FUTURE ALTERNATIVES FOR INDUSTRIAL ARTS

25th YEARBOOK 1976

American Council on Industrial Arts Teacher Education

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American Council on Industrial Arts Teacher Education

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Foreword

One of the responsibilities of any professional group is to research for the future through resources available and, in light of the findings, to act responsibly to establish professional goals and to try to attain these goals. This responsibility was given a group of knowledgeable, professional industrial arts teacher educators as the subject for the 25th Yearbook of the American Council on Industrial Arts Teacher Education.

The contributors to this yearbook have sought to identify factors affecting the future of industrial arts and to suggest implications for the profession. Valuable insights will be gained by the industrial arts professional as he studies the content of this yearbook and reflects upon his own knowledge and goals. The outcome should result in a much improved program of industrial arts education.

The ACIATE is gratified with the research and dedication of the Yearbook editor, Lee Smalley, and chapter authors of this 25th Yearbook. The willingness of these individuals to give of their time and talent to study future alternatives will contribute greatly to the growth and development of industrial arts teacher education.

The Council is also most appreciative of the contribution made by the McKnight Publishing Company whose support over the past 25 years has made the ACIATE Yearbook series possible.

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Yearbook Proposals

Each year, at the AIAA national convention, the ACIATE Yearbook Committee reviews the progress of yearbooks in preparation and evaluates proposals for additional yearbooks. Any member is welcome to submit a yearbook proposal. It should be written in sufficient detail for the committee to be able to understand the proposed substance and format, and sent to the committee chairman by February 1 of the year in which the convention is held. Below are the criteria employed by the committee in making yearbook selections.

ACIATE Yearbook Committee

Guidelines for ACIATE Yearbook Topic Selection

With reference to a specific yearbook topic:

1. It should make a direct contribution to the understanding and the improvement of industrial arts teacher education.
2. It should avoid duplication of the publications activities of other professional groups.
3. It should confine its content to professional education subject matter of a kind that does not infringe upon the area of textbook publication which treats a specific body of subject matter in a structured, formal way.
4. It should not be exploited as an opportunity to promote and publicize one man's or one institution's philosophy unless the volume includes other similar efforts that have enjoyed some degree of popularity and acceptance in the profession.
5. While it may encourage and extend what is generally accepted as good in existing theory and practice, it should also actively and constantly seek to upgrade and modernize professional action in the area of industrial arts teacher education.
6. It can raise controversial questions in an effort to get a national hearing and as a prelude to achieving something approaching a national consensus.

7. It may consider as available for discussion and criticism any ideas of individuals or organizations that have gained some degree of acceptance as a result of dissemination either through formal publication, through oral presentation, or both.
8. It can consider a variety of seemingly conflicting trends and statements emanating from a variety of sources and motives, analyze them, consolidate and thus seek out and delineate key problems to enable the profession to make a more concerted effort at finding a solution.

Approved, Yearbook Planning Committee
March 15, 1967, Philadelphia, Pa.

Previously Published Yearbooks

1. *Inventory-Analysis of Industrial Arts Teacher Education Facilities, Personnel and Programs*, 1952. Walter R. Williams, Jr. and Harvey Kessler Meyer, eds.
* 2. *Who's Who in Industrial Arts Teacher Education*, 1953. Walter R. Williams, Jr. and Roy F. Bergengren, Jr., eds.
* 3. *Some Components of Current Leadership.* Roy F. Bergengren, Jr. *Techniques of Selection and Guidance of Graduate Students.* George F. Henry. *An Analysis of Textbook Emphases.* Talmage B. Young. 1954, three studies.
* 4. *Superior Practices in Industrial Arts Teacher Education*, 1955. R. Lee Hornbake and Donald Maley, eds.
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* 9. *Research in Industrial Arts Education*, 1960. Raymond Van Tassel, ed.
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*12. *Action and Thought in Industrial Arts Education*, 1963. E.A.T. Svendsen, ed.
*13. *Classroom Research in Industrial Arts*, 1964. Charles B. Porter, ed.
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23. *Industrial Arts for the Elementary School*, 1974. Robert G. Thrower and Robert D. Weber, eds.
24. *A Guide to the Planning of Industrial Arts Facilities*, 1975. Donald E. Moon, ed.

*Out-of-print yearbooks can be obtained in microform and in Xerox copies. For information on price and delivery, write to Xerox University Microfilms, 300 North Zeeb Road, Ann Arbor, Michigan, 48106.

Contents

Prologue

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The post-industrial society evolving in the United States promises to bring new meanings for industry and technology. Expected are new demands on our social and technological capabilities, a population of unprecedented size, and an educational environment expanding beyond the physical confines of the school.

