very important; a complete restructuring of the economic process associated with the Industrial Age is necessary. Liberalization of all markets creates a free-world community in which unregulated trade of ideas, people and products can occur. Deregulation leads to new possibilities regarding purpose, products and services provided to consumers. Finally, privatization allows the ultimate freeing of the market in terms of removing restrictive guidelines, regulations and

limitations, thus creating the greatest opportunities for all individuals. Although this change in process resolves some of the previous problems of the economic markets, as with all change, these changes create new and unpredicted problems.

Many of the previously limiting factors, such as tariffs and economic constraints, had their foundation in an economy built upon maintaining national sentiments: removal of these limiting factors can thus be expected as society moves toward a global community. For example, during times when markets became unruly it was common for France, Germany and Italy to establish regulatory bodies responsible for coordinating investments and financial capital, purchasing raw materials, marketing goods and consumer pricing. America imposed tariffs on materials imported from other countries which then forced American companies to buy local resources (Petrella, 1997). Both these measures ensured national strength, even if not directly helping the people or companies of that country.

Time and Space Limitations Reduced

Globalization of the economic process has brought on a revolutionary way of trading through the diminution of time and space limitations. This results in a market community where trade can occur between companies continuously and instantaneously. Computer communication technology has allowed global companies to operate twenty-four hours a day, three hundred and sixty five days a year, providing continuous service for customers. This requires a networking of technology that allows employees in one

country to pick up where employees in another country left off, or allows employees in different countries to work simultaneously on one project. This was not possible before computer communication technology since the immediate and direct transfer of information was hindered by space limitations. Now this boundary is invisible: people and their ideas can easily come together.

Transformations in Structure of Economic Sector

Social Structure of Workers Changed (Congregated to Dispersed)

A consequence of any new economy is that the organizational structure for work performance is altered because productivity gains require incorporating the new technology. The use of technology determines a type of physical plan or structure for workers and employees of the economy. For example, as we moved from the Agrarian to the Industrial economy, the steam engine technology became central to factories in which large numbers of once dispersed workers congregated every day. This industrial organization model also led to the development and growth of a hierarchical, 'top-down' management system. This bureaucracy supported a large workforce at the bottom, guided by a few influential superiors, all of whom had very specific tasks and skills. Elemental to this process was serial processing, efficiency, and control; three factors essential to the ultimate goal of this economy - the product. Computer communication technology neither limits people to one physical area, nor does it require multitudes of employees to perform

isolated, fragmented tasks. Consequently, workers are being dispersed and jobs diversified since the need for mass 'factories' of people working on one project is less important.

Hierarchy of Decision-Making Changed (Centralized to Decentralized)

In addition to a restructuring of the workforce, a reform of the management structure has also occurred. The top-down decision-making model has become outdated because it does not fit the requirements of the new economy. The once task-oriented responsibility of the worker has been replaced by the necessity for each to make decisions. This is due to the ease for everyone within a company to access information and the empowerment of the worker to do so. Consequently, the power for making decisions has become more equally dispersed between employees and managerial staff. Decentralized decision-making is the term utilized to explain this shift in power.

Transformed Values Connected with Economic Sector

Change in Types of Skills and Jobs That Are Valued

Changing the focus, process and structures in an economy causes a consequential change in the nature of the work. In the February 8, 1998 issue of *Newsweek Extra* entitled, "2000, A New Millennium - The Power of Invention," comments were made regarding the evolving role of the worker:

> For the workers of the world, it was a century of revolutions on the job. Mass production was pioneered on the Ford assembly line, and with it came the rise of the consumer economy .... But another revolution was coming. The transistor and the fax changed global communication. The photocopier changed the office. The personal computer changed everything. We still make things, of course. But the future belongs to the knowledge of workers. Technology has given them the tools to build a world in constant transformation.

Rather than working toward creating an end-product, the new system emphasizes process. Workers must be thinkers who utilize information. This proposal is well-supported by a claim made by Janet Gandy, in her article *Business Education, A Point of View*: "In a world which is shrinking due to increased access to information technologies, the value of a work force trained to access, analyze and make decisions based upon rapidly transmitted data is significant." The National Academy of Sciences (National Center for Education Statistics, 1995) states, "Seventy-five percent of Americans now work in service and information jobs, with nearly half of all Americans involved in the generation, dissemination, and use of information. New technologies are creating workplaces where creativity, cooperation, and critical thinking are valued at all levels of an organization." With markets becoming more global and companies desperately striving to stay ahead, jobs of the future will demand more highly-skilled employees. During the coming years, jobs that require skills with information-processing technology will be of the norm rather than a rarity (Scale, 1994).

A change in job description necessitates a change in the types of required skills. The Secretary's Commission on Achieving Necessary Skills (SCANS) in 1991 defined five competency skills that they felt all future employees must possess. (SCANS was established by the U.S. Secretary of Labor in conjunction with the American 2000 strategy, to identify the skills young people need to enter the workplace, and to propose levels of proficiency and methods of assessment that can be incorporated into the school program.) The five competencies are:

1. Resources: Identifies, organizes, plans, and allocates resources
2. Interpersonal: Works with others
3. Information: Acquires and uses information
4. Systems: Understands complex interrelationships
5. Technology: Works with a variety of technologies

All five of these competencies reflect the new, global, technologically-oriented ideologies coming into the mainstream population. Competencies 1, 2 and 4 reflect the necessity for an inter-related view of one's job, in relation to positions both within and outside of the company. Competencies 3 and 5 reflect the necessity of technology and its link to information in this new society. The increased emphasis on interpersonal relationships, ability to manipulate resources and information, and insight into whole systems are factors that were not concerns of most employees during the Industrial Age.

Increasing Dependence on Computer Technology

The new economy is very dependent on technology for maintaining the processes necessary to sustain profit. An article published in the Sunday December 14, 1997, *Calgary Herald* stated that, "The industry [Bill Gates] has helped generate now accounts for hundreds of thousands of jobs and five percent of U.S. gross domestic product – the difference between healthy growth and recession." This quote not only exemplifies the economic profit of technologically-oriented companies, but also reflects the consumer demand for these products. This technology has been irreversibly integrated into our economy. According to A Nation at Risk, a report by the National Commission on Excellence in Education, "Computers and computer-controlled equipment are penetrating every aspect of our lives -- homes, factories, and offices."

Computer Communication Technology

Specifically connected with the Global Age is communication technology. As Bikson and Panis (1997) express in their on-line publication of Computers and Connectivity: Current Trends, computers as communication tools are becoming increasingly ingrained in the economic and social fabric of society. "The number of individuals who engage in computer-based communications in the United States has increased dramatically in recent years and is expected to continue growing well into the next century. Although its reach at present is far from universal, information technology is

already woven into the fabric of the economic and social life of developed countries." Bikson and Panis (1997) point out that the increase in computer communication technology has been heightened by two mutually influencing benefits:

1. Improvements in price-to-performance ratios. That is, prices for equal amounts of processing power drop by about half every two years. Having started at least two decades ago, such changes are viewed as the enabling force behind the widespread diffusion of computers to households and offices. Communication technologies are likewise beginning to show price/performance improvements while at the same time shedding their terrestrial and bandwidth constraints.

2. Convergence of computing and communication technology within an integrated information medium. This integration, for instance, permits individuals to communicate information as readily as they create it, to one or many others, sometimes scarcely noticing that generating, editing, storing, and sending are distinct activities.

These two phenomena are of extreme importance because they represent how communication technology is becoming an integral part of our daily functioning. By lowering the price-to-performance ratio this type of technology becomes increasingly useful and accessible to everyone. To give an analogy, Toong and Gutpa (1982) claim that, "If [aircraft technology] had evolved as spectacularly as the computer industry over the last 25 years, a Boeing 767 would cost $500 today and it would circle the globe in 20 minutes on 5 gallons of fuel." It is the decrease in cost, increase in functioning, and enhanced means for real time, worldwide communication that has provided the fundation for computer technology to continue as not only an integral part of the functioning of the economic field, but also an area for monetary potential.

Internet

The Internet is a predominant example of a computer communication technology that has become completely integrated into daily functioning. The Internet continues to expand at an outstanding rate because it has become a mainstream factor in our lives. This expansion is exemplified by two factors: the first is an increase in access from places not conventional in the past, and the second is simply an increase in the amount of time people spend using the Internet. A study by *Net News* (1996) concluded, "Over 23 million people (42% of the on-line population) reported accessing the Internet or on-line services from multiple locations in the third quarter -- more than double the number found doing so fifteen months earlier. Also, the average amount of time a user spent on-line has grown from an average of 6.9 hours per week on-line in Q2 1996 to a current mean level of 9.8 hours per week."

The Internet is currently the primary means for the global sharing of all types of information between all types of individuals. According to the *Net News*, the results of a recent survey of the United States population's use of the Internet and on-line devices shows that:

> 56 million adults, or 27% of the U.S. population age 16 and older are on-line as of the third quarter of 1997. This represents 4.9 million new users of the Internet/On-line services within the past three months. This study also found an additional 16 million adults intend to begin accessing the Internet and on-line services within the next year. If these people follow through with their intentions, the number of wired U.S. residents could approach 72 million within a year. This would amount to a doubling of the on-line population from when IntelliQuest began studying the medium in Q2 1996.

The managing director of Internet services for IntelliQuest, Tom Fornoff, supports this by revealing, "The thousands of users we have interviewed over the course of this study are telling us that the medium is becoming more mainstream in their lives. They are getting on-line from more locations, spending more time on-line, performing a wider variety of activities, and finding it to be a highly useful channel for shopping and buying."

As Internet access increased within the general population, home and work have been the most common points of access. These access points reflect the primary intent for using the Internet: either for a work requirement or for enjoyment and 'surfing' at home. Internet 'users' performed a variety of personal and work-related activities of which the most popular were sending or receiving e-mail, obtaining information about hobbies, researching products or services and accessing general news. A recent IntelliQuest Information poll revealed that these are still the most common points of access. "Home is the most popular access location, with 66% of users accessing from home. Work follows, with 46% of the on-line population accessing from work at least some of the time."

However, a new phenomenon, termed 'alternative points of access' has emerged. An alternate point of access is defined as any venue other than home, school or work where the public or a group's members have access to the Internet. These venues are classified as 'alternative points' because going on-line has not been a service or activity associated with these locations. An article in *Net News* (1997) identifies this new trend: "The number of people who regularly access the Internet through points other than home,

office or school has nearly tripled in the last year. Alternate points of access include libraries, museums, churches, community centers, retailers, hospitals, recreational centers and other civic organizations, and illustrate the heightened interest for the Internet among diverse audiences."

A more in-depth analysis of this trend was commissioned by MCI LibraryLINK, a public-private partnership between MCI and the American Library Association. The analysis was based on Internet research from the *CommerceNet/Neilsen Media Research Internet Demographic Studies* and concluded, "In the spring of 1996, approximately 1.5% of the Internet users claimed to access the Internet through an 'alternate point of access,' such as a library. Today, that number has almost tripled to 4% and the analysis shows it will continue to grow exponentially as communities respond to the public's growing need for increased public access." An analysis of use of the Internet via alternative points of access, revealing the increasing usage of these access vehicles, is shown in Table 2.

Table 2: Percentage of Internet Users from Various Points

Point of Access	Percent of Users
Public Libraries	36%
Churches/Community Centers	14%
Retail Outlet (mall computer stores, coffeehouse)	11%
Hotels	6%
Museums/Recreational Facilities	5%
Hospitals	3%
Airports	3%

For people who do not use computers in the workplace or have the ability to go on-line from home, these alternative points of access are their lifeline to the Internet and to the wealth of information it holds. As stated by Diane Strahan, Executive Director of Corporate Community Partnerships at MCI, "These public points of access are important because they help level the playing field. By the year 2000, nearly 30% of all Internet users could be accessing through alternative points."

Recent Changes Within the Social Sector

The visible economic changes resulting from the re-structuring and transformation within the economic sector of society have been outlined previously. However, these changes did not occur in a closed system and, due to the interrelated nature of all aspects of society, changes within the economic sector had an immense impact on the social and political sectors as well. Analogous to the changes within the economic realm, the social and political also resonate with the recurring themes of quintessential dynamic mind-set and the consequential re-engineering of old organizational structures (i.e., spatial, administrative and organizational) that must occur to embrace the revolutionary technology and its capacity.

The social sector is unshielded from economic changes because, essentially, it is comprised of the workforce, consumers and citizens of the economic nation. Therefore, the social sector has experienced a transformation of ideologies, similar to that found

within the economic sector (i.e., what was and now is valued as important). The political sector, responsible for maintaining and ordering the economic and social sectors of society, adopted new ways to remain competitive and successful in the new global economy. Parallel to the changes which occurred within the economic realm, the political realm was required to re-structure, re-organize and re-plan in order to promote, support and induce the new technology.

Why Technology Affects Social Realm of Society

Technological change induces alternate ways of promoting change or creates revolutionary possibilities that simply did not previously exist. Either aspect of technological change will extend the range of what human beings can do, which is what technology is all about. The initial impact of any new technology is that it will multiply and diversify material possibilities and offer new and altered opportunities to society. However, and it must be noted, the reaction of a society (i.e., positive or negative) to similar new possibilities differs greatly, depending on the values previously held. To meet these new possibilities and opportunities requires new organizations of human effort to realize and exploit them: this results in social change (Lowenthal, 1990).

Inherent in social change is a simultaneous change in individual and social values due to the increased potential for choice allowed by the technology. Options not possible without the new technology are now readily available and old value clusters, whose

hierarchical ordering was determined in the sense of being delimited by antecedent conditions of material possibility, are now changing because technology has altered the material possibilities (Lowenthal, 1990). In the emerging Global Age the meaning of 'material possibilities' has far surpassed the 'material or matter' products of the Industrial Age and now incorporates the digital information exchanged on-line or via computer communication technology.

Complementing the increased possible choices available to individuals within society through technological integration is a change in values that promote the continued emergence of the new technology. The extent and direction of these changes in values within society are predictable. "Technological change leads to value change of a particular sort in exact analogy to the subject of possible social changes that a new technology may augur" (Lowenthal, 1990). Two reasons for the predictability of value changes are as follows. First, certain attitudes and values are more conducive than others for effective exploitation of the potentialities of new tools or technologies. Secondly, whereas technological choices will be made according to the values prevailing in society at any given time, those choices will be based on the foreseeable consequences of the new technology. Inherently, technology has an irreducible element of uncertainty and unforeseeable consequences, since it has the potential for unlimited creative possibilities (Lowenthal, 1990).

Emergence of Mind-Set that Computer Technology is Irreversible and an Important Part of Future Life

Advances in computer technology have changed the mind-set of society regarding the value and role that this technology is to play in the future. Unequivocal integration and increasing reliance on this technology within the economic sector has created a new perspective: computers are a part of our daily functioning. An example of the media's perspective of the powerful role of the computer in North American life is found in *Newsweek Extra* (February 8, 1998):

> As the century comes to a close, the technology that obsesses us, captivates us, infuriates us and dominates us is the computer. But ultimately, this most amazing of inventions won't be seen as an artifact of the old millennium but the defining force of the one just dawning. Do you really think that we're already into the computer age? That's a gross underestimation of what the computer will eventually do to change our world, our lives and perhaps the nature of reality itself.

A public poll taken in 1996 directly probed participants regarding their views of computer technology; the results of that poll support the above perception. This study was done by Intel, the world's largest chip maker, and was conducted via telephone by Yankelovich Partners with a stratified random sample of 2,302 respondents aged 13 and over between October 1-18, 1996. (The article [*Net News*] reported the results of a public opinion poll regarding computers taken in 1996: the margin of error estimated, +/-5%.)