Much of this discussion is speculative, but what effect will these and other events have on the field of industrial arts education? Will industrial arts exist by the year 2000? Assuming that it will, will it still be known by its present name — "industrial arts"? Educators in the field of industrial arts have often deliberated such topics as the nature of classroom activities, the effect of the computer on instructional methods, and alternatives to be used in evaluation procedures. The future of industrial arts, examining the next year or twenty-five years, is what this yearbook is about.

This is not a book for those who want to be told how to think. There are no set answers presented in the form of objectives, programs, or strategies. Nor, is this a yearbook written by palm readers, astrologers, necromancers, or oracles. It is written by concerned educators in an effort to assist the reader in perceiving possible futures more distinctly. In writing this book, the authors do not claim to be experts at predicting. Rather, the purpose of this book is to make known the work of those who are considering the future of industrial arts education. There is no claim to completeness in the work presented, but an attempt is made to focus upon the reasons, methods, and implications of a vast array of alternatives open to decision makers.

Considering the future in a book such as this is not an easy task. Projections have been made forecasting shorter work days, work weeks of only a couple of days, and extended vacations. An individual may start his career earlier, be retrained several times for new occupations, and retire at an age considerably below the present norm. Man's ability to develop sophisticated machinery will force him to take on a new life style. We no longer have the luxury of knowing that our children will live in a society similar to our own and of preparing them for it. Nor, can we predict the exact nature of the world that our children will inhabit in the Twenty-First Century. However, we can predict that man will be struggling to assert some form of human values in a technological society. We can also predict that an effort will be made to develop a healthy relationship between man and his environment.

The advent of advancing technology and its effect upon mankind will also give new meaning to the purposes and procedures of education. Education by the year 2000 is projected as beginning at an earlier age than is customary in today's schools and continuing intermittently until the individual no longer wishes to continue. Education and leisure may become synonomous. Educational technology will eventually allow the learner to learn what he wants to learn, when he wants to learn it. The student may acquire knowledge alone or within groups using sophisticated communication systems in a home-study atmosphere. Goodlad observes that at the point when teaching material is made available throughout the twenty-four hours of the day to all individuals anywhere, then schools will no longer be what we have known them to be. They will have functions which have not been fully recognized (Conference on Children, 1970).

How then does industrial arts fit into this framework projected for the future? What will be the nature of future industrial arts programs, teachers, student activities, facilities, and evaluation models? In an attempt to answer these questions, research was undertaken using the Delphi technique to gain a consensus about the future of industrial arts during the years 1975-2000. The Delphi technique is a method of systematically combining individual judgments to obtain a reasoned consensus. The opinions of experts are combined in a meaningful way so that collective knowledge and judgments can be brought together. The unique feature and merit of this procedure lies in requiring the experts to consider the opinions of other panel members in an anonymous circumstance free from the bias of personalities. The panel of experts used in the Delphi study were identified by first taking a random sample of 50 department chairmen in the field of industrial arts at the higher education level. Each of these department chairmen was asked to identify from three to five persons in the field of industrial arts who, in their estimation, would be most competent in making effective judgments regarding the nature of industrial arts in the next twenty-five or thirty years. The information gathered from each person was placed in individual folders and submitted for an ordinal ranking to a jury of three industrial education graduate faculty members. The response from each individual jury member was analyzed and the first eleven persons selected by the jury were told of their selection as panel members in the study and asked to cooperate. Thus, a panel of ten experts and one alternate were selected for the research.

The research for this study consisted of a five-round (questionnaire) Delphi procedure with a dual purpose: (1) to gain a consensus of items to be used for the study, and (2) to attain a consensus of the percentage of projected student population in industrial arts affected by each item during a given time period. The initial three rounds of the procedure allowed for the listing of items to be used in the study, categorizing the items under five major headings, and arriving at a consensus of the items to be used for purposes of the research. Rounds four and five assisted the researcher in attaining a consensus on the percentage of projected student population in industrial arts affected by each item during a given time period. The following conclusions are based on the results of this research generated by a panel of ten experts from the field of industrial arts education.*

THE NATURE OF PROJECTED INDUSTRIAL ARTS PROGRAMS

A new name should be created for the educational area presently known as "industrial arts." This new name should be appropriate for an educational profession seeking to interpret the many aspects of technology and industry in a post-industrial society.

The two central themes of industrial arts, occupational-vocational and general education, will continue to have an effect on the field. This split in the interpretation of the philosophy of industrial

*Additional information on this study (other than the following conclusions) may be found in the Appendix.

arts will continue into the Twenty-First Century. At the same time, that group of industrial arts leaders who see it as the interpreter of technology will seek stronger affiliation with the academics for acceptance and support of their position.