Results reflected the public's belief that the Computer Revolution is just beginning and that technology will continue to play an ever-increasingly important role in our daily lives:

> Americans are expecting new capabilities and opportunities from the computer and believe that we have only begun to tap its potential. When asked to place the computer today on a scale of 1-10 (where 1 means the computer revolution is just beginning and 10 means it is over), 60 percent of those surveyed respond between 1-3. In addition, over half indicate that they look to the computer to expand their capabilities and possibilities by helping them to accomplish new things rather than merely enabling them to do current things better. Many of the activities Americans believe they will very likely do with a computer in their lifetimes involve the use of connectivity and multimedia applications. *(Emphasis is mine)*

This increased dependence on computer technology to aid in accomplishments revealed that Americans felt this is a 'must have' technology, and that it is irreversibly ingrained in contemporary society. Another Internet *Net News* article (1996) reveals the profound interest Americans have in technology:

> Three-quarters of Americans view technology as playing a major role in influencing the U.S. economy. This puts technology third, behind health care and agriculture/food, but ahead of such traditional economic heavyweights as defense and transportation. Interest in technology generally outscores interest levels in sports, politics and international news, among other areas. *(Emphasis is mine)*

Changes in What Citizens Value

The value associated with computer technology has changed from the onset of its use as a communication medium. Viewing computer technology as a tool or means to an end, as opposed to an end in and of itself, is a new concept and results from the realization that information is the resource of the future. A *Net News* (1996) article supports this by

revealing respondents' interests in accessing information and the associated role of the PC as essential to this endeavor. "Americans believe that the PC will have a positive impact on continuous/lifelong learning and helping them find the information they want most."

New Skills Required to be Active Members of Society

Citizens around the world are influenced daily by technology introduced through the economic sector. As computer communication technology becomes increasingly ingrained in our society, citizens are forced to become competent users of this technology in order to remain functional in this economy. Hence, the types of skills that are needed and valued also change. Of foremost importance is the adoption of new competencies and procedures, the release of old ones and the ability to continuously adapt to evolving technologies.

Recent Changes Within the Political Sector

New Ideas Regarding the Promotion of Economic Sector

Creating an atmosphere that is supportive and well-adjusted to the transformed economic system requires the re-engineering of political strategies, organizations and ideologies. This restructuring is necessary to remain adjusted and competitive within the global marketplace. The Canadian government has identified three areas of concern as essential to promoting and adjusting to the economic reform. As stated in a Government release

found on the Internet (National Advisory Board On Science and Technology [NABST], 1997) these are:

1. Effective new institutions, relationships and networks -- a stronger national innovation system -- must be established to enhance Canadians' abilities to gain and share knowledge and information.

2. The links between job creation, economic growth, quality of life and advancement of knowledge must be well understood and strengthened.

3. The federal government must improve its approach to partnerships with business, academic institutions, other governments and voluntary organizations.

Paradigms shaping these three areas are borrowed from the economic sector. Point number three focuses on increasing networks and partnerships within the government and towards its outside agencies, reflective of networking created through mergers and globalization within the economic system. Point number one stresses the need to promote innovation via enhanced communication between people, institutions and bureaucracy, a paradigm adopted from the economic sector. Point number two supports the economic sector by bringing attention to the direct relationship between knowledge and the new economy and the need to advance innovative ideas within this sector.

Expressed Emphasis Regarding the Importance of Computer Technology

Worldwide, governments have been quick to realize the competitive advantage and necessity of promoting technology (especially computer communication technology) for

the continued competitiveness of their country. This ideology was premature in that these governments lacked fundamental understanding of the technology, did not have implementation targets for it and only weakly expressed the goals associated with using the technology. For example, as early as 1981 Margaret Thatcher stated, in a press release, that "The Government fully recognizes the importance of information technology for future industrial and commercial success of the U.K., and the central role the government must play in promoting its development and application." A poll, released a year later, in 1982, revealed that 80% of people in the U.K. did not know what information technology encompassed, neither was the government initiating any substantial plans for the promotion of it. These findings support the premise that although governments did not initially know how to promote information technology, they did realize it would have a great future impact (Hawkridge, 1983).

This sentiment upholding the benefits of computer technology is also held by the Canadian political sector. In Ottawa on March 11, 1996, Industry Minister John Manley, on behalf of the Canadian Government, emphasized the importance of technology in the creation of a successful future for Canadians: "Technology is one of the keys to economic success in the 21st century. We have to do more to harness its power for job creation and economic growth." This is reinforced by a recent study conducted by the *Organization for Economic Cooperation and Development (OECD)* (1997) that concluded,

"Technological development is the main force determining growth in productivity, employment and living standards in the medium- and long-term."

Improving Canadian achievements in information technology was realized to be of fundamental importance because technology drives innovation in all sectors of the Canadian economy, bringing increases in competitiveness and productivity which, in turn, result in long-term growth and job creation. As stated in an Internet article released by Industry Canada (Manley, 1997):

> While Canada has a strong tradition of achievement in fields such as telecommunications, medicine and software, there is evidence that our performance is lagging behind our international competitors. Canada ranked 18th out of 45 countries in the World Economic Forum's 1995 review of Science and Technology performance. This "innovation gap" as the OECD has described it, has contributed to weak productivity performance over the past two decades, resulting in sub-optimal employment growth and contributing to high government deficits.

Technologically-competent people are fundamental to maintaining a technology-orientated society, but to create a technologically *innovative* society, people that have advanced technological skills and who are adept at manipulating new ideas for the promotion and advancement of technology are required.

New Plans for Meeting Technological Needs

To meet this new technologically-oriented objective, the Canadian Government has been transforming its long-term objectives and the means of meeting those objectives. The

Government of Canada has prescribed three technological challenges in which Canada must excel (Manley, 1997). These three objectives are outlined in a 1997 Government News Release found on the Internet:

1. Developing and commercializing advanced technology so that Canada shares in the profits and the jobs that result from the creation of new products and new businesses.

2. Improving Canada's innovation system and helping business access the technologies they need to increase their competitiveness and productivity.

3. Building the information highway and increasing access to the highway for small- and medium-sized businesses and individual Canadians, especially young people.

To realize these objectives the Canadian Government has established such ongoing initiatives as Science and Technology Action Plans, Technology Partnerships Canada, and the Information Highway.

Science and Technology Division

One area that the government found paramount to greater innovative achievement was through redirecting Science and Technology endeavors within the country. "Science and technology plays a very key role in the ability of our government to attain the three coherent national goals of sustainable job creation and economic growth, improved quality of life and advancement of knowledge, because it has potential to affect each of these areas" (Manley, 1997). In February 1994, the Government of Canada launched a

sweeping examination of the challenges facing science and technology in Canada and the opportunities for federal action. Based on public consultations and valuable input from other sources, this review produced the Federal science and technology strategy, *Science and Technology for the New Century*. The Industry Portfolio consists of two departments (Industry Canada and Western Economic Diversification Canada) and nine related agencies that belong to the portfolio of the Minister of Industry; all report through the Minister to Parliament. The Industry Portfolio Vision is as follows: "The Portfolio will use its unique tools and capabilities, maximizing linkages and partnerships, to help Canada become a world leader in knowledge-based innovation that will result in jobs, exports and economic growth" (Manley, 1997).

To build a more innovative economy, the Federal Government is taking a systemic approach to strengthening Canadian innovation. This involves an understanding of how the current innovation system functions, playing on strengths and re-addressing weaknesses, engaging all the participants and correctly interpreting the Federal Government's Science and Technology role. Three core activities that the Canadian Government has outlined are as follows (John Manley, 1997, http://xinfo.ic.gc.ca/ic-data/announcements/news-release/1997/enlgish/e_03_11.html):

1. Funding and performing scientific research to support the mandates of departments and agencies (sound science is central to policy and decision making).

2. Supporting research in universities and colleges, Networks of Centers of Excellence and other non-governmental research institutions (generates discoveries essential to Canadian innovation and ensures our ability to adopt and adapt technologies from other parts of the world).

3. Supporting private sector research and technology development .

4. Providing information and analysis, and building networks.

To encourage the means for invention and exchange of ideas within a Science and Technological framework, the Federal Government has outlined four elements essential for shaping a new governance system (Manley, 1997). These are:

1. Expert external advice.

2. Decision-making mechanism for stronger coordination of the Government's overall Science and Technology effort.

3. An effective, transparent and accountable management system common to all departments and agencies.

4. Improved intergovernmental cooperation and coordination.

Once again, these new directives reflect administrative themes found to be working successfully within the new economic order. Key points include inter-related organizations, networking between systems both within and outside of the governmental establishment and decentralization of the decision-making process.

Technology Partnerships Canada

Fundamental to the promotion of innovation is increasing the networking between organizations through what the government has called *Technology Partnerships Canada*. This is an organization designed to encourage the research and development of advanced technology projects in Canada. Investments are fully repayable and are intended to help ensure that products with a high potential to stimulate economic growth and job creation actually reach the marketplace. The fund's focus is on environmental technologies, strategic 'enabling' technologies (i.e., biotechnology), selected information technologies, advanced manufacturing technologies which make industries more efficient and productive and aerospace or defense industries, including defense conversion. Two important themes exist within this endeavor. The first and foremost is the networking of previously separate organizations to increase funding in the promotion of a common goal. Bringing organizations together is creating symbiotic relationships previously unrealized. Second is the extreme focus on promoting technology within non-traditional areas such as environmental technologies, enabling technologies and information technologies.

Information Highway

A third mechanism, aimed at promoting communication technology, as stated by John Manley, is the promotion of the Internet (http://www.gsh.org/wce/heller12/htm, 1997):

> The Canadian Information Highway will be an affordable, high-quality information infrastructure that gives Canadians access to the employment and educational opportunities of the Information Age. By the end of 1997, Canada will have one of the world's most forward-looking policy and regulatory regimes. The government is promoting competition in all aspects of the Information Highway. This will result in more jobs and a broader choice of innovative products and services that will benefit Canadians and Canadian businesses.

In support of this objective, Canada is launching a program that will promote use of the Internet to those least likely to use it. During the next three years, the Community Access Program will provide up to 1,500 rural communities with access to the Information Highway and delivery of public services. The next few months will bring the total number of 'connected' communities to about 400 (http://www.nap.edu/readingroom/books/techgap/index.html, 1997). The rationale for pursuing such a project lies in its capacity to integrate the technology while increasing the exposure of it. As a consequence, increasing numbers of people will be familiar with, comfortable using and accepting of this technology as well as the resulting change in economic focus. This project will be beneficial in that it promotes two necessary aspects of successful revolution: affecting ideologies and increasing the numbers of skilled people necessary to the use and development of technology.

CHAPTER THREE: IMPACT OF GLOBAL AGE ON THE EDUCATIONAL SYSTEM

Influences on Institutions Within Society

Inherent in the transformation of systems, organizations, procedures and ideologies is the pressure placed on supportive institutions to adapt to the change. This pressure to adapt requires fundamental re-assessments and transformations within systems, initially induced by a crisis or chaos within the institution when it fails to adequately meet its objectives. At such a time, an evaluation of the methods used to meet objectives as well as examination of the validity of the objectives themselves, occurs. This reactionary response to larger societal change occurs because institutions, by definition, deal with problems inherent in ordered social life. Eisenstadt (1967) outlines three basic aspects of social institutions which illustrate their function. First, the patterns of behavior, regulated by institutions or 'institutionalized,' deal with some of the problems basic to any society. Second, institutions involve the regulation of behavior of individuals in society according to some definite, continuous and organized patterns. Finally, these patterns involve a definite, normative ordering and regulation, that is, regulation upheld by norms and the sanctions legitimized by these norms.

In other words, institutions can be viewed as upholding the set of practices necessary for the basic survival of an organized society. If institutions fail, the continuity and ordered set of values, norms and beliefs they advocate would also crumble. Roberta Snow (1985) states that, "Institutions are a conservative force within society. Through regulation they attempt to maintain certain patterns of behavior necessary for a society's survival." Although institutional organizations are the 'sacred pillars' upon which society rests during times of stability, when society -- as a whole -- is in disarray, so are the internal sub-systems. It is during these times of sweeping change that institutions often cannot support society and, paradoxically, become destructive elements, a process that recurs unless and until institutions transform themselves to complement the evolving change, in context.

The institution of education is doubly conservative in nature because it serves to uphold other institutions and to maintain those elements of society which resist change. Two opposing objectives prevail: one that makes this institution resistant to change, and another that makes it essential to propagating change (i.e., it serves to preserve the society by instilling commonality of ideas and goals within static institutions, but also promotes evolving ideals and values which require the induction and instillation of change).

Inability to support societal change is extremely detrimental within the context of education because education is necessary to the promotion of an upcoming era. This is exemplified as we move into the Global Era. Educational institutions, which should be

upholding and redefining that leadership role in supporting others to assimilate and accommodate the changes that have recently occurred, have instead moved into a permanent state of dysfunction, a protracted crisis (Snow, 1985). The remainder of this thesis is devoted to an analysis of the pressures influencing educational institutions, the role education plays in the economic, political and social sectors, the crisis within education consequential to societal changes, the need to adapt to these changes and, finally, the methods to allow adaptation to these changes.

Social Pressure to Integrate Technology

Explanation of Societal Pressures on Education

According to Green (1980), social pressures on education can be divided into three categories: societal, parental and incumbent. He describes societal pressures as "Interests whose advancement benefits everyone in the society, but which do not themselves fall directly under the jurisdiction of the state. They [societal pressures] are examples of those interests that are important not for the continuation of society, but for its improvement." He separates parental from any political or societal interests because parents have a direct investment in children doing their best, not merely meeting minimal standards. This differs from social interests because social interests are aggregate rather than specific and, in that respect, they are like the interests of the state and unlike the interest of parents. Social interests are concerned with those goods that benefit everyone directly, even if distribution

is restricted to only a few, as well as such goods and services as orderly government and good roads which cannot be possessed by anyone unless they are secured for everyone. We do not really care, for instance, who *in particular* is a good plumber as long as somebody is and as long as there are enough of them. Essentially, social interests are minimal. They are interests not in what is essential for society, but in what is essential for a *good* society. In this respect, social interests are similar to the interests of parents and unlike the compelling and derived interests of the state.

Interestingly, the incumbents (i.e., the teachers and administrators who work within the system) are seen as having the least influence on the system because they are not a coalition. Instead, they have diverse roles and beliefs which make it difficult to combine their differing ideas into finding one common objective. They provide the internal pressures to change and are directly impacted by any changes (Snow, 1985). This gives them one investment that the other social institutions lack: that is, changes within the system will inherently change the nature and structure of their work environment.

Specific Pressures on Education from Social Sector

The initial movement for innovation, using computers in schools, originated both within the schools and the community (Evans-Andris, 1991). As expressed in Melissa Evans-Andris dissertation, Technology Change in Schools, "The 1980's, generally, were a time when educational effectiveness was challenged nationally. Frequently schools were

criticized for their inability to provide sufficient responsive and appropriate service to students." Interestingly, it was during this time of fiscal crisis that the educational systems' interest in and use of microcomputers was highest (Evans-Andris, 1991). This was due to the educator's belief that the computer might help in the endeavor to prepare students for the future, in addition to the pervasive attitudes within the general population that computer technology would enhance the schools' ability to equip and prepare students with the technological skills necessary for success (Evans-Andris, 1991). The acquisition of this technology was marked by a need for a large sum of money, accumulated through a joint effort between community and school boards.

Political Influences Within Education

Explanation of Political Influences on Education

The intent of a nation's political sector in advocating education is minimal. As stated by Snow (1985), "The [government] is not interested in creating the best possible economic or political conditions, or educating its people in the best possible way. It is interested in setting the lowest standards which allow survival and, for this reason, the interests of the [government] are labeled 'minimal'." Snow (1985) continues her discussion by explaining that the power of the political sector over education is maximal since it is the government's role to assure that minimal levels of knowledge and skills are met. "The [government] can specify and enforce systemic behavior through law. It

therefore represents the most powerful set of interests operating within the system and in situations where there is disagreement with others it will prevail."