The current trend in industrial arts of interpreting the many issues of technology will continue and will receive even more emphasis. Programs will move in the direction of applying technology to solve the major problems facing mankind. Content will stress both the positive and negative impacts of technology on society. The greater emphasis on man's need to learn to live in new relationships with other men will bend the program more strongly toward man's social-technological problems. This emphasis on technology and its impact on society will tend to supplement the skill emphasis in traditional programs. Subject matter focus will shift from the work of selected skilled tradesmen to industrial technology. Movements will shift the focal points of the study of industry and technology from employment, profits and gross national product to contributions to society. Technology will begin to be studied from an international base, while materials continue to be modified through manipulative experiences. The study of industry, free enterprise, and its organization in providing goods and services will be included to a greater extent in classwork.

New areas of industrial arts will emerge with materials (e.g., plastics, metals, ceramics) becoming more important aspects of the content. The inclusion of technical courses for graduate credit will become increasingly acceptable within the profession. Traditional industrial arts activities such as wood, metal, etc. will be grouped into broader areas of study (e.g., materials and processes, communications).

Course content will have an emphasis on environmental considerations, safety, pollution, and effective utilization of resources. Product disposal and salvage will become more important as a factor in the total process of system and ecological influences. Recycling of materials and the use of new materials and resources will be considered by industrial arts classes. Conservation of resources, energy, and production materials will also become important aspects of the content.

The post-industrial development of the United States will influence industrial arts content with increased emphasis on technical knowledge, research methodology, sophisticated data retrieval and process monitoring, design of new processes, and technological change. Systems concepts will become accepted methodology, and systems analysis will be used for content identification. Systems modeling will contribute to individualized learning materials, and work systems research will influence work-learning environmental design. An increasing acceptance of research and development as both substance and means will develop for all levels of industrial arts education.

The industrial arts program will involve a strong interaction with the world outside of the formal school, not only as a resource, but as a setting in which substantial parts of the program will be conducted. Societal and educational institutions will be forced into better interfacing relationships as the work society progresses toward a knowledge society. There will be an even broader range of experiences that will substitute for organized classes, credits, and experiences. There will be more flexible programs and administrative schedules for education in general — year 'round schools, modular schedules, and home study centers linked to computers at school (computer-assisted instruction). Industrial arts courses will be offered for varying lengths of time rather than the traditional 180 days, one period per day. The "new form" of industrial arts will increasingly become a kindergarten-through-adult concern in fact rather than in theory.

Finally, industrial arts will become more interdisciplinary and systems oriented. Broadly based curriculum will overlap all subject areas in the school. Industrial arts will overlap with such subjects as the languages, social studies, and politics.

THE TEACHER IN THE FUTURE INDUSTRIAL ARTS CLASSROOM

There will be a gradual but small increase in the number of women teaching industrial arts in the public educational system. The teacher will be more of a learning coordinator and guide than a lecturer. Lectures will be television and computer based, leaving time for the teacher to assist the student. The teacher will be further supported with the use of paraprofessionals. A new type of educator will emerge in the form of an entrepreneur or a teacher-scholar with the capability of understanding a technological society and its effect on people.

PROJECTED ACTIVITIES FOR THE STUDENT DURING THE INDUSTRIAL ARTS EXPERIENCE

The content employed by the industrial arts profession for television, computers, and other automated teaching devices will be organized for individualized instruction. There will be greater use of independent or individualized instruction. More female students will be enrolled in all classes at all levels. Activities will be designed to accommodate a wide spectrum of individual talents and interests. Utilization of functional enterprise operations and individualized learning materials will be characteristic of industrial arts classroom activities. Computerized lessons will be available through public libraries and two-way television on a state-wide basis in some states. The use of calculators and computers will allow students to advance much more rapidly in the understanding of concepts.

FACILITIES FOR FUTURE INDUSTRIAL ARTS PROGRAMS

A development of a general industries laboratory away from a unit or specific laboratory will occur in an effort to achieve a more integrated program using a variety of materials and processes. Facilities also will be developed for the study of technological systems in areas such as production, communications, and transportation. The physical plant for industrial arts activities will become more open and flexible with little or no fixed, large equipment. Changes will be made to include items associated with testing, analysis, and simulation, while still maintaining items of a constructional nature to support these new emphases. The facilities will more nearly approach laboratory settings in contrast to the present construction environment. New programs will require facilities which provide a wide range of capabilities in a variety of technical areas.

EVALUATION MODELS PROJECTED FOR INDUSTRIAL ARTS PROGRAMS

Evaluation models will be based upon a more analytical, individualized behavioral change construct with emphasis on personal goal attainment. Accountability, competency- or performance-based instruction with behavioral objectives, will continue to have an influence on the field. This type of instruction will peak and decline from the impact of technology and emphasis upon individual fulfillment, creativity and change. Programs will be developed from competency skills which are knowledge based. The affective domain and value systems will gain in importance. Finally, teachers will become more accountable in their performance and will be measured by the product — student outcomes.

SUMMARY

The preceding paragraphs have presented a brief perspective on possible futures for industrial arts. Information pertaining to the nature of programs, the teacher, student activities, facilities, and evaluation have been presented to provide a series of statements which would be descriptive of certain aspects of future programs in industrial arts. Hopefully this information may be useful for planning new curricula and improving current procedures.