Governments Worldwide Emphasize the Importance of Computer Technology in Education

As society advances into the Global Age the political sector has increasing interest in supporting the integration of technology in schools. Three reasons to promote integration are: the contribution of multimedia to the learning process, the desire to prepare the next generation for the information society and, finally, to provide skilled workers which can compete in the Information Age. The majority of these efforts are geared towards integrating communication technology in which the Internet is the focus. Ambitious, government-led initiatives to put schools on-line have been launched in North America, Japan and Europe.

In 1996, in the United States, Bill Clinton launched the concept of an education rate, or 'E-rate,' which would provide Internet connection to all U.S. schools and libraries for 20% to 90% lower then regular rates. Clinton also launched the Internet II initiative, which will provide advanced Internet connectivity to the U.S. scientific and educational communities. The Internet II initiative will be aimed at developing a new generation of transmission protocols and faster networks capable of supporting high-speed communications services, including real time transmission of video. To help U.S. schools

acquire the necessary equipment, Clinton created a five year, $2 billion Technology Literacy Challenge Fund (TLC Fund). Under this scheme, states and local communities will be eligible for financial support from the TLC Fund. Funding for connection networks within schools will be additionally supported by the private U.S. National Cable TV Association, which pledged to wire up all U.S. elementary and secondary schools in areas served by cable TV networks.

Canada has similar government-supported objectives, as stated in a news release from Industry Canada found on the Internet (http://xinfo.ic.gc.canada.english/minmess-e.html, 1997):

> By 1998, through the SchoolNet program, all of Canada's 16,500 schools and 3,400 public libraries will be connected to the Information Highway and have access to the knowledge and skills that will be required in the information economy. As of March 1996, students are logging-on and using SchoolNet approximately one million times per month.

Whether educators are in agreement or not regarding the benefits of technology within the educational system, funding for the implementation of technology in education has increased dramatically. The Quality Education Data (1996) research findings revealed that:

> More American students are using technology as a regular part of learning. Quality Education Data's research also shows that federal, state, and local technology funding programs are having a direct and positive impact on student and teacher access to technology. More computers are being used in classrooms and more students are integrating Internet-based resources into their school work.

Since communication technology has become a focus for the utilization of technology in schools, the debate regarding technological implementation has become less about what type of programs are beneficial for teaching students and more about students' ability to access information. The Internet is focal to this goal due to its innate ability to provide access to vast quantities of information and students must be good learners to derive what they need from this 'data bank.' In addition, the Internet can link students to a global community in which they can go directly to the source (i.e., e-mail an author, video-conferencing of students around the world to discuss topics they are studying). Within Quality Education Data's (QED) 10th annual report of Educational Technology Trends (1996) the Internet was a recurrent factor in the most significant of the report's findings. For example:

1. Technology funding increases at the federal, state and local levels are having a direct and positive impact on both students' and teachers' access to technology. Only 59% of the study's respondents cited funding as a major barrier to increased telecommunications use in their schools.

2. 29.2% of K-12 public school classrooms now have access to the Internet, more than double what was reported just 12 months ago, and 72% of schools reported Internet Access in some location.

3. Teacher and student use of computers and the Internet is increasingly aligned with the curriculum, with 35% of the respondents stated showing student using computers for writing and analyzing data.

Canadian Provincial Government Emphasizes the Importance of Computer Technology in Education

The Province of Alberta has also analyzed accessibility and integration of technology within provincial schools. A representation of its findings can be found in a Technology Implementation Review regarding Grande Regional Division No. 35 and Wolf Creek Regional Division No. 32 entitled, The Best Practices and Key Learnings with Respect to Technology, It's Implementation and Management in Education (http://ednet.edc.government.ca/educational-practices/executive.html, 1997). The executive summary of these reports as of December, 1997 is as follows:

> Many school jurisdictions in the Province of Alberta are pursuing major technology initiatives aimed at equipping their schools with modern technology infrastructures. The initiatives will lead to modern computers in the schools, the establishment of local area networks (LANs) within schools and the interconnection of schools throughout jurisdictions via wide area networks (WANs). Technology has the potential to redefine the learning process and to make significant improvements in the administrative processes.

These two school jurisdictions were the focus of the Alberta analysis because they are leaders in the struggle to implement technology and each has distinctive philosophies as to efficiency in heavy spending on technology. From this study, five themes have emerged and could be used as guidelines for other schools within the province. These five themes are stated below:

> **Theme One** - Technology Integration in Education ... the ultimate goal is to integrate technology into a student's educational experience making it as familiar as other traditional skills, such as handwriting.

Theme Two - Technology and Administration ... by streamlining administrative processes with technology, the amount of time spent doing administrative tasks is reduced in favor of more time with students.

Theme Three - Technology Planning and Management ... network technology is complex ... management of the resource is critical and should not be underestimated.

Theme Four - Funding and Fiscal Management of Technology ... there is a cost of ownership associated with technology, this needs to be recognized and managed accordingly.

Theme Five - Telecommunications Infrastructure ... efforts to bring global information resources to Alberta students requires access to telecommunications solutions for both urban and rural schools.

All five of these themes promote the integration of technology and are inherently reflective of a methodology similar to that found within the economic sector. For example, themes one and four promote the commitment to embracing technology completely, theme two advocates the changing of the process, and themes three and five create a networked, interconnected atmosphere in which technology functions best.

Economic Pressures to Integrate Technology

Following are three ways in which the economic sector exhibits pressure on an institution such as education.

The Educational System as a Consumer of Computer Communication Technology

Pivotal to the economic sector is the selling of products to consumers. With the advent of computer technology in schools, another opportunity for sales has arisen. Thus, a new focus for economic development and research into advancing communication technology within schools begins. This point is made in an Internet article (http://www.nap.edu/readingroom/books/techgap/market.html, 1997):

> As technology moves from the periphery to the center of education, it is creating many new opportunities for establishing businesses, for startup companies and for venture capitalists to make a profit while serving educational ends. The linkages between technologies used in school and technologies used at home further increase the size of this market. By making educational technologies profitable, these trends could unleash a powerful entrepreneurial force within education.

New Partnerships between Businesses and the Educational System

Mergers, partnerships and joint efforts are familiar within the economic sector but are very new for the educational system. They are becoming increasingly popular due to the increased need for computer set-up and networking, technological training and use within schools. Teachers can no longer serve all of these functions alone. Consequently, a new synergy between the educational system and entrepreneurial efforts is emerging (http://www.gsh.org/wce/heller13.htm, 1997):

> The potential for crossover between the educational and business systems is great. Educators can use new technologies to invest in learning activities, while venture capitalists can invest in educational products and services as a way of developing new markets. Children can gain access to interesting educational technologies, educators can benefit from children who are more interested in learning, and

> investments made today will produce both short-term and long-term economic returns for the companies and individuals who make them.

Creation of Skilled Workers

In her article, Further Fragmentation – Computer Technology in the Classroom, Gretchen Schwarz (1997) argues that the economic sector also has a very personal investment for bringing computer technology into the classroom, since the educational system today creates the skilled workers of tomorrow. Education plays a very important role in enhancing competitiveness and global economic success because the education system serves to 'feed back' into the economic sector by creating technologically-skilled workers, technologically innovative minds, and individuals capable of successfully accessing information and solving problems. Riccardo Petrella (1997) nicely highlighted the function education can serve in this new global market:

> Educational systems produce knowledge which is then incorporated into the production of devices, into goods and services. Education is also an instrument to serve - through technological innovation and through the ability of "highly qualified" human resources - the competitiveness of the various enterprises in many different countries, each of them competing to be the winner in the new globalized, liberalized, deregulated markets.

CHAPTER FOUR: FEEDBACK ROLE OF THE EDUCATIONAL SYSTEM IN SOCIETY

Definition of Society

As previously discussed, the educational system is an institute within the larger whole of society, in which social, political and economic pressures all exert an influence. However, the educational system plays a specific and distinct role in that it is part of feedback for these realms as well. Before the feedback role and purpose of education in society can be discussed, a definition of society is needed. For the purposes of this argument, Ackoff's (1969) notion of the 'ideal society' will be used:

> This [the ideal] society would be one within which every member could attain whatever he wanted with perfect efficiency, and in which he would always have an expanding set of desires.... Man's ideal state is hardly a steady state; rather, it is one that is dynamic and continually expanding in meaning and significance.

In this context, the educational system serves multiple roles during periods of transition. First, it transmits the norms and values of society to successive generations. Secondly, it imparts the skills needed to maintain an adequate workforce. Lastly, it supplies the foundational knowledge, aiding all individuals to be active and responsible members in the diverging society (Snow, 1985).

Education Meant to Meet Compelling and Derived Interests of Society

According to Green (1980) there are two types of interests, compelling and derived, that are fundamental in shaping the institution of education. Compelling interests arise out of the need to maintain a society's survival both economically and politically. As Green states, "The compelling interests of the [nation] can be summed up in two requirements - that (1) each individual attain economic independence, and (2) that each grant minimum obedience to civil law." The derived interests are the consequence of the compelling interests: the latter secures the former. In Green's words, "...the determination of who can teach, who will be educated for how long, what will be taught under what conditions and what will constitute an acceptable level of attention to these problems on the part of the family and the local community..." supports the two requirements and, hence, translate into derived and compelling interests.

Essentially, institutions such as education sustain a society by influencing the economic, political and social areas so that they function successfully. An outline for how education can help guide citizens towards attainment of an ideal society is found in A Nation at Risk (1983):

> All, regardless of race or class or economic status, are entitled to a fair chance and to the tools for developing their individual powers of mind and spirit to the utmost. This promise means that all children, by virtue of their own efforts, competently guided, can hope to attain the mature and informed judgment needed to secure gainful employment, and to manage their own lives, thereby serving not only their own interests but also the progress of society itself. *(Emphasis mine)*

Inherently, education has a responsibility to respond to changes and evolving societal features so it can continue to provide a supportive framework for society. To do this, it must continually assess and analyze the conditions necessary for the attainment of an ideal society, since the ideal itself is dynamic. Failure to keep up-to-date with progressive transformations creates a sense of urgency throughout all aspects of society because the entire social fabric is characterized by society's institutions providing a meaningful pattern for living today (Chippendal and Wilkes, 1977).

How Education Meets Societal Objectives

Four conditions essential for the attainment of an ideal society are identified by Ackoff (1969). From these conditions he derives a taxonomy of behavior patterns as general societal functions which must be met:

1. The Politico-Economic Function: The Pursuit of Plenty. To provide each individual with instruments that are perfectly efficient in the pursuit of his objectives.

2. The Scientific Function: The Pursuit of Knowledge or Truth. To develop the instruments and identify the means by which objectives can be obtained with maximum efficiency and to provide every individual with the ability to identify perfectly efficient instruments and means in the pursuit of his objectives.

3. The Ethico-Moral Function: The Pursuit of the Good. To remove conflict of objectives within individuals (i.e., to produce peace of mind), and conflict between individuals (i.e., to produce peace among men).

4. The Aesthetic Function: The Pursuit of the Beautiful. To enable every individual to enlarge the range of his objectives through the conceptualization of new desirable states.

Education is seen as supporting all of these functions. It supports the Politico-Economic Function by providing the specific information and training so individuals can attain the goals they desire; the Scientific Function by providing knowledge and patterns of thinking elemental for the development of innovative ideas and tools; the Ethico-Moral Function by removing conflict between individuals through the expansion of correct and enlightening information; and finally, the Aesthetic Function by focusing on different learning styles, motivational techniques, promoting art and drama classes, and through acknowledgment of good work completed. Together, the accomplishing of these tasks allows education to provide a feedback role in the creation of future members of society that eventually will infiltrate and effect the political, economic and social areas of our society. Although pressures to change and reform society may begin in all three of these sectors of society, it is the educational system itself that magnifies these ideological changes and enables them to be ingrained and advanced within our society.

CHAPTER FIVE: CONSEQUENTIAL PROBLEMS FOR EDUCATION DUE TO GLOBAL REVOLUTION

A result of the societal transformation we are experiencing, and its pressure on the educational system to adopt new ways of functioning, is an array of areas that must be altered within the educational system. Older methods no longer meet the requirements of our evolving society and, consequently, an 'educational crisis' has emerged. Analysis of the transformations required due to the onset of communication technology reveals three major objectives that education is failing to meet. These include the necessity to create a different student, one that is not necessarily proficient in certain subject areas but is an able and life-long learner, the necessity to fully integrate communication technology since it is a new and will be the predominant medium for communication and, finally, the need to prepare citizens for all aspects of the future of communication technology.

New Importance in Creating Life-Long Learners

Naisbitt (1982) argues that "In the new information society where the only constant is change, we can no longer expect to get an education and be done with it. There is not one education, no one skill, that lasts a lifetime now." The truth of this is evident in, "Times of turbulence and rapid change render much knowledge tentative and

inconclusive. Today's students and tomorrow's workers and citizens must be able to struggle through the puzzling process of making sense out of nonsense" (McKenzie, 1995). Stated another way, scientific and technical data has been doubling every five years since the 1970's, and is expected to continue to do so every 20 months during the 1990's. Thus, it is estimated that the information half-life (the time period during which half of the information in a field becomes outdated) of some fields is only 6 years (Kezar, 1991).

As another private-sector visionary, Bill Gates, writes in his book The Road Ahead, "In a changing world, education is the best preparation for being able to adapt. As the economy shifts, people and societies who are appropriately educated will tend to do the best. The premium that society pays for skills is going to climb, so my advice is to get a good formal education and then keep on learning." This renewed emphasis on creating life-long learners is unique to education for two reasons. The first is that it reduces the strong ideology that learning only occurs in a school-type institution. Accordingly to Jack Pellichi of the Oracle software company, "Increasingly, education and work are becoming closely integrated. Forget K through 12 education, it is now K through 95 (years old!)." The new economy is teaching us that work and learning are becoming one and the same and that learning never ends (http://www.soicc.ca...nograph/trends.html, 1996).

The second revolutionary insight is that it is more important to teach the learning process than it is to impart a specific knowledge base. This is due to the rapidly changing

information base in our society and the realization that we cannot train future citizens for all the jobs, technology and other advancements that they will face in the future. For example, 85% of children in grade 5 will be entering a workforce in which the positions have not been designed and the technology not yet developed (Stager, 1996). To excel in this dynamic situation, workers at all levels will be expected to have advanced decision-making skills and the ability to learn new material quickly and proficiently. The old paradigm encouraged schools to sort and sift students by their 'potential,' using tracking and grouping to aim a stream of workers toward their intended occupations, establishing academic expectations accordingly. Those in the Honors and AP sections -- usually about 10 percent -- were expected to perform the most reasoning and ultimately become lawyers or managers. Descending the ladder, the expectations and requirements lessened dramatically. All employees of today, however, including the front-line service worker, are called upon to make decisions and solve problems in ways that contrast strongly with what was expected in the 'smokestack' economy. Today's employees are expected to exercise judgment, demonstrate flexibility and convert data into information and then insight. As stated by Jamie McKenzie (1996):

> Countries with the broadest percentage of citizens who are brainworkers will have the strongest societies and economies during the next few decades. We must shift away from the smokestack paradigm which saw the schools' job as preparing most people for mindless factory jobs. The fewer than 10 percent of American eleventh graders who can perform reasoning tasks on the National Assessment of Educational Progress tests (NAEP) must be expanded to something more like 85 to 90 percent.

Need to Completely Integrate Communication Technology

The education system has experienced great pressure to integrate technology, but attempts to do this have been fragmented, peripheral and non-directive. Fundamental to these failures is that no common ideology of technology has been developed in the educational system. Currently, the debate regarding whether computer technology has a place in student learning is irrelevant. The communication benefit that this technology imparts is revolutionary and cannot be ignored, neither can the irreversible and fully-ingrained position that computer technology has reached in all aspects of society be denied. Realizing this does not solve the problem of how to integrate this technology; however, it does reinforce the growing need to fully integrate it, as Heide and Henderson conclude (1994):

> There is a difference between what is happening in education and what is happening in other work settings. The difference is that while other institutions and work settings have adopted the technologies into the heart of their functioning, and the technologies, in turn, have changed the nature of the work, education has not changed a single basic process that is essential to its operation. Education has tended to keep the technologies apart from the basic process of learning and teaching. *(Emphasis mine)*

Need to Redefine Objectives to Match Skills and Proficiencies Required in Upcoming Era

Computers must be in classrooms because now, more than ever, they are needed as a tool to access information and to communicate, and must be used by skillful,

innovative, life-long learners. Familiarity and proficiency at using computer technology, especially in regards to communication technology, is a skill which will be of undeniable benefit in the up-coming millennium.