Additional perspectives on the future of industrial arts are offered in the following chapters. Chapter One of this book presents a rationale for looking into the future. The rationale is followed with information pertaining to methods of forecasting and projections for education. These projections are succeeded with chapters addressed to the implications for industrial arts and general education. The last chapter presents a variety of resources which will help the reader in pursuing the future, beyond the information presented in this book. An epilogue concludes the work. This yearbook is intended as a learning tool allowing the reader to further his ideas about alternatives for the field of industrial arts education. Hopefully, it will assist him in appreciating the impact that his life can make on the future of education.

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CHAPTER I

Rationale

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WHAT IS THE FUTURE?

A Time Frame of Reference

During the 14th century the division of time into hours, minutes and seconds became common. This abstract framework for divided time became the point of reference for both human action and human thought. The abstraction of time became the new medium of existence. Mumford (1962) characterized this existence by pointing out that organic functions of the body were regulated by it: not eating when hungry, but when sanctioned by clock; not sleeping when tired, but when the clock permitted. A time-consciousness has descended upon civilization and human events and experiences are recorded by their time of occurrence.

The dimensions of time such as the past, present and future have no fixed location in time. St. Augustine said that time is a three-fold present: the present as we experience it, the past as a memory, and the future as a present expectation. If the past is represented as prologue, the present is the experience of the moment which is transformed into the past, then the future is conceived as the anticipation of expected experiences. Thus time is an abstract dimension and to refer to "tomorrow" or to "the future" is to indicate a time perimeter. Cover (1974, p. 66) describes these time frame perimeters as continuous. We knew the future would be pretty much like the present, which, in turn, was like the past. But, in our rapidly changing world the three dimensions of time — past, present, and future — have become discontinuous.

The future is a time frame of reference or an expression of time which is yet to happen. It consists of events or occurrences yet to come or that will be within the parameter of time. In the words of McHale:

> The future is an integral aspect of the human condition. Man survives, uniquely, by his capacity to act in the present on the basis of past experience considered in terms of future consequences. By assuming a future, man makes his present endurable and his past meaningful. (1966, 3).

The future can be divided into five basic categories. Joseph considered them as *planning horizons* from which degrees of planning and control are recognized:

NOW is the immediate future up to one (1) year:
- frozen
- dictated by the past
- not much choice

NEAR TERM is the short term future of one (1) to five (5) years away:
- some control still available
- mostly past programmed
- some decisions in policy available

INTERMEDIATE is the middle range future of five (5) to twenty (20) years:
- wide latitude of choice
- most desirable selection period for alternatives
- small changes may evolve into revolutionary change

LONG RANGE is the long term future of twenty (20) to fifty (50) years:
- little control from today
- many alternatives, highly visible and speculative
- unrecognized variables easily alter events

FAR TERM is the extreme reach of the future of fifty (50) years and beyond:
- largely unknown and uncontrollable
- pure speculation
- utopian and dystopian nature undistinguishable (Smalley and Lauda, p. 2)

These planning horizons provide bases upon which the future may be viewed and once viewed, planned or controlled. They provide guidelines, show their relationship to possibilities, direction of movement or change, and thus a growing dimension of information and knowledge which form the bases for improving the human condition.

Another perspective of the future as a time frame was pointed out in this analysis:

The future starts now, this moment, and extends forever. The future as viewed from today, any today, is made up of a multiplicity of possible alternative futures toward which we can move, with or without control. The further ahead we project, the more alternatives exist (AIAA, 1974, p. 233).

Young (1974, p. 184) discussed the future by definition as untouchable, that which has not yet happened; and by beginning to think about the future, its unlimited potential can be experienced.

Our concern for this time reference, the future, will be pointed out repeatedly in this yearbook but its importance has a cultural reference. The eminent social anthropologist, Kluckholn, suggested that cultures can be characterized in respect to time orientation. Their emphasis on past, present or future reveals the direction of change and knowledge regarding such a focus. This type of an orientation has led Singer (Toffler, 1974, pp. 21-22) to describe a time perspective with the role identity and termed it "future-focused role-image." This FFRI provides stanchions of identity, goals of expression and a sense of time. The development of a future time perspective early in a child's life provides a motive as well as a means for achievement in later life (the future). Further research by Singer is cited which asserts that a future time perspective likely will avoid restricting that youngster to a present or past orientation.

This seems to suggest that children will benefit in terms of social change and recognize the emergence of probabilities to help them shape their future. Such a time frame of reference will assist in negating the telescoping of time due to rapidity of change.

Change Cycles

Of all the revolutions various societies have faced, one element which has continuously been evident and has remained the most challenging is surely the one termed "change." We may know change as growth, a reversion to past standards or new developmental patterns. In this vein, change is always and continuously occurring. In studying change we must consider its type, direction and the speed of its occurrence. The type of change may be specified as unplanned or planned, or any position between. Planned change is recognized as a deliberate attempt to bring about change while some would view such an effort as a strategy to effect change.

A research report (DeVore, 1971, p. 32) focused on this facet, "Planned change of course involves control and intervention. It requires a high level of knowledge about the phenomena that is being controlled and planned." Thus, planned change requires that the change be directed toward a goal, and further, that a high degree of information regarding the phenomena (in our case the future or even technological change) be sought out and collected. Such requirements will illustrate the relationships of alternatives, priorities and the collecting of information regarding the change. Planned change becomes imperative in order to avoid the aura of legitimacy surrounding initial patterns, establishing them as traditions or set routines, and the disease of change which Toffler described as "future shock."

When change is given direction, it refers to change resulting in the achievement of established goals. We attempt to delimit a plausible future when we pursue established goals and set policies. In discussing the increased importance of goals for the learning designs for tomorrow, Shane (1973, p. 61) identified the clarification of goals as a major focal point. Meanwhile Toffler (1970, p. 431) was recommending on a broad scale, both national (U. S.) and global, that a set of positive technological goals for the future should be formulated.

The passage of laws and policies are the positive ways in which future conditions are defined. Long-term projects which require years to develop are obviously dependent upon the passage of laws, bills, or policies in the present. These policies, statues, and bills obviously are dependent upon the expectations of a condition that will exist in the future, which must be resolved through a long-range development system, which will result in needed outcomes. If our goal is to have integrated schools, and if we wish to be assured that this occurs, then politicians must, as they have, pass laws which will result in this goal being attained at some point in the future. This kind of planning is essential to achieve desired goals, or to fully implement a way of life, a political philosophy, or economic theory.

Most knowledgeable persons presently conceive the speed of change as accelerating at a rate which is developing anxieties to astronomical heights. Toffler (1970) attempted to show that the *rate* of change has implications far more significant than the *direction* of change. As the rate of change increases, there is an accompanying increase in the resistance to change and hostility occurs within many people. Chin cautions that it is important to recognize that a conflict of values here requires options and alternative diagnoses. He thus calls for strategies to minimize such conflicts. Toffler (1970, p. 374) while specifying strategies, talked of coping with tomorrow by employing techniques to lower stimulation of people while raising their consciousness, in order to arrive at a state of equilibrium in which the person can accommodate the speeding acceleration of change.

In seeking to identify how change is affected, its elements, and its strategies, we must become familiar with change itself. It has a certain amount of looseness in semantic meaning ranging from innovation to dissemination. Most simply, change may refer to alterations in the client, client system or structure of an organization. This is the opinion of Chin (Morphet and Ryan, 1967, p. 54). The definition may be altered by the addition of an identifiable element or a variable which may be viewed as casual. In a clarifying statement of his position, Chin concluded that a theory of change must be formulated. In this way, once the elements for the theory are identified, then the theory can be developed.

The process of change and its evolvement to effect change must then be analyzed as a first step to developing such a theory. However, it is generally agreed, among various disciplines concerned with change theory or the process of change, that an exclusive model does not exist. Chin (Morphet and Ryan, 1967, p. 54) suggested that five levels of hierarchy constitute the process: substitution, alteration, oscillation, restructuring and value orientation change. As further evidence that the change process does have structure, Hansen offered six sequential steps:

identification of problem
diagnoses of problem-situation
clarification of diagnostic finding
search for solutions
mobilizing for change
making the actual change decisions (Morphet and Ryan, 1967, p. 55)

In essence, Hansen (Morphet and Ryan, 1967, p. 79) reported that the process of planned change involved several items: a change agent, a client system, valid knowledge, and a deliberate and interactive relationship. A remaining facet of this process which was identified by numerous writers and is yet a most vital aspect is that of communications. The dissemination of information has been recognized as imperative for change to occur. In this way ideas may be transferred or conveyed from one group to another, from region to region, and between a possible user (client) and the person already possessing the idea.

In a most closely related fashion another process of change that futurists must know is that of technological change. Simply, it has been described as the passage from one stable state to another. Mesthene (1970, p. 28) indicates that a technological change will result in social or value changes. This process usually consists of a number of related events occurring in sequence. In the further study of technological change by Schon, it was useful to identify three stages:

> Invention, the creation of a new product or process;
> innovation, the introduction of that product or process into use;
> and diffusion, the spread of the product or process beyond first use (1967, p. 759).

Like change itself, technological change is not totally understood; thus, there is a reliance on trends, patterns and projections from that which is theoretically possible to that which is plausible.

We are then extending the human capability, interrelating technology with other societal goals, conditions and needs, and necessary information in order to determine control and intervention within these processes. While they become difficult to identify, they are basic to the achievement of our goals. Our increasing sense of need for planned response and the development of fleet-footed reaction to the unanticipated emerges as a major requirement.