The educational system is obliged to prepare citizens adequately for a global and technologically rich future economy (Snow, 1985). The practicality of preparing citizens for the future workforce is self-explanatory. In the emerging global revolution large corporations would not benefit if future employees did not develop the skills to use the computer and communication technology as well as the mental abilities to provide creative solutions and alternate options continually in regards to this technology. However, it is not sufficient to be prepared only for working in a technologically-advanced environment; one must also be prepared to live in this society. Living in this society requires citizens to be proficient users of the technology available, while also being informed and active members of society adept at making reasonable decisions and choices. An article released by the National Academy of Sciences (1995) reveals the changing role of citizens due to communication technology:

> With today's technologies, the consumer of information can engage in dialogues instead of simply absorbing monologues. They can interrupt and redirect the flow of information. They can modify the complexity of information, the speed at which it is communicated, and its manner of presentation. They can control the elements of sophisticated multi-sensory experiences, combining audio, video, text, and graphics into a single immersive reality.

The Educational System Must Adapt Through Transformations

Renewed Requirement for Change to Adapt to Dynamic Society

The realization that our society has fundamentally changed is exemplified by the significance of our current economic shift from an industrial society to an information society. This transition has produced a visible change in the focus, process, structure and values within the economic sector but, more importantly, it has put pressure on all other areas of society to adapt to this change. The educational system is no exception. Utilizing this perspective in approaching the crisis of technological implementation in schools is crucial in two ways. First of all, it provides an expansive framework for viewing the technology crisis found in the educational system. By understanding the source and varying causes of the pressures on the educational system, an accurate perception of the necessity to integrate technology and the desired outcome of doing so can be attained. In addition, understanding prompts an exploration of how the current educational system adapts to this pressure to change. These combined reflections provide an ideal approach to resolving the problem of integrating technology and formulation of a solution. Secondly, the economic sector provides a paradigm exemplifying the types of changes needed in the educational system in order to accommodate resultant societal changes. New focuses, processes, structures as well as organizational models and values can be adopted by the educational system to enable the direction and types of changes needed. Finally, the educational system creates a feedback loop into the economic, political and

social sectors of society; it therefore serves an important role in promoting the values, ideologies and skills needed by individuals if they are to function in the changed society.

The Educational System Has Fundamental Elements Limiting Educational Transformation

School systems, historically, have only marginally adapted to societal change. Successive changes associated with the transformation from the Industrial Age to the Post Industrial Age and finally to the Information Age resulted in only minimal restructuring of the school environment. The 'first wave' of school reform met the needs of the country's rural, farm-based society, the 'second wave' responded to the needs of the industrial age and the 'third wave' of change in the school system is now underway as we progress into the Information/Communication Age (Goodman, 1995). Each of these waves responded to a need for transformation but, in each case, restructuring of schools' physical organization, student expectation and curriculum requirements was minimal, even though the paralleling societal transformations were of revolutionary proportions (Roemer, 1991). Experiments in team teaching, open classrooms and computer-assisted instruction are relics of these short-lived, and generally unsuccessful, reforms (Snow, 1985).

Such minor attempts as these did nothing to correct the fundamental crisis in education and dissatisfaction of various groups towards education throughout these periods prevailed (Snow, 1985). Some characteristics common to these criticisms are that

public concern with the state of education continues to escalate; these concerns, however, have been repeatedly expressed (especially in relation to the role education plays in society) (Snow, 1985). Consequently, this has led to recognition of the inability of policy makers to develop action plans capable of treating this complex social problem (Snow, 1985).

Analysis of the purpose of education within society reveals two elements fundamental to the failed attempts at rectifying educational problems. First of all, the institute of education is inherently conservative, not dynamic; thus, educators are part of a system that is not responsive to change because it characteristically sustains consistency and stability. Secondly, the analytical approach used by educators is characterized by a mechanistic mind-set toward problem-solving and they continue to uphold the reductionistic framework (Scale, 1994).

Institute of Education Resists Change

One factor limiting adaptability to change within the educational system is the function of this institution. As discussed earlier, inherent in the institution of education is the ability to remain in a steady state. This is a fundamental function of education and necessary for upholding the beliefs and values of society. One way that this institution can sustain this function is to seemingly adapt to change while essentially changing nothing at all. Margorie Roemer (1991) calls this 'change without difference' while another scholar,

Schon (1971), refers to this as 'dynamic conservatism.' Both of these references make a distinction between ameliorative and radical reform, and argue that the former is representative of current reform found in our educational system. Instead of examining the basic values and power relationships within the school institution as part of the effort towards change, the focus remains on improving current practices to make them more efficient and effective (Romberg & Price, 1983).

Thus, the tendency to *fight to remain the same* is reflective of the educational systems' past response to transforming pressures (Schon, 1971). Essentially, when "Processes embodying threat cannot be repelled, ignored, contained or transformed, social systems tend to respond by change – but by the least change capable of neutralizing or meeting the intrusive process" (Schron, 1971). Thus, school restructuring reinforces the basic values upon which conventional education is based, and even with the impassioned rhetoric of school reform, the methods of educating children have remained remarkably unaltered over the last hundred years. This lack of substantial change can be observed in nominalistic or minimal compliance to the demand for change.

In contrast, radical school reform projects would confront the cultural and pedagogical traditions and beliefs that underlie current practices and organizational arrangements. This reform includes changes that would alter the fundamental ways in which organizations are constructed and the introduction of new goals, structures and roles that would transform familiar ways of doing things into new ways of solving

persistent problems. Changes of this revolutionary nature have not occurred in the history of computer integration in schools. Minor or token changes encompassed the majority of attempts to integrate this technology, resulting in two discernible consequences. The first is that the resultant change is so minimal that the conservatism found within the rest of the system undermines it (Dockterman, 1988). For example, computer technology in schools frequently exists in such minimal amounts that it is impossible to allow each student an opportunity to utilize this technology to its full capacity. Thus, without necessitating change, educators disregard the value of this technology and continue to teach using previous methods. The second outcome is that one 'super solution' abides and is expected to change the entire system, including all of its subsystems (Dockterman, 1988). Educators who believe that the computer will one day be a 'tutor' of students, thus relieving learning, motivational and discipline problems, are guilty of this attitude. This thinking attached unwarranted responsibilities to the new technology and, when it failed, this group of educators disregarded all the capabilities of computers.

Wrong Analytical Approach

Another factor limiting a successful resolution to the educational crisis stems from an unsuitable mind-set. This is a critical element because the dialectic framework used to analyze a problem is vital to the type of assessment and solutions that will be developed.

"Failure to resolve [a] continuing 'crisis' indicates that there is something fundamentally wrong with the way the problem has been formulated" (Snow, 1985).

The crisis within education demands that the relevant history, in any of its particular forms, (i.e., economic, philosophic, social, cultural, etc.) be regarded as a process. In other words, development should be seen as internal and necessary self-movement, while each aspect of movement is interrelated and interacts with the things around it (Davies, 1976). This principle, however, is the exact opposite of the current mind-set. Today, educators utilize a mechanistic framework in which every problem is fragmented into parts and thus a solution to the individual parts is assumed, regardless of external or internal interactions and influences. Lacking in this model is an outlet for incorporating outside interactions and their influences, as well as an insufficient means of connecting with similar divisions within education. This perspective is summarized by Jenlink, in his book Systemic Change: Touchstones for the Future School (1995):

> The incoherent and fragmented nature of educational reform initiatives reflects the prevailing fragmented approach to the study of education. This approach depends on scholarship in a variety of disciplines, each claiming a part of the "educational pie." This division can provide only a partial interpretation of the system studied and develops descriptions that are based on disparate theoretical frameworks. For example, in education we study the sociology of the classroom, the psychology of learning, the technology of instruction, the economics of education, the anthropology of school culture, and the politics of governance. Compartmentalized inquiry combined with the use of widely differing orientations, methods, and languages of the separate disciplines, results in nonintegrated, disjointed, and incomplete knowledge and characterization. Thus the disparate, discipline-based theoretical frameworks currently used in educational inquiry cannot offer a conceptualization of depiction of education as a total system. It cannot portray the complex interactions and systemic connectedness among the

> various components of the system, or the mutually interacting and recursive dynamics of system processes.

Primary to utilizing an interconnected approach to problem-solving is being able to properly interpret the problem. For the crisis of integrating computer technology in schools this begins with identifying the sources causing the crisis. Continuing debates such as, "Should computer technology be in schools?", "What is the purpose of computer technology in schools?" and "How can we successfully integrate communication technology?" would be quickly resolved by looking at the pressures causing change. Secondary to utilizing an approach which views education in light of the larger whole is that it provides new insights as to why previous computer integration techniques failed, while also providing different alternatives that might prove successful.

Previous Failures Limiting Integration of Computer Technology

Utilizing the two previous limiting characteristics within education allows a foundational analysis for the following depiction of why integrating computer technology in the past has been so unsuccessful. Following is an example of nine limiting factors of computerization with the educational system, many of which remain visible.

Inappropriate Ideology Regarding Computers (Wrong Mind-Set)

The old mind-set characterized computers as another technology, like the television, tape recorder or film projector, in the classroom to aid in the teaching process. This bias caused computer technology to be seen as an end in itself, instead of as a means to an end. "Educators typically viewed it as a gilded add-on instead of a tool of reform" (Holland, Jan/Feb, 1996). Two reoccurring themes resulting from this mind-set are found in the literature. (1) Educators view computers as another bandwagon on which to jump, with little or no long-term validity, and (2) educators anticipate computers to be an all-inclusive solution to every educational problem. Both of these points of view inevitably lead to the 'failure' of this technology because it can neither meet these expectations, nor was it ever meant to.

The Bandwagon Approach

The bandwagon approach does not allow for communication technology to be regarded differently when compared to previous assimilations of new technology. Communication technology differs from previous technology. Although it is a source of information such as that derived from books, it is also a means of relaying information and, thus, becomes an individualized, manipulated and user-orientated tool. Since this technology revolutionizes our means of communicating, it is a tool that is becoming deeply ingrained within the constructs of society as people use it in all aspects of their

lives, from leisure to work. When computers are viewed in this way, their potential surpasses 'educational technology' and instead becomes a valuable life tool needed to access the resource of the future: information. However, when teachers view communication technology as another educational technology 'fad' they are far less willing to embrace the changes this technology will bring (Holland, Jan/Feb, 1996).

Improper use of and uncertainty pertaining to computer technology resulted from the lack of perception regarding the wide-spread societal use of this technology. Schools, utilizing a reductionistic mind-set, were not looking at the broad framework of what this technology would do for society, but instead tried to focus on what it would do for education. With this in mind, it is not important to teach computer literacy (i.e., learning about the computer and its use), but instead educators must focus on information literacy (i.e., the ability to find, evaluate, retrieve, manipulate, store and present data in a meaningful form) (Smythe, 1997). This shift in focus reflects a change in ideology in which the emphasis is teaching future citizens how to learn. As summarized by Smythe (1997), "Focusing on the acquisition and processing of information leads to the development of an information taxonomy – data, information, knowledge, understanding and wisdom. Thus, we are looking at a learner taking unconnected bits of information, making meaningful connections between these to construct knowledge and, hopefully, evaluating this in an ethical context to ensure that it is used for one's personal development and for the benefits of humankind."

The "All-Encompassing" Approach

A second result of the reductionistic framework is that a multitude of opinions regarding the benefits of computer technology was conceived and, without a framework to combine these ideas, an unfounded opinion that technology was an all-inclusive solution was formulated. This is, inherently, an ineffective way of thinking since computer technology was intended to be a tool, not a teacher. Computers, initially, came into the classroom with little direction. Quotes such as, "We want them so we can stay ahead, catch up, and maintain national power," reflect the vague understanding regarding what -- specifically -- the computer is capable of doing (Roszak, 1994). For example, in the United States of America, initial funding for computers and enthusiasm amongst educators was high, and hardware was readily available (in 1980, there were 50,000 computers in schools, by 1994, 2.4 million); however, the problem was that nobody knew precisely what to do with them. Computers were labeled the solution and educators began looking for problems to solve using these machines.

One way to avoid the reductionist task of finding the perfect application for this technology requires the analysis of related systems, past examples and the effect of this technology on the current system. With this approach to the inquiry framework, the application of an educational technology is an evolutionary process, and the application of one type of technology as a solution for all problems is never successful (Eisele & Eisele, 1990).

Computer Technology Was Not Viewed as Essential to the Educational System

Initially, great debates took place regarding the placement of technology in schools. Arguments regarding student benefit from using computer technology, the acquisition of funding, implementation, appropriate software and the objective outcomes were continually rehashed. No unifying solution could be reached by educators because they failed to substantially observe technology's use outside of the educational system to obtain a perspective of what computer technology is achieving in other facets of society. Studies regarding the benefit to students' learning by using computers versus traditional methods became irrelevant to the conflict regarding the integration of technology into schools. Communication technology will unquestionably have as profound an impact upon the future of schools as books once did. Perceived computer technology failure was due to a misuse of the technology and insufficient understanding regarding the changing pedagogy that must accompany it. The confusion, arguments and disorganization were all elements arising from the lack of understanding that initially surrounded this new medium. Educational objectives were not explicitly addressed in the beginning and, thus, cross-purpose arguments remain (Seidel and Rubin, 1977).

Incorrect Pedagogy

A fundamental change in our ideologies as we move into the Global Age is the focus on learning rather than on knowing. Recurrent themes such as *life-long learning*,

decentralized decision-making and *increased individual accountability* are being widely used within the economic sector of society and are rapidly spreading to other areas. The emphasis on knowledge as an internal process rather than externally-derived and then memorized has resulted in a need to change the teaching pedagogy. Jiang Lan (1997) makes this point in his speech for the *Annual Meeting of the American Association of Colleges for Teacher Education*, "We are reminded of Dewey's observation that all 'knowledge is external,' all 'knowing is internal.' Knowing is the process. The computer has become a powerful adjunct to the human mind and the 'knowing' process."

Currently, schools do not reflect this change in pedagogy. Instead, they continue to utilize a model of teaching known as 'objectivist.' This method is characterized by teachers who view themselves as the source of all knowledge and understanding and utilize didactic teaching methods to instruct students and then measure their understanding via an objective test, as Heflich states (1996):

> Objectivist thought assumes that reliable knowledge of the world exists, independent of an individual's ability to perceive it. The objective tradition assumes that the world itself is objective, and measurable. Aspects of the world can thus be structured and modeled in ways that learners can understand. Learners gain knowledge and develop understanding as information about reality is transmitted to them by teachers. The mind, according to objectivists, exists to reflect the objective reality of the world, by processing external meaning through its interactions with structured models of reality. Thus, objectivist education is conceived of as the assimilation of an objective reality.

Recently, constructivism has been suggested as an alternative to this old pedagogy. Constructivism is the general belief that individuals learn by constructing their own idiosyncratic meaning of reality as they interact with the environment. Essentially, learning is the goal of this model rather than knowing and, thus, the role of the teacher changes from an authority to that of a coach who seeks to facilitate student learning.

A constructivist conception of learning assumes that children learn best when problems are presented to them in the context of authentic situations, in an open cooperative environment that can be called a *learning community* (Brown & Campione, 1994). The social interactions in which they are involved in the classroom help students construct unique understandings that they integrate into their previously-held views of the world. Thus, constructivist learning can be conceptualized as a movement from an objectivist view of the world in which knowledge is rigid and fixed to a constructivist in which knowledge is an individual creation. Technology is therefore about knowledge, perhaps best described as experiential, about understanding and also about doing (Shield, 1996). Communication technology provides an unmatched media in which students can be constructivists, that is, they develop their own understanding of the world. However, a continuing barrier to this opportunity lies in the inability of educators to adopt a 'coach' or 'facilitator' type mind-set with respect to their role.