The processes of change have no direct relationship to clock time patterns. They evolve into the final stages of development as social needs require their dispersion among the culture or as pressure groups are successful. Each stage of the process of action alters some segment of the environment and should be recognized as cumulative, growth processes. They enhance rather than diminish, but this phase is dependent on the good or evil intentions of the implementors. The futurists in proceeding through the change process make the future completely open to human decision-making, be it for good or ill.

Value Systems and Change

When individuals adopt goals for long-term or even the short-term future, they pursue a value or try to sustain a value currently held by trying to promote or reconfirm its future existence. In this regard it is easy to think of a goal set for the long-term future as an attempt to attain or support some value.

Alvin Toffler makes the following statement which shows the complexity of this issue:

> Indeed, the increasing velocity of value change confronts us not merely with the question 'What will future generations value?' but also with the more pressing question 'What will we, ourselves, value a decade or two from now?' This question stares us in the face every day as we go about our business of making decisions in politics, in urban planning, in international affairs, education, science and technology – decisions that will reverberate powerfully at least through the end of this century. Which values should be served by these decisions, those we hold today or those we are likely to hold at some point in the future? Can the conflict between these be resolved? In whose favor and at what cost? (Baier and Rescher, 1969, p. 2)

Nicholas Rescher shows the interrelationship of values and their impact upon our choices in the following statement:

> Many corners of man's environment, and virtually all facets of his actions reflect the fact that people make choices. These choices manifest their preferences which, in turn, mirror their values. Man's technological and social environment in the future will thus in significant measure be the reflection of his future values. Yet not only is scientific and technical progress itself difficult to predict, but the issue of its implementation imposes yet another stratum of difficulty for such progress presents us with opportunities, but just how – and indeed whether – we capitalize upon these opportunities will depend upon what these values will be.
>
> Planning involves goal setting and goal setting involves our value system; therefore, to aid in planning and to gain insight into the possible concerns of the consequences of our decisions, it is most important to prove the relationship which exists between our decision-making and our value systems. (Baier and Rescher, 1969, p. 108).

There is an obvious interrelationship between change and our values systems. Most changes are introduced because someone values them above existing practice. Once a change is implemented it in turn will bring about change behavior of those who hold differing values. Laws, statutes, and policies are developed in an attempt to bring about a desired change of attitude, one that is deemed appropriate and in keeping with our way of life, but perhaps not held by all. Thus, much of the social unrest which was evident in the 60's has resulted in legislation in an attempt to bring about desired changes, which in turn will bring about a change of attitude on the part of those who possess or act in ways differing from the desired behavior.

The cultural lag between the material and non-material aspects of our society, as logically described by Ogburn (1927, pp. 200-213) presents us with a growing problem. The material aspects of our society grow by multiple factors and bring with them social changes which occur in an additive sense. Thus, the development of the automobile resulted in changes in the material aspects of our culture and the social changes to handle the resulting changes in our material culture lagged behind. Thus, we have transportation methods which effectively move us from one location to another handled by individuals who have not developed an understanding of the consequences of their use of technology.

Numerous other illustrations point to the obvious problem between the technological advances that have been and are being made versus the social changes that must accompany them and which usually lag behind. Thus, while some philosophers still argue as to whether or not we should go to the moon, we have been there and are making additional plans for extraterrestrial travel. Our technological ability to achieve certain results speed ahead of our philosophical decisions as to whether or not it should be done. We are witnessing today a growing concern for the need for social consciousness on the part of scientists, technologists, and industrialists. This is an obvious attempt to reduce the lag between the philosophical decisions and the technological implementations.

One of the exciting aspects of today's world is the fact that we have begun to see the long-range impact of our short-range actions. The pollution problems that we now face with alarm have been with us for centuries — obviously magnified in today's world, but the optimistic dimension is that people have now become concerned to the point of realizing that if immediate actions are not implemented, long-range impacts will obviously follow. With greater frequency we see the question of whether it should be done taking some precedent over actual implementation of technological advances which may have long-range impacts. As Theodore J. Gordon suggests:

> How do values held by a society affect the technology which that society produced? In what manner does the technology which a society employs affect its values? The answers to these questions are important because our society is beginning to plan the course of its technological development . . . (Baier and Rescher, 1969, p. 148).

Planning Versus Forecasting

Probably no other aspect of future studies is more misunderstood than the question of whether or not futurists can "in fact" accurately predict events that will occur in the future. It is apparent that futurists can be accurate in what they have projected but that is not the same as suggesting that their projections at the time they are made have a knowledge-base from which we can assume "truth." Projections are not based upon knowledge or truth but upon insight, wisdom, or simple conviction. Thus, as Stewart A. Sandow suggests:

> Questions we ask about the future are of a type whose answers cannot be known to be true at the moment of utterance. Utterances do not fulfill the criteria for answers because they simply do not satisfy the truth condition imposed on answers. In this pedagogy, I have called all answers to future questions 'responses', arguing that a response is an acceptable reply with a logic and believable connection to the question but without necessary truth. This distinction has the pedagogical value of freeing the individual to trust his response almost as a belief, without having to contend that it is true (Sandow, 1971, p. 4).