Insufficient Funding and Hardware

The funding challenge is substantial due to both the limited access most schools have -- today -- to the basic infrastructure and because of the fiscal pressures at work in the current budgetary environment (Princeton Survey Research Associates, 1993). To place the funding discussion in context, in the 1993-94 school year approximately 1.3% of the American National Budget was spent on educational technology. This amount could almost cover the cost of supplying schools with computer labs, as this endeavor was calculated to consume 1.5% of the National Budget. However, the shift in focus over the last few years, with the advancement of communication technologies, has been the integration of this technology into the classroom where it can become an integral part of the learning process. For a skeletal structure of computers in the classroom a budget of 3.9% (nearly triple that of the lab model) would be required (National Center for Education Statistics, Projections of Education Statistics to 2005, 1995). Although these statistics are for the United States of America, Canadian ratios to meet the same minimal standard are similar.

The number of computers found in schools has grown over the years and ninety-nine percent of all elementary and middle schools in the United States have computers. However, in many schools the ratios between computer access and students remains low. Quality Education Data (1995) monitored the student/computer ratio and found that in 1983 this number was 125:1, in 1988-89 it was 22:1, and in 1995 it was 12:1 (Ely, 1995).

These ratios reflect the best scenario. One problem limiting this ratio is that allocated money is not necessarily spent on computer hardware. Since there is no directive as to the type, amount and organization of computer technology, schools can spend whatever they feel is necessary. This leads to great inequality in the hardware available between different schools. Schools with educators that do not value computer technology as important to the learning environment can ignore integrating this technology.

Non-Inductive Classroom Structure and Computer Location

Trivette (1994) explains how structure is very important for the successful integration of technology into the classroom. "When an innovation does not fit classroom routines the response is often token compliance. In other words, stockrooms are filled with projectors and televisions, and labs are outfitted with computers, but teachers are generally free to ignore the machines." Due to the lack of clarity in intent and the inconvenience of going to a physically removed laboratory, teachers have not readily accepted this technology into their regular routine. A study conducted by the Office of Technology Assessment (OTA) found that "Most school computers were not in classrooms where teachers could use them regularly as instructional tools, regardless of their teaching approach" (Holland, Jan/Feb, 1996). Without enough hardware to put significant numbers of computers in the classrooms, teachers find it difficult to allocate limited time to a technology that can only accommodate a few students at a time. Current

teaching techniques do not allow for the utilization of computer technology, nor does the existing school structure.

Lack of Teacher Training and Professional Development

Most professionals in the economic sector have accepted computer technology, even communication technology, as an integral part of their job. Due to the increased importance placed on computer literacy and the ability to utilize computers' communication and information storing and retrieving capacity, many potential employees seek training in these areas. Teachers, on the other hand resist utilizing computer technology in the school setting. One reason for this is the lack of teacher support via training workshops. A study conducted by Office of Technology Assessment (OTA) found that of, "The $2.13 billion that public schools spent on technology in 1993, less than 15 percent was used to train and support teachers, critical to making changes in what goes on in the classroom" (Holland, Jan/Feb, 1996). This means that teachers receive very little support as to the direction and utilization of this largely unfamiliar and complex technology. The lack of teacher support is also recognized by the National Academy of Science:

> Teachers receive less technical support than does any other group of professionals. Computers occupy the desk-tops of most professionals in the United States, but not in the classrooms; there, computers are often used exclusively by students. The average worker in America can take advantage of $50,000 worth of capital invested in that job; the comparable figure for teachers is $1,000.

In addition, most of the in-service training in technology skills that teachers receive is, at best, exposure rather than real skill-building. Electronic learning found that only 21% of training courses are geared toward integrating technology into the curriculum. In addition, half of all training is delivered in the form of a half-day workshop. A lecture or half-day seminar with little or no follow-up or classroom support is unlikely to promote mastery of the technology or any of the changes in teaching approaches required to incorporate the technology (Siegel, 1995).

Resistance of Educators

Lack of educator support for the adoption of computers as an integral part of the school curriculum and process remains a limiting factor. "Perhaps the biggest obstacle to change in schools is teacher buy-in" (Holland, Jan/Feb, 1996). Having educators as one of the barriers to the integration of computer technology is the reverse of the norm, since it is usually the staff nearest the work core that originates the idea for technical change within organizations. Their position allows them to see performance gaps or other activity needs. Noting the source of pressure on education to adopt computer technology is of great importance because it helps reveal why the current opinions and feelings towards technology exist in schools. As revealed in Evans-Andris' dissertation (1991), having technology 'forced' upon educators creates feelings of resentment and resistance. This

challenges the ability of teachers and administrators to view technological innovation in an objective and unbiased manner.

In addition, the current hierarchy of decision-making within the educational system creates a situation in which teachers feel lack of control over computer technology (Becker, April, 1992). Previously, teachers may have felt little control over the following actions and policies that affect both access and utilization of computer technology (Becker, April, 1992):

- The acquisition of hardware and software.
- Policies restricting or mandating how computers should be or should not be used, where they should be used (and located), and who should or should not use them.
- Decisions about the content of courses or the specific software to be used in classes where computers are taught about or used.
- The existence and the focus of training, support and encouragement for teachers' computer use.

Lack of control over technology implementation may also be a reflection of teachers' opinions regarding the impact of their autonomous behavior. That is to say, although the educational system provides opportunities for individuals to make autonomous and classroom-based decisions regarding the innovative process, the degree to which teachers act autonomously may be inhibited by the existing system structure. The freedom of autonomy among workers creates a heterogeneous mix of innovative decisions, all with little influence and support in regards to large-scale change or

innovation (Evans-Andris, 1991). This lack of support is detrimental to the adoption of technology because teachers do not personalize this technology, and thus are reluctant to bring it into their classroom.

Insufficient Teacher Time

Lack of teacher time is relevant in two different dimensions. The first is that teachers have only minimal class time to cover the necessary curriculum and objectives. "The teacher is expected to maintain control, teach a prescribed content, capture student interest in that content, match levels of instruction to differences among students and show tangible evidence that students have performed satisfactorily" (Trivett, 1994). In dealing with these demands, teachers must ration their time and energy, organize their classrooms appropriately, and develop practical techniques to allow them to meet the prescribed objectives. Thus, the inconvenience and low student-to-computer ratio makes computer technology a hindrance in this endeavor. Consequently, teachers revert to old technologies such as chalkboards and textbooks because they are flexible, inexpensive, readily available and a familiar and proven way to accomplish the tasks at hand (Trivett, 1994). A second dimension in which teacher time-limitations are an inhibiting factor to the integration of computer technology is the amount of time allocated for a teacher to learn about new technology. The schedule of an educator does not leave much time for learning new techniques and trying to integrate these into the curriculum. Marking,

preparing, and dealing with student concerns requires such a large portion of time that little is left over for trying new techniques and processes. Hinton and Orlich (1996) argue that "We as teachers have often found ourselves overwhelmed by the sheer volume of ever-changing information related to teaching the new technology," and thus keeping up-to-date and informed regarding new technologies is very difficult.

Insufficient Infrastructure and Contingency Between Schools

Schools, to date, have had little connection with other institutions within society. Utilizing communication technology to interconnect schools has been difficult due to the lack of consistency within the infrastructure. For example, the brand names of hardware purchased within schools in North America vary extensively. Statistics from the 1995 Quality Educational Data, eighty-six percent of schools use Apple, forty percent use IBM, thirty-seven percent use Macintosh and twenty percent use other DOS units (Ely, May, 1996). In addition, the networking, Internet access and software programs between schools vary greatly, making it difficult to connect and network between schools.

CHAPTER SIX: CHANGE IS OCCURRING WITHIN THE EDUCATIONAL SYSTEM

Analysis of computer technology within the economic sector of society, and the change in mind-set induced within the social and political sectors, suggests examples that can be used by the educational system to guide the types of changes required within this institution. Utilizing these examples helps to create a foundation that determines how research is methodically formatted and how the results obtained are evaluated (Lowenthal, 1990). This is a paradigm. Although there are multiple meanings associated with this terminology, I will use the word 'paradigm' to refer to a way of looking at things, shared assumptions which govern the outlook of an epoch and its approach to scientific problems, generating an example which can serve as a pattern (Lowenthal, 1990). Paradigms regarding the new focus of teaching, the process by which that focus can be achieved, the structure which will facilitate this and the values resulting from this endeavor can all be deciphered from existing methods found in many fields of study.

Areas Focal to Promotion of Change

Change in Focus

In an information-driven society, care must be taken not to equate information with knowledge. As Naisbitt (1982) forecasts the 'megatrends' from 'industrial society to information society,' he views the new economic order as the mass-production of knowledge:

> We now mass-produce information the way we used to mass-produce cars. In the information society, we have systematized the production of knowledge and amplified our brain-power. To use an industrial metaphor, we now mass-produce knowledge and this knowledge is the driving force of our economy.

However, the leap from information to knowledge depends upon the conception of the individual exposed to the information. As Roszak warns in his book, The Cult of Information, (1994):

> In the space of three sentences, one notes that "information" has become synonymous with "knowledge," as if there were no significant distinction between the two, and we finish with the idea that *knowledge* is being "mass-produced." But since knowledge (like "brain-power," if this means something like intelligence) is the creation of individual minds and has a great deal to do with the quality of thought, what relationship - even of a metaphorical kind - does this bear to the assembly-line construction of a car from interchangeable parts? Depth, originality, excellence, which have always been factors in the evaluation of knowledge, have somewhere been lost in the fast, futurological shuffle.

Thus, it is more crucial now than ever before that educators help their students to decipher and create knowledge from vast amounts of information. The content of the

curriculum is of less importance because information, and the type of information individuals require, is changing so rapidly. This creates conflict between educators of differing mind-sets. Those who feel that the *content* educators teach is of primary importance believe that teaching one *how to learn* is 'dumbing-down' the curriculum, whereas someone who believes in teaching others how to learn will view it as increasing the selection of knowledge available to the learner. As Seymour Papert (1993), a seminal thinker in the use of the computer as a machine to think with, suggests, "Why quibble? At best we can teach one billionth of a percent of all the information that is available in the world, yet we argue endlessly over which billionth of a percent is the most important." Within this context, teaching young learners the skill of accessing, retrieving and understanding the pieces of information they will require in the future becomes a more advantageous and preparatory endeavor.

Change in Process

Miles Bair (1996) points out that teaching has always been a relatively low-technology activity. Schools have typically developed with a minimal technocratic structure. However, new technologies have continually seeped into the system and now, with the advent of computer and communication technology in the economic sector, the pressure to update the system has heightened. To date, there is a multitude of information regarding the use of technology in schools. Most of this literature focuses on the

integration of the computer into the classroom and it is still being argued whether the computer is an appropriate tool for educational purposes. This is an unproductive argument because, as stated by Marie Smyth (1997), "When society has been radically reshaped by the introduction of computer-mediated technologies and telecommunications, it is unrealistic to expect that education can remain shielded from similar impact" (http://www.unimelb:edu.au/tisp/teaching/teachings.html, 1997).

In this last quote, the importance of changing the process of teaching so that it incorporates computer technology is apparent. More specifically, it is important that teaching embrace the communicating advantages of communication technology, thus expanding the learning opportunities for students. Communication technology provides an alternate and revolutionary means of exchanging information. Unlike tools such as books and film, communication technology is interactive in process and vast in quantity. Communication technology has the potential of connecting students with others almost anywhere in the world. This creates the potential for collaborative work environments such as AT&T's Learning Circles projects in which students from around the world work together to create publications about their cultures, writing or current events (Trivett, 1994). A further benefit is that communication technology allows students to interact with others, via electronic print, without being judged by their appearance or physical handicaps. Accessing information 'on-line' also has the potential of making information more widely available. Information has been made more accessible by 'net-centric'

computers. These are IPCs (Interpersonal Computers) that are lightweight boxes built for speed and connectivity, designed to locate software on remote servers, and quickly download an application (such as a spreadsheet or word processor) to networked users. The 'guts' of the end-users' network, processing and storage, would reside in a powerful server connected to users' dumb terminals in a local area network (LAN) or wide area network (WAN). This set-up would be less expensive because these terminals need fewer parts (Salvador, Jan/Feb, 1996). Since this is a new technology, revolutionizing the way we communicate, it requires a new process for proper utilization within the educational system.

In schools today, the structures promoting communication technology are at the beginning of the development process but need to be advanced and development accelerated. "Seventy-five percent of public schools have access to some kind of computer network, such as a local area network (LAN) or wide area network (WAN) but only 30 percent of public elementary schools have Internet access" (Plotnick, 1997).

Change in Structure

At the *Annual National Conference on Liberal Arts and the Education of Artists* (1996), Miles Bair expressed the sentiment that "Today's [schools] are schizophrenic combinations of high-powered computational infrastructures and highly conventional institutional practices .... Information technology will not integrate into existing

structures, rather it will transform the structure of higher education into a form that is impossible to predict." This integration involves reforming the physical setting of the school environment, the employee hierarchy, school–community interaction, student orientation in classrooms and a multitude of other avenues.

Fundamental to the discussion of school restructuring is an analysis of the process of change, not just the mechanism to promote it. Literature pertaining to the organization of systems has focused on developing a model of innovation which predicts the likelihood of change. Theorists argue that the innovative behavior of an institution is dependent upon its structural characteristics (Evans-Andris, 1991). Although the school structure is inherently conducive to change, the chance for the adoption of the change among workers is slim. "This suggests that, though it may be valuable to ascertain the structural characteristics promoting change, it also may be meaningful to study **innovation as a process**, rather than as an end product" (emphasis is mine) (Evans-Andris, 1991).

Change in Values

Teachers must change the ideologies that are fundamental to their current teaching practices. This change includes adopting a new mind-set regarding computer technology and changing the values associated with it. Adopting a new mind-set is necessary for educators because they must adapt to the new priorities emerging within the economic sector. Three elements must be incorporated into educators' perspectives in order that an

evolved view of technology result (Means & Olson, 1993). The first is understanding that the values of educational technology change with the specific technological use. For example, utilizing computers in schools for document processing, as opposed to a communication tool, emphasizes very different values. The former use allows students to polish their documents by re-arranging them, saving them, and returning later to work on them. This is simply a new mechanism for editing language. However, when the computer is used as a means of receiving information by linking up with an author writing an autobiography on the other side of the world during a real-time open chat teleconference, a totally new importance is associated with this technology. Analogous to this might be the discovery of the printing press, a striking advancement which made it possible to put thought into printed literature. Another fundamental value of computer technology has been that it allows for personal reflection: when it is possible to put language into written form, one can pause, reread, think and consider what has appeared several sentences earlier and ponder the relationship between different areas within the text.

Secondly, one must realize that the technology itself, as it becomes predominant, changes the consciousness of the society. Once again using the printing press as an example, the development of this technology brought about a new form of cultural expression called literacy and the advent of lists, scripts, recipes, encyclopedias, libraries, archives, textbooks, newspapers, memos, policy statements, constitutions, and by

extension, formal logic (Ong, 1982). Thus, as literacy became interiorized, the thought processes of society changed, as did the direction of their development. This history is repeated with the introduction of computer technology as it provides new means of accessing information, the ability to access much greater quantities of it, and the ability for a new means of worldwide communication. Society's ideologies are molded through exposure to new information and, with these new world-wide connections and revolutionary means allowing the simultaneous development, editing and sending of written literature, the gap between the process of writing and the process of communication is increasingly lessened.

Old ideologies associated with outdated technology must therefore be re-evaluated. This is not to say that the older technology has no value and should be discarded, but rather to point out that it is merely displaced by the newer technology and must find a new role. Possibly it will co-exist with the new technology, support that new technology or become an 'antique classic' of our heritage. In any of these instances, the values surrounding the old technology need to be altered as well so it can evolve and succeed in its new role (Stager, 1996).

Finally, a third element that must be incorporated into a perspective of technology is that any aspect of technology has the potential to be viewed as educational. This stems from Rousseau's ideas that education is based on experiences and senses, not on the academic imparting of knowledge (Nadler, 1981). In essence, any object in the

environment has the educational potential for providing a starting point in an encounter with learning through experiential elaboration. For example, communication technology, which can lead to the access of false or misleading information, can be a learning lesson in developing the skill of decision-making.

CHAPTER SEVEN: NEW PERSPECTIVE ON EDUCATIONAL REFORM

Reconstructing these areas (i.e., focus, process, structure, values), which are essential to the transformation of the educational system, requires new approaches to understanding the system. Previous analytical attempts have utilized a reductionistic approach that does not provide an adequate theoretical basis for conceptualizing education as a complex social system. Barriers inherent within the institution, including the inability to accommodate reform and the nominalistic nature of past attempts to fix the system, reveal the roots of the current crisis. Instead of reviewing the educational system in light of an entire societal transformation, former analytical techniques focused on changing some parts of the system and neglected to reflect on changes occurring outside of the system itself. This narrowed both the scope of solutions possible for educators and the reason for initiating transformation within the system.

Current reform efforts, on the other hand, are based on a more holistic approach. "Recently, the educational reform movement has been shifting from a disjointed, incremental effort towards more of a Gestalt perspective, where the focus of change is on the whole educational system" (Scale, 1994).

Systems View

Why Use a Systems View?

The persistent nature of the crisis suggests that the educational system has been undergoing a prolonged deterioration, resulting from problems caused by the broader societal changes which began after World War II. Educational reformers are attempting to perpetuate a system that is appropriate to the waning era and at odds with the emerging one. Therefore, the organization of education and the process by which its problems are solved impedes, rather than promotes, societal progress (Snow, 1985). One analytical approach that emerged during and after World War II as a result of research and development in problem solving, efficiency analysis and, most significantly, the development of complex man-machine systems, is a *systems* concept (Lowenthal, 1990). Banathy (1973) provides not only the history of this analytical approach, but also an analogy from the aircraft industry as to why a *holistic* analytical approach is necessary:

> During the war, aircraft designers wanted to build a machine that contained complex weapons that could provide a decisive edge for the U.S. Air Force. These designers found that they could not simply take an existing airplane and refit it with a variety of additional equipment, such as armor plating, weapons, and communication and detection equipment because the random addition of these components greatly affected the machine's performance. They then developed a new strategy – they first identified the purpose and performance expectations of the system before they developed all of the parts that made up the system as a whole. That is, it was the system as a whole, not the parts separately, that had to be planned, designed, developed, installed, and managed.

The historic beginning of a holistic analytical approach highlights some of its beneficial aspects. Such ideas as the need to look at the entire system and review how changes to one part affect the functioning and purpose of the whole are essential. Three important elements within this approach are prioritized as follows: purpose of the system, processes that must be undertaken, and the content or parts that comprise the system (Lowenthal, 1990). The reason for this sequential order is that the purpose gives direction to the whole system, which in turn determines the processes that have to be generated in order to maintain the system, which ultimately suggests the kind of components that are to be employed and comprise the system (Lowenthal, 1990). See Appendix, Figure 3.

The initial failures of the aircraft designers ring true for educators as well. Past attempts at rectifying a failing system involved mainly 'add-on' attempts, where no analysis of the entire system was provoked. This led to continued deficiency. Embracing a new approach to the analysis and resolution of problems, such as systems analysis, within the institute of education is a primary step towards creating change within education and is increasing in popularity.

What is a Systems View?

The systems view is a way of looking at ourselves and the environment we live in as well as at the entities that surround and interact with us (Banathy, 1973). Essentially, the systems view is a way of thinking, a point of view. Systems science incorporates three

interrelated streams: systems theory, systems philosophy and systems methodology (Jenlink, 1995). See Appendix, Figure 4. Through study of the isomorphism of differing systems, a 'systems theory' was developed which comprises an interrelated web of concepts and principles. This led to a complete re-orientation of thought known as a 'systems philosophy'. Together, these provide a framework in which a working 'systems methodology' has been developed and, hence, can be applied to the world around us. Utilizing these three streams creates a mode of inquiry that is comprehensive, extensive and thorough.

A good summary of what a systems view encompasses is found in Capra's book The Turning Point (1982):

> The systems view looks at the world in terms of relationships and integration. Systems are integrated wholes whose properties cannot be reduced to those of smaller units. Instead of concentrating on basic building blocks or basic substances, the systems approach emphasized basic principles of organization.... [Systems] are wholes whose specific structures arise from the interactions and interdependence of their parts. The activity of systems involves a process known as transaction – the simultaneous and mutually interdependent interaction between multiple components. Systemic properties are destroyed when a system is dissected, whether physically or theoretically, into isolated elements. Although we can discern individual parts in any system, the nature of the whole is always different from the mere sum of its parts.

Essentially, a systems approach to solving problems is unique because it focuses on the connections and processes working within the system as a whole. Rather than seeking out the part of a whole that is not 'functioning' properly, and thus causing the entire

system to be faulty, a systems approach looks at how changes to one part affect the other components within the whole.

The systems theory is not new in origin. In The Fifth Discipline, Senge (1990) provides a brief history of systems theory:

> [Systems thinking] is a set of general principles – distilled over the course of the twentieth century, spanning fields as diverse as the physical and social sciences, engineering, and management. It is also a set of specific tools and techniques, originating in two threads: in "feedback" concepts of cybernetics and in "servo-mechanism' engineering theory dating back to the nineteenth century. During the last thirty years, these tools have been applied to understand a wide range of corporate, urban, regional, economic, political, ecological, and even physiological systems.

The reason that systems theory is beginning to be integrated readily into many differing philosophies, and is so appropriate for the Global Age, is that it readily embraces complexity and change. These qualities are inherent within an open system, the type of structure that a systems framework is meant to encompass. Social organizations such as the school system are open systems and, according to Katz and Kahn (1996), this means that they meet nine requirements:

1. Importation of energy
2. Throughput
3. Output
4. Systems as cycles of events
5. Negative entropy
6. Information input, negative feedback, and the coding process
7. Steady state via dynamic homeostasis
8. Differentiation
9. Equifinality

These characteristics reveal the necessity for utilizing a systems approach when studying open institutions (i.e., open systems). Requirements 1 – 3 reveal the 'connectedness' of an open system with other systems outside of, as well as within, its own system. For example, educational systems receive input from such various sources as policy direction, school site councils, advisory accountability committees, legislature, and -- consequently -- these influence and direct the students that pass through the system, thus affecting the final 'product.' Requiring energy from systems outside and 'feeding back' into these environments heightens the need of each system for other systems and reinforces the impact that outside systems have on the processes which eventually affect the original system.

Characteristics 4 - 7 emphasize the element of 'change' that is fundamental to the existence of open systems. Although currently limited within the educational system, change is still recognized in a number of different outlets (i.e., differentiation of roles in administration, social workers, counselors, diversified endorsements, increased regulations). Minimal change is essential for the basic existence of the schools because, as Katz & Kahn (1966) suggest, "It is conceivable that a school system that fails to respond to signals for change from its environment will ultimately suffer the dire consequences of reduced funding, legal sanctions or a loss of enrollment that could, if not stemmed, lead to failure and eventual death of the system." Thus, the system is continually looking for a dynamic balance through self-regulation. However, school systems also maintain some

consistency in society as reflected by characteristics 8 and 9 which reinforce the static merit of schools determined by outside limiting factors (e.g. the continued government legislature that states any youth under the age of sixteen must receive an education).

Systems Model in Education

Although utilization of a systems model is not new, it has not been seriously considered for the field of education until very recently. As stated by Michael Fullan in the book, Systemic Change-Touchstones for the Future Schools (Jenlink, 1995):

> Systemic reform is perhaps the most overused and misunderstood concept in education today. It is used loosely to refer to almost any attempt that a given author considers to be major. In fact, systems thinking has a strong tradition in theory, albeit with a much less well-developed knowledge base in practice.

Currently, the term 'systemic' is used in at least five ways in the school-change literature (Bielefeldt, 1997). It can mean affecting entire systems, affecting all schools in a system, affecting all aspects of a system, 'systematic' and 'fundamental.' Complete integration of a 'systemic' system would address all these areas.

A systemic approach to educational reform is of great benefit to educators because it not only allows the exploration and characterization of the system, but also of its environment, components and parts. 'Systems philosophy' calls for a dynamic and holistic approach rather than the traditional reductionistic and linear analytical approach. It provides the foundation for a type of inquiry into areas that will lead to revolutionary

solutions and adaptations to the Global Revolution. This mode of inquiry provides insight and explanation into seven areas. These, as outlined in Jenlink's book (1995), are as follows:

1. The characteristics of the "embeddedness" of education systems operating at several interconnected levels (i.e. institutional, administrational, instructional and learning experience levels).

2. The relationships and mutual interdependencies of systems operating at those levels.

3. The purposes and the boundaries of educational systems.

4. The relationships, interactions, and information, matter and energy that are exchanged between our systems and their environments.

5. The dynamics of interactions, relationships and patterns of connectedness among the components of systems.

6. The properties of wholeness and the characteristics that emerge at various systems levels as a result of systemic interaction and synthesis.

7. The behavior and change of systems and their environments over time.

These seven points suggest outlets for inquiry that have been given little time, effort or value in the reductionistic method of inquiry, when the purpose of the inquiry has been to determine which part of the system needs to be 'fixed.'

How to Utilize Systems View

Application of Systems Model to Multiple Areas Within Education

The success of utilizing a systems model is not totally hypothetical. The systems mode of inquiry has been utilized in numerous social institutions, including education, and we thus have a working model that needs only to be applied and integrated. Jenlink (1995) has organized the best of the current models into one workable model, characterized by four complementary domains of organizational inquiry. Reviewing these provides an understanding of differing areas that must encompass a systems philosophy, thereby ensuring a complete integration of this model. The four domains are as follows:

1. Systems analysis and description of educational systems by the application of three systems models (the systems environment, functions/structure, and process/behavioral models).

2. Systems design, the conducting of comprehensive design inquiry with the use of design models, methods and tools appropriate to education (Ackoff, 1981; Nadler, 1981; Banathy, 1991).

3. Implementation of the design by systems development and institutionalization (Ackoff, 1991; Checkland, 1981; Nadler, 1981).

4. Systems management and the management of change (Checkland, 1981; Morgan, 1986; Senge, 1990).

Essentially, these domains point out the necessity for the educational system to fully adapt a systems analytical approach via a transformed design inquiry (i.e., system design), all of which must be overseen by a party - or parties - responsible for

implementing and maintaining the change. See Appendix, Figure 5, which represents the relationship between the four domains.

Primary Steps to Promote Systems Theory

Complete Integration of Systems Methodology

The first step in facilitating a systems model is restructuring the organization. Senge, in his book, The Fifth Discipline (1990), discusses five aspects that an organization must incorporate before a systems view is utilized. These five disciplines, as he calls them, are found within the educational system and serve as areas essential for the integration of a systems approach. These disciplines, upon which a learning organization is based, include systems thinking, personal mastery, mental models, building a shared vision and team learning (Senge, 1990). In order that the institution of education flourish and advance, these five areas must be refined. There are many outlets for advancement utilizing a systems approach since these five areas are not inclusive but contain three distinct sublevels.

The three sublevels include practices, principles and essences. Practices refer to what you do, that is, the activities upon which practitioners of the discipline focus their time and energy. Principles are also central to an organization but they represent the guiding ideas and insights (i.e., the theory that lies behind the practice of the disciplines). "Learning always involves new understandings and new behaviors, 'thinking' and 'doing.'

This is the reason for distinguishing principles from practices" (Senge, 1990). The last level, essence, refers to the state of being of those with high levels of mastery in the discipline. This is not a visible act and is difficult to express in words; however, it is vital that individuals in the discipline grasp fully the meaning and purpose of each discipline. Thus, a systems mode of thinking (i.e., systems philosophy, analytical approach, etc.) must be fully accepted by individuals and incorporated within each of the five areas found in learning institutions. For example, it may be obvious that to achieve system thinking a systems philosophy should be used; however, understanding why team learning would benefit from this methodology may not be so obvious. Upon inspection, it is found that the collaboration required to team-teach, and thus create the ultimate team learning environment, is fundamentally a facet of a systems philosophy. In addition, it is important that a systems philosophy be applied to all levels (i.e., practices, principles or essences) because the adoption of a systems methodology needs to be uniform to promote an understanding of the social interconnectedness and resulting 'productive' outcomes that occur with an institution such as education. See Appendix, Figure 6.

Changing the Educational Mode of Inquiry

The second application aimed at bringing about educational transformation is to incorporate a systems model of inquiry into the analytical approach used to solve problems. A workable framework which promotes the systems mode of inquiry, utilized

to transform our existing framework and create new alternatives and perspectives for analysis and interactions, is found in Appendix, Figure 7. This framework provides a scope of inquiry as well as a focus for inquiry. It shows how these two concepts integrate with and relate to the system we are currently examining. Figure 7 suggests possible implications of using a systems framework. Approaching problems by staying within the boundaries marked 'A' and 'B' creates solutions that involve improving or restructuring the existing system. Utilizing options 'C' or 'D' fosters a designing approach, providing an outlet for expanding the dimensions of the existing framework (Jenlink, 1995). Thus, this model can be used to guide educators' ultimate purposes. For example, as Jenlink (1995) suggests, "If the system we aspire to create is expected to co-evolve with the societal environment in which it is embedded, and if we wish to work continuously with ongoing changes, we must select the overall society as the functional context for design."

Summary of Systems View

For schools to adapt to the new Global Age we face, it is essential that a systems mode of inquiry be adopted. This method is reflective of the interconnected worldview we are beginning to see developing around us. Communication technology is key to this endeavor but it requires that schools be reformed in ways that were never contemplated before. The new realities of educational reform are stated by Reich (1991) in his book, The Work of Nations: (1) rather than improve education we should transcend it, (2) rather

than revise education we should re-vision it and (3) rather than re-form education we should transform it by design. These three points are further explained in Jenlink's (1995) book:

> Staying within the existing boundaries of education constrains and delimits perception and locks us into prevailing practices. At best, improvement or restructuring of the existing system can attain some marginal adjustment of an educational design that is still rooted in the perceptions and practices of the nineteenth-century machine age. But, adjusting a design rooted in an outdated image creates far more problems than it solves.

CHAPTER EIGHT: OUTCOME OF THIS STUDY

Summation of Thesis

I began with a description of the forces that comprise society and how they relate to each other, i.e. the interaction between the economic, political and social realms of society. The role of computer technology catalyzing the revolution within the economic sector, exemplified by the transformation from the Industrial Revolution to the Information Era to the Global Age, shows that we are in the midst of a transformation of significant proportions. The first section of this thesis outlined the changes that have occurred in society due to computer technology, initiating transformations in the focus, structure, process and values of all areas that comprise society. The next section of the thesis narrowed the analysis to view the impact of these changes as they relate specifically to the institution of education.

I discussed how the institution of education fits into society, and revealed how concurrent transformations in the economic, social and political sectors of society affect the educational system. This background provided a perspective of the role education plays in perpetuating the current transformation and how the pressure to adapt to these new circumstances have resulted in an educational crisis. I offered two insights regarding the purpose, direction and necessity of change within the educational system. The first

insight involves two aspects inhibitory to change within education: 1) the institution of education itself and 2) an inadequate mind-set for approaching the technological crisis, (namely, problem-solving approaches appropriate to the industrial age). I suggested specific examples of how these factors attribute to debilitating educational transformation regarding the integration of computer technology.