Sandow further suggests that by suspending our disbeliefs and temporarily trusting in our conjectured responses or projections enough to shape them as tentative or plausible truths, we can then proceed to plan. We can in effect begin to build towards future actions by trusting the incomplete knowledge and data that we have in the present. As Sandow suggests:

> It is often been noted by policy planners, if not physical planners, that one never has enough knowledge on which to base a decision at the moment that such decisions become imperative. If one waits until knowledge is sufficient, the opportunity for effective decision has often slipped away (Sandow, 1971, p. 4).

The Accuracy of Forecasting

The further into the future that we extend our best projections of what might occur, the more unknown and uncontrolled variables we face. The parameters of short-term projections can be fairly accurate forecasts; however, technological, economic, and social issues may well intervene and rupture our forecasts. Unlike most short-term future projections, the long-term future projections can be perceived as a continuous extrapolation of the past in quantifiably larger terms. Long-term projections must be perceived as an array of possible futures or futurables. New unknowns in technological innovation have eliminated the pursuit of surprise-free future projections. The casting of alternative future conjectures are only limited by man's perceptions of what can be.

The problems faced by the futurist and historian are similar. When past and future time periods are studied for planning purposes, they are normally broken into short-term and long-term periods. The short-term or more recent past is examined with a set of techniques which are usually based upon direct examination of evidence which the event has left behind. Long-term or more distant tasks are examined with techniques appropriate to them. However, the subjectivity that the historian must impose on whatever accounts he chooses to believe and accept are not unlike those of the futurist. Thus, the methods of the futurist in examining the short and long-term futures also differ. The short-term future can be rather clearly specified and its parameters detailed from extrapolations of existing data which result in trends and patterns. The long-term future, however, offers no hard data and the expertise and objectivity are difficult to recognize. The further into the future we project, the greater the number of intervening variables which may be posed as limitations to those projections or conflicts to their plausibility.

It has been suggested by many critics of future studies that the forecasts and projections of the futurists are normally inaccurate. This is a valid criticism, if criticisms are in order. Some of the reasons why the projections of futurists are normally incorrect is the incomplete examination of possible intervening and uncontrollable events. Another frequent error made by futurists is an attempt to study an event in isolation, when in fact its existence is dependent upon closely related, associated activities. However, the primary reasons why many futurists are inaccurate in their projections is that society rarely takes a lukewarm attitude toward them. This reason is why they are inaccurate and it is also one of the strongest justifications for their need. Futurists project the plausibility of an event and society is unwilling to merely accept the possibility of such an occurrence without attaching some value of its occurrence. Thus, when various futurists suggested that over-population may lead to our ultimate destruction by 1985, society responded. Most who have made these earlier projections are now saying that they were wrong. If they are wrong, it is because society took rather immediate action to prove them.

wrong. Population, at least in the United States, has stabilized and thus, although population may continue to be a problem, it will not be at the level which had been suggested earlier by many futurists. Good futurists will normally be wrong because they will be dealing with issues and occurrences that are of such a nature society will respond in some way to either enhance the happening or inhibit the happening; and thus, the real significance of their efforts lies in the effect on individuals, who were, through planning and involvement, becoming involved in long-range planning and imposing their own value systems and their actions to bring about desired outcomes.

WHY STUDY THE FUTURE

George Bernard Shaw once stated, "A reasonable man adapts himself to the world and the unreasonable man attempts to adapt the world to himself; therefore, all progress depends upon unreasonable men." It has always been a characteristic of the human condition to attempt to improve the state of affairs. It has been through the aspirations, the dreams, and the energies of those who aspire for a better world that we have arrived at our present state of development. People, by both their natural curiosity and their attempt to improve upon their state, have always attempted to design a future that has been to their liking.

Ever since people could fathom the concept labeled "future," they have tried to guess what unknowns were before them. They have posed questions like: Where are we going? Why is this happening? What is going to happen? Is there going to be a tomorrow?

How should they view the future? How valid is the description provided in the book, *The World of Tomorrow*:

> A century ahead of us, the World of Tomorrow is waiting to happen. It sparkles in the midst of the future like a diamond glistening darkly, as we try to trace its outline (Goldstein, 1968, p. 7).

Perhaps one could also describe the future as a balloon capable of lifting us temporarily and precariously above the smoke and din of earthly problems so that we might scan and observe the more distant but ever closer horizon that we term the future. Or, is the future an image viewed on a crystal ball accessible only to a small group of persons aware of all information in order to make decisions affecting the larger group of persons we call society? Or, will there even be a tomorrow to be concerned about? Since experts tell us that more and more of the world's irreplaceable resources are being used up by a population which is rising ever so steeply, it is a possibility. Since famine, plague and resource depletion have been evident in the fall of glimmering societies in the past, can our society, therefore, expect such a life cycle to continue? The avoidance of a recurrence of such disasters can only be through long-range planning. A simple declaration that people and events will overcome difficulties and conflicts will not be sufficient. The viewpoint that concern over the future is not worthy of the effort must be avoided. It is very aptly pointed out in *Future Shock* (Toffler, 1970) what will happen if such are the attitudes of our society.

Some critics of futurists seem to fear the attempts of those who would like to dream of a better world and develop plans for achieving it as being "anti" the present. All change has resulted because someone determined a way that they would like to see society change and then pressed that dream into a plan which eventually actuates itself in something that approaches the desired outcome. That will never change. It is the hope of some to increase the amount of involvement of all people to assure their right to participate in the designing of a future to their liking. What future studies attempt to accomplish is an educated citizenry that is future-oriented rather than historically-oriented. Future-oriented is the attitude of constantly striving for an improved human condition by acting in the present to affect the future state of affairs. This has been man's natural quest; our hope is to increase the number who will participate in that quest and to offer plausible alternatives for their considerations.

Considerations

A constant consideration in today's world is the ability to reconcile the conflict in changes that occur between the cultural, ideological, and technological dimensions of our society. Part of the role of futurists is not necessarily to reconcile these conflicts as much as to make people well aware of their existence. A study of history will clearly show the relationship that exists between these three critical dimensions. The greatest of these forces is technology. In no other age has such a force played such a pervasive, determining role in the destiny of mankind, or has a force played a greater role in the shaping of the future. It is both a source and a disrupter of progress. Its influence continues to bring changes in our society and in our ideological and philosophical beliefs. As Richard Kostelanetz states, "Major social transformations of all kinds can be traced directly to the impact of technology: and no matter who makes or markets the machines, intrinsic in their autonomous development and dissemination are certain ecumenical and egalitarian social bases" (Kostelanetz, 1971, p. 230).

The greatest contribution that can be made by studying the future is the development of an awareness on the part of more and more people as to the ramifications of technological changes on the sociological aspects of our society. Because of this awareness, technological advancements are sometimes challenged prior to their implementation and dissemination, which results in greater coordination between opposing forces. We see some evidence that this is starting to occur in today's world. For example, today's population is aware of the struggle with the technological resolution to energy problems versus the social, political, and physical aspects of some new forms of energy development which are being considered. We find a growing understanding of the public's concern over nuclear energy plants versus energy needs. Regardless of one's position on the question, few would argue that a total awareness of all facets of the issue prior to a massive implementation of the technology is highly desirable. It has become apparent that we have developed a greater social conscience within the last few decades. With greater frequency we ask the question, "Should we?" not "Can we?"; or, at least, the two questions are asked in closer proximity.

Concern for human needs is vitally important as the technology of a society becomes more sophisticated and yields a more determinant role. Thus, the greatest problem facing humanity is the need to gain control over technology in order to exploit it, so that identifying and meeting human needs will increase the understanding of our powers. Ferkiss termed such a creature "technological man," who has the capacity to both create and control his technology. He further elaborated on the future form of society as

> only determined in the course of the process of interaction among individuals and groups and society as a whole as they strive to achieve a greater sense of identity and purpose . . . (Ferkiss, 1974, p. 88).

Such an evolvement toward controlled growth and developmental patterns will develop social ideals or goals and these will change as society changes. This requires an alertness to recognize trends that show long-term growth probabilities or expanded dimensions and accelerating frequencies.

As growth and change take place at accelerated rates, they impinge on society as technology itself is undergoing fundamental change. This interaction of society and technology generates a new form of technology. Such a technological change causes social changes as noted by Mesthene (1970, p. 47) between the need for social action and the pull of traditional values. How the people of the future will interact socially and culturally, order their societies and perform the necessary functions of living will depend on their technologies. Toffler (1970, p. 186) projects that the enormous technological changes of the future will transform traditional family structures, sexual attitudes and motherhood. What will happen then is that a values change will occur in a process of accommodation and concession between the current values and the technological and social changes that bombard it. The earlier discussed concept of alternatives, options or opportunities are a result of changes that create these alternatives and options.

Therefore, as technological and social changes produce new sets of values or adopted values, and present an array of alternatives, then society or humanity must formulate a set of positive goals for the future. As the conditions in society are altered, social change occurs making necessary new forms of behavior, if valued human needs and clarified goals are to be met.

Reasons to Study the Future

In order to examine why the future should be studied, there needs to be a concern for value development, the image of man, social responsibilities, and the realms of possibilities, options and alternatives that we as a society must face. We must realize