The second insight was that larger societal changes resulting from computer technology can be used as paradigms for change within education. Methods, processes and direction of changes that need to occur within the educational system can be attained through this means. In regard to the economic sector, areas such as the focus, structure, process and values associated with the educational system must all be transformed or changed to allow this institution to adapt to the Global Age. Essential to this attempt is the need for educators to embrace a new mind-set, known as the systems viewpoint. Utilizing this philosophy not only provides an accurate assessment and examination of the problem involving computer technology in education, but also provides methods for resolution and continued adaptation to a technologically dynamic culture. Finally, I offered specific examples of how a systems approach can be incorporated into the educational system, ensuring the promotion of necessary changes within education.

The fundamental premise of this thesis is that to end the educational crisis which is a result of inefficient implementation of computer technology, educators must adopt a new mind-set. This will allow the incorporation of a systems theory which will provide new

problem-solving approaches, new insights and the ability to become a dynamic institution capable of accommodating the dynamic society of the 21st century.

Dynamic Mind-Set Creates New Reality

The mind-set that we adopt as individuals is not a product of nature, but rather an accumulation of ideologies presented to us throughout our life. Many factors, such as gender, nationality, cultural heritage, religion, personal interests, life experiences and education influence the ideological framework we develop. As stated by Trivett (1994), "Our understanding of the world is not simply a reflection of reality, produced like a mirror image; nor is it built up from certain basic sense-data or intuitively given ideas." Instead, it is the society of which we are a part that shapes the mind-set that we will eventually uphold. More specifically, this mind-set is based on certain assumptions, many of which we come to hold as 'truths' (even though we do not have any proof) and, consequently, these can change depending on the circumstances surrounding the society at that time (Trivett, 1994). These assumptions have changed due to the advancement of computer technology as our culture has progressed into the Global Age.

Technology alters the ways in which people perceive reality because technology has such a great impact on society: a great many of our activities are affected by it and, thus, many technologies are taken for granted and become virtually invisible (Trivett, 1994). Computer technology has had a profound impact on our mind-set. Beginning with

the promise that the computer would replace man, a new definition of *man* as an 'information processor' and *nature* as 'information to be processed' developed (Trivett, 1994). People, for example, use such expressions from the computer world as being 'programmed' to behave in certain ways, or of receiving 'input' from their environment (Trivett, 1994). These types of expressions serve to reinforce the industrially-based perception of man as a machine. Such a viewpoint exalts the objective, rational world in which everything is reduced into small, working parts and the relationships with other systems is irrelevant to the successful functioning of each 'machine.' This represents the old framework, characteristic of the Industrial Age and which is still used, unsuccessfully, within the institution of education. Senge, in his book, The Fifth Discipline (1990), warns of the problems associated with a reductionistic framework for fixing problems:

> From a very early age, we are taught to break apart problems, to fragment the world. This apparently makes complex tasks and subjects more manageable, but we pay a hidden, enormous price. We can no longer see the consequences of our actions; we lose our intrinsic sense of connection to a larger whole. When we then try to "see the big picture," we try to reassemble the fragments in our minds, to list and organize all the pieces. But as physicist David Bohm says, the task is futile – similar to trying to reassemble the fragments of a broken mirror to see a true reflection. Thus, after a while we give up trying to see the whole altogether.

This mind-set needs to change as we move into an era fabricated around computerization and new communication mediums. Computerization has reinforced such attitudes as the value of technological innovation, the desirability of change and progress, and the primacy of abstract reasoning (Trivett, 1994). The institution of education has a

role in adapting to the changes as well as helping to initiate them. Appropriate methods of change and the ability to accommodate changes within the system require a new framework of reality for educators. "We have ridden the waves of change across the last century, experiencing major shifts in the mind-sets that govern organizational, cultural, economic, technological, geo-political and social affairs. And now we face the new realities of a changing world and the promises of a new future" (Jenlink, 1995). Senge (1990) sums up the importance of systems thinking in adapting to our new realities in this North American culture: "Vision without systems thinking ends up painting lovely pictures of the future with no deep understanding of the forces that must be mastered to move from here to there."

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APPENDIX

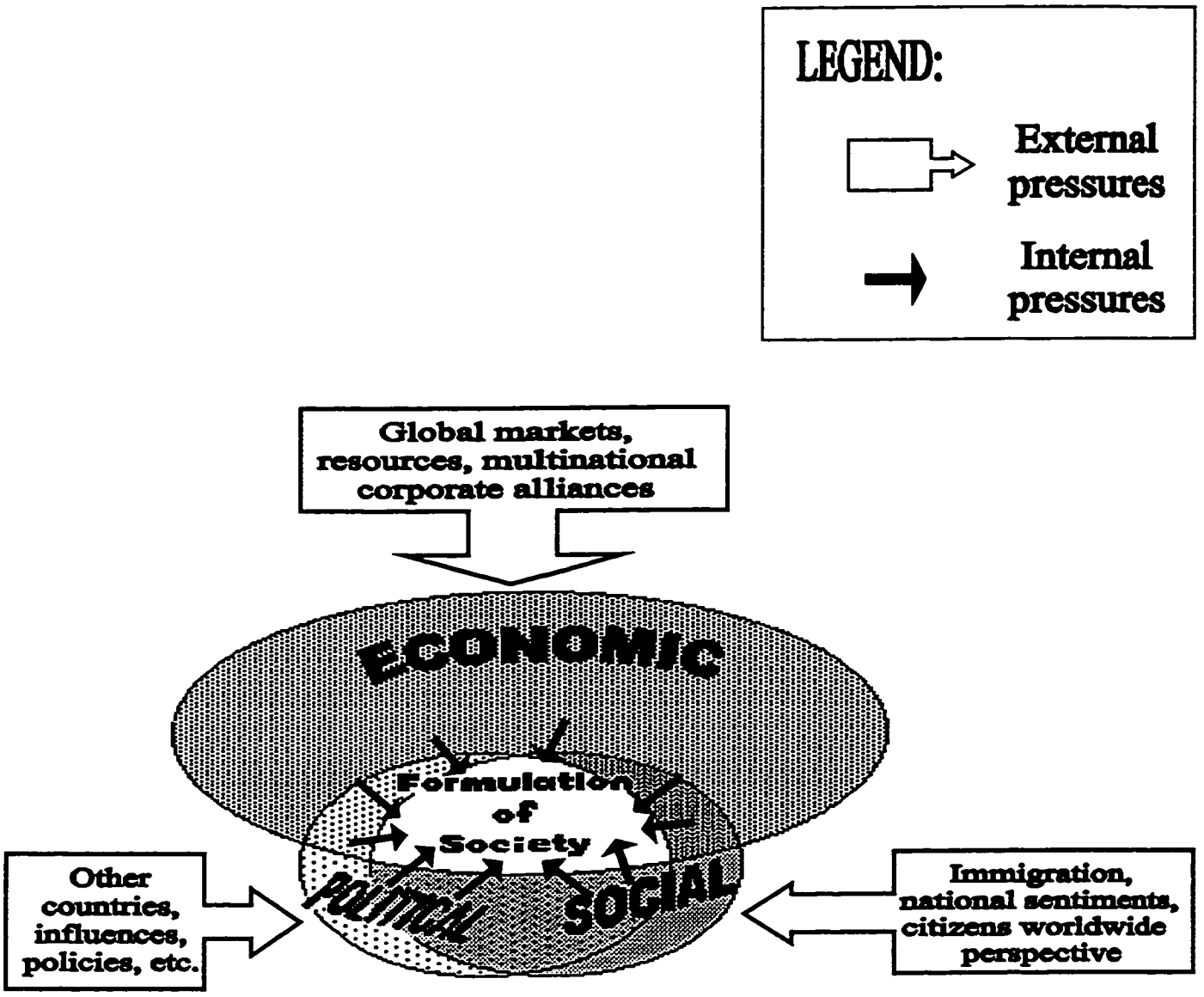


Figure 1: Pressures Influencing the Formulation of Society

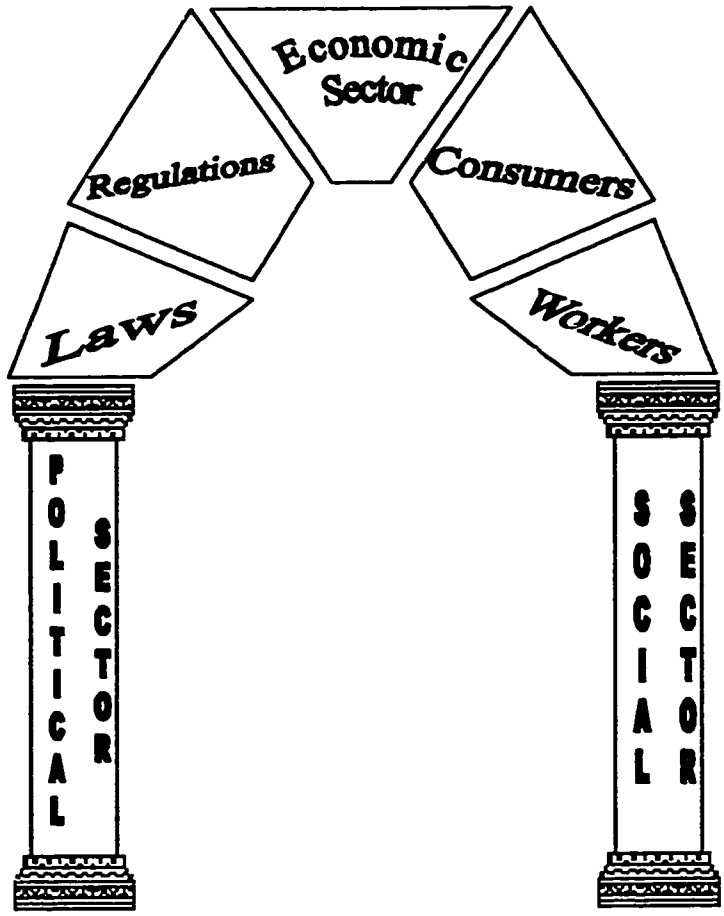
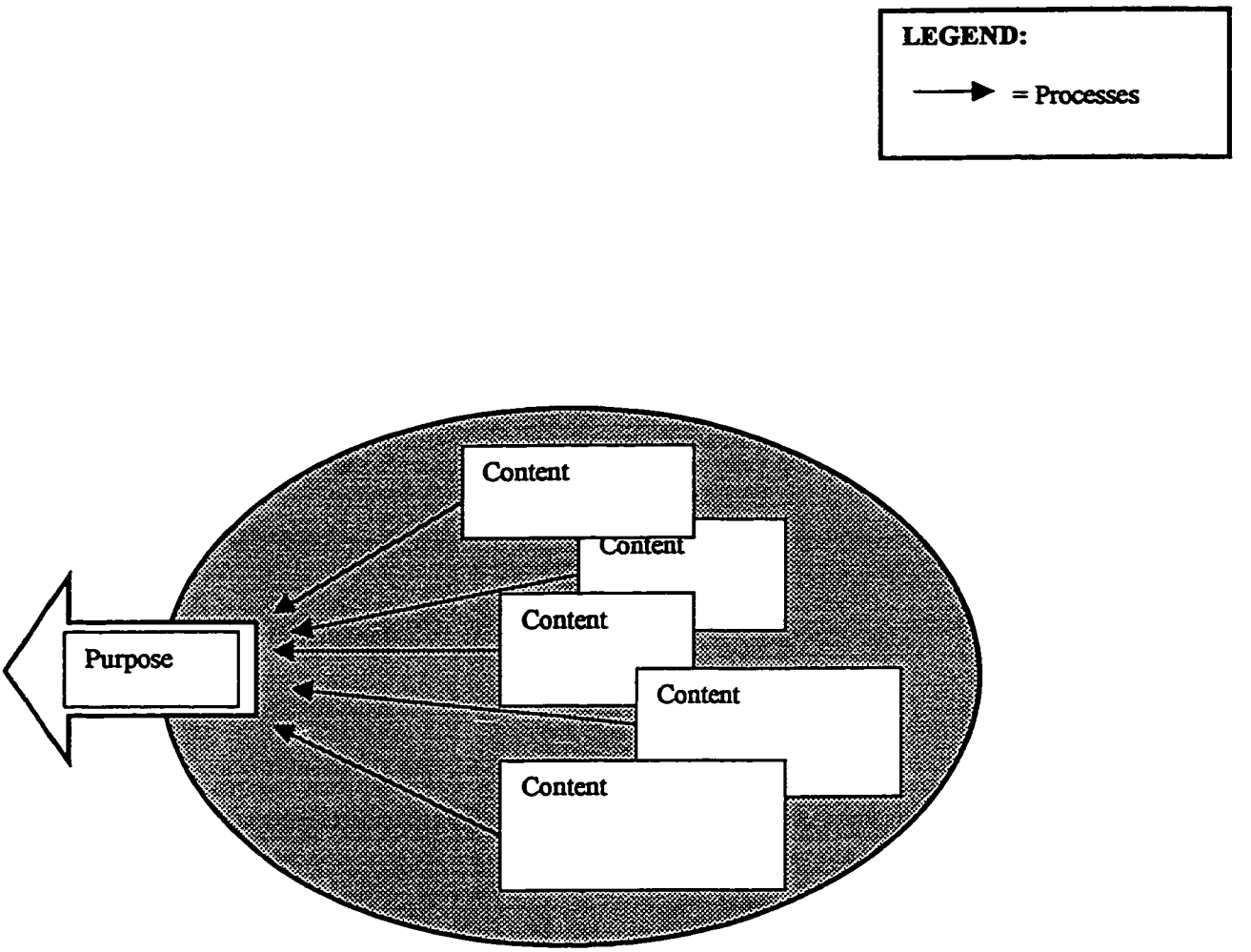
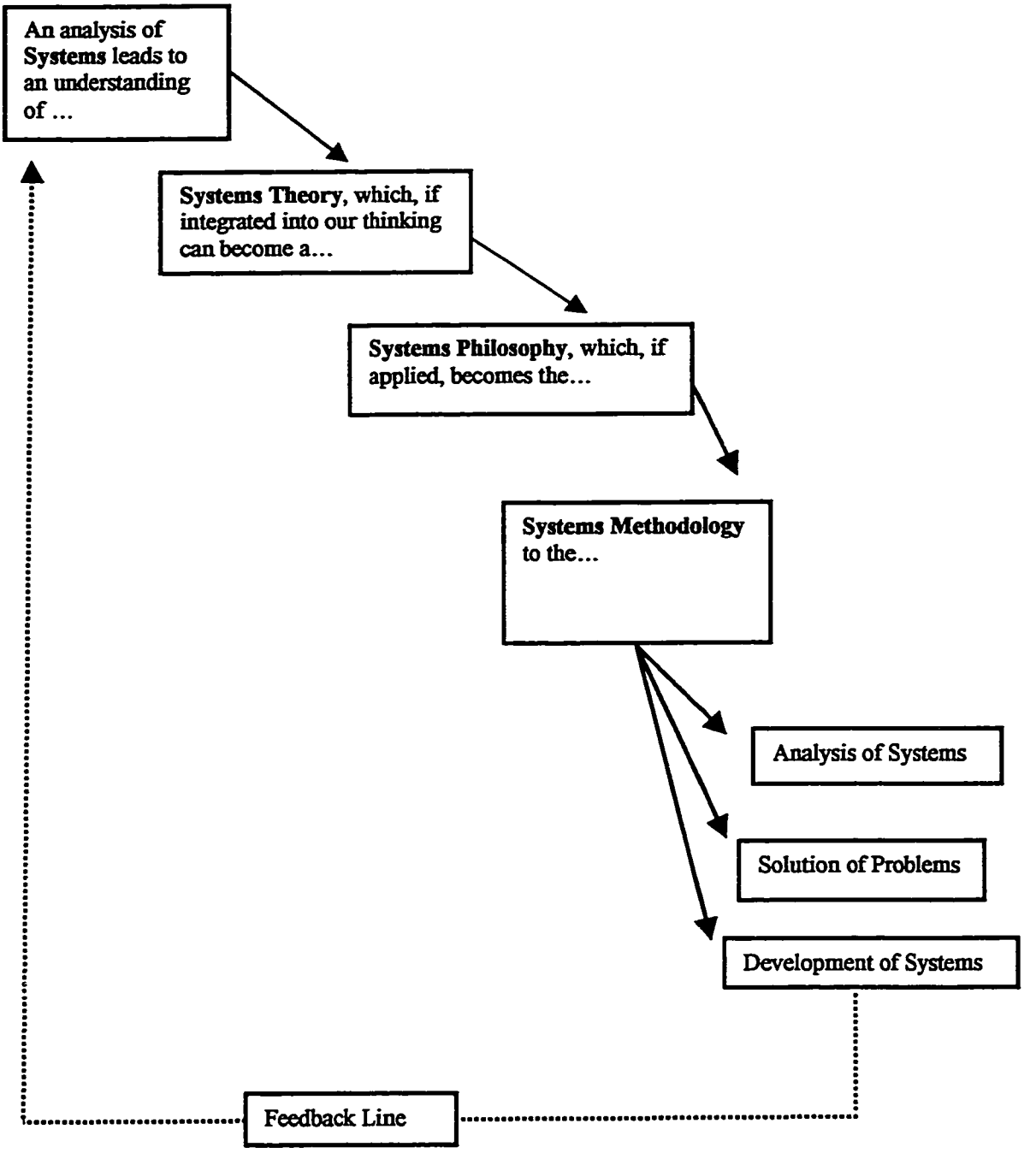


Figure 2: Supportive Arch for the Economic Sector



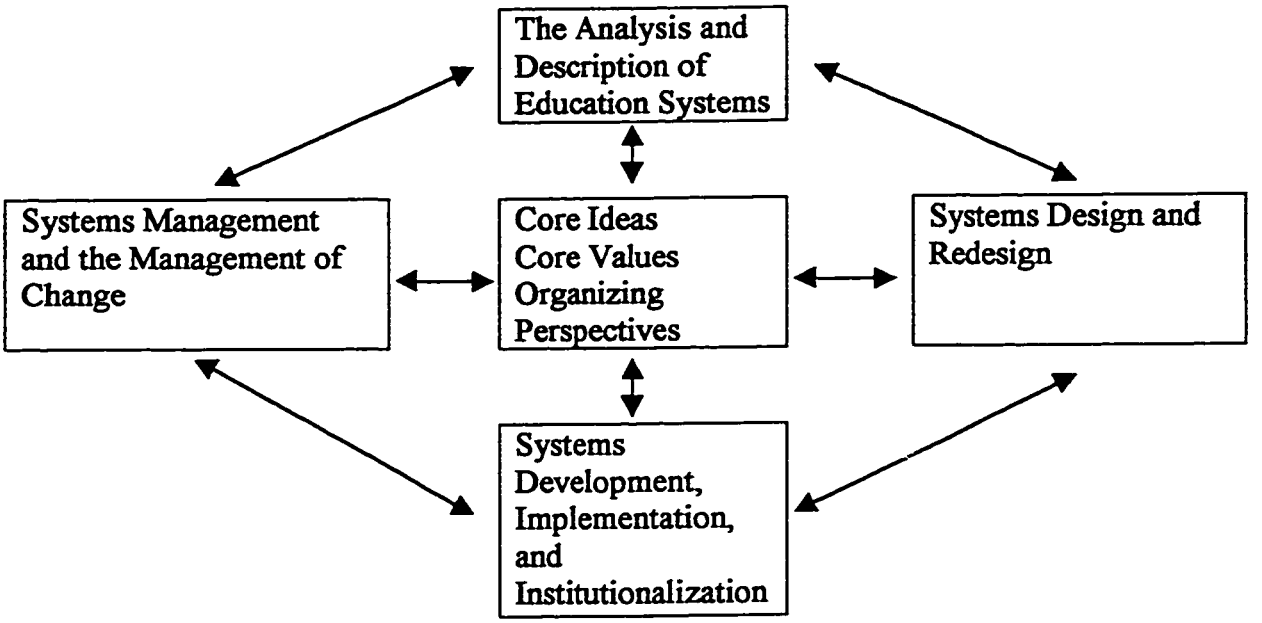
Lowenthal, 1990, p.128

Figure 3: Sequential Ordering of Three Main Aspects Comprising a System



Lowenthal, 1990, p.131

Figure 4: Interrelated Streams Comprising a Workable Systems Framework



Jenlink, 1995, p.13

Figure 5: A Comprehensive System of Educational Inquiry

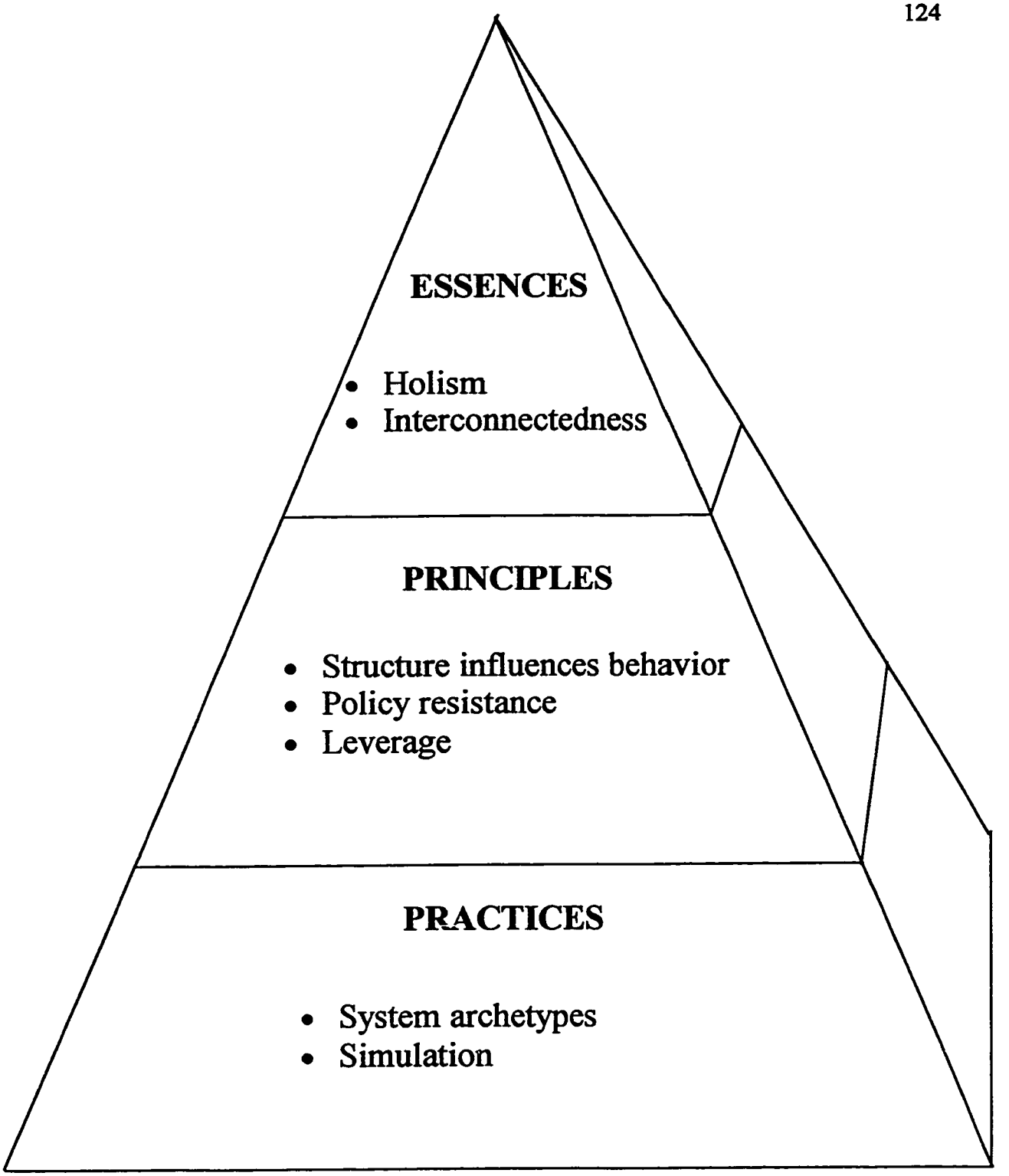
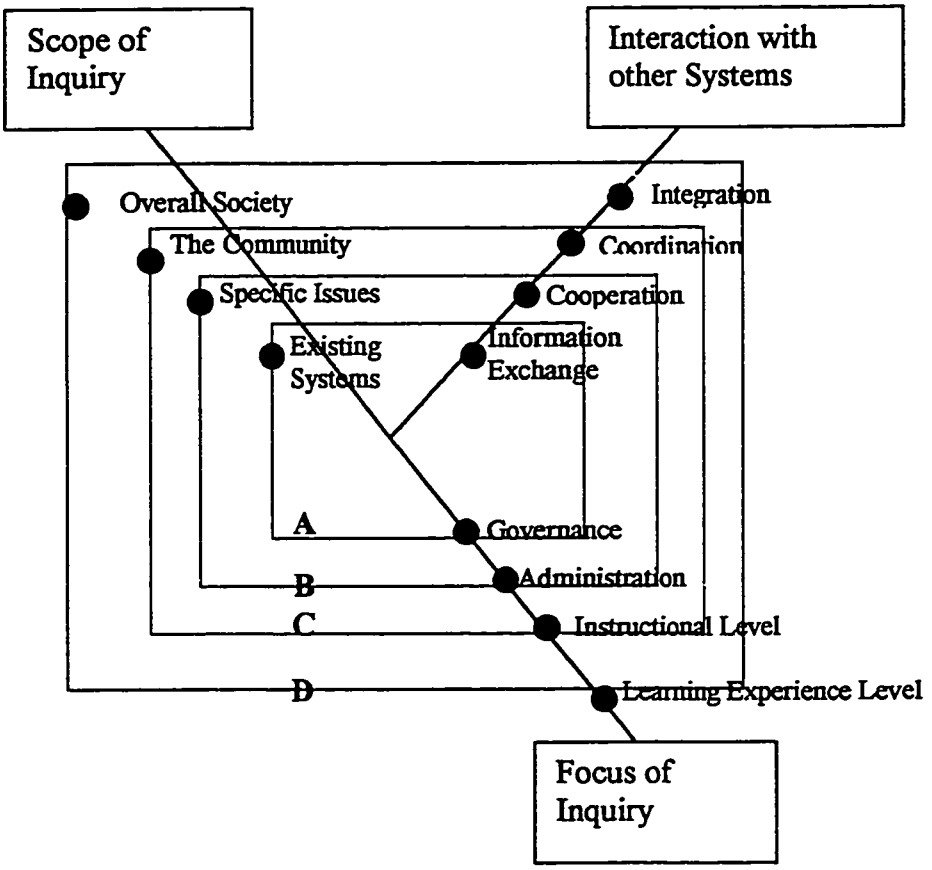


Figure 6: Application of Systems Philosophy within Sublevels Formulating the Institute of Education

LEGEND:

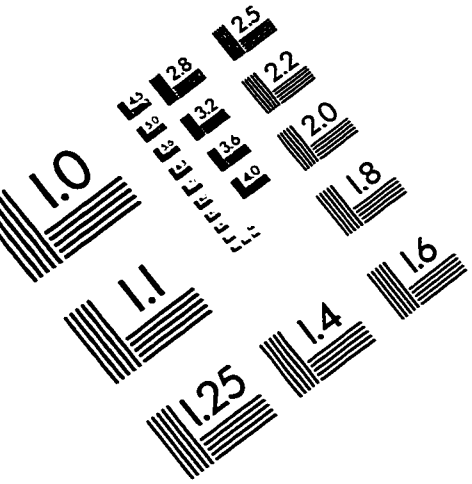
- **Boundary Line 'A'** marks the space of current improvement efforts.
- **Boundary Line 'B'** marks extension into specific issues.
- **Boundary line 'C'** marks an option space which bounds inquiry in a community context.
- **Boundary line 'D'** designates the inquiry space of designing new (viable) systems of learning and human development.

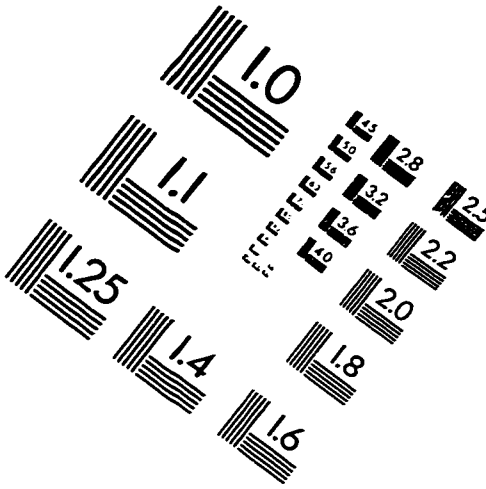


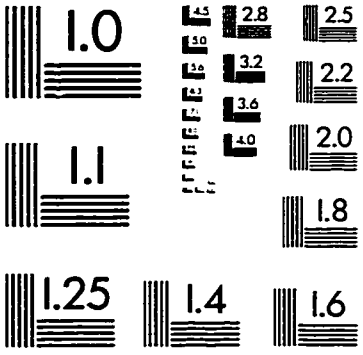
Jenlink, 1995, p.15

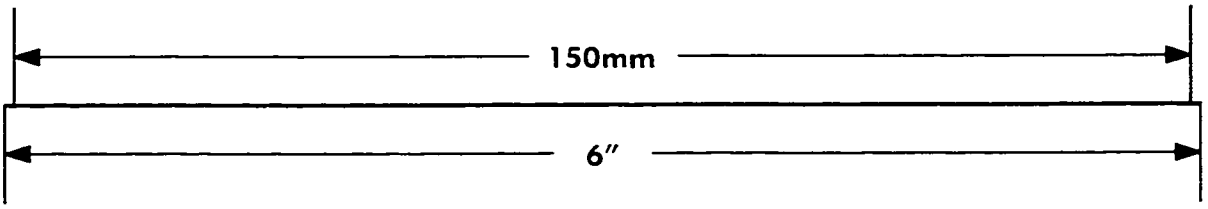
Figure 7: The Framework and Optional Field for a Systems Approach to the Institute of Education

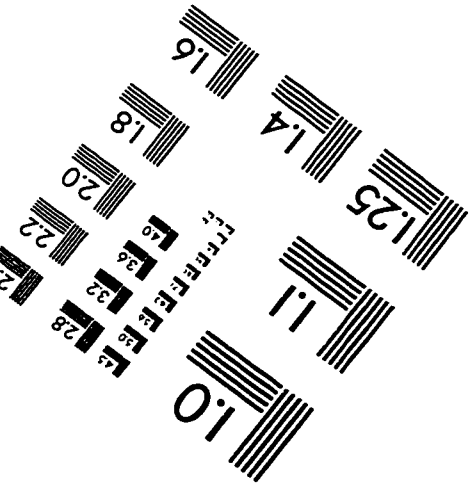
IMAGE EVALUATION TEST TARGET (QA-3)

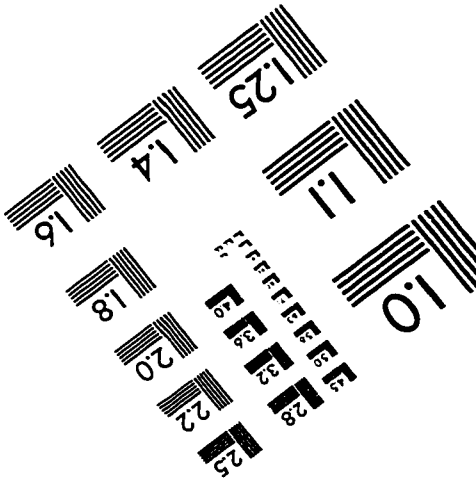












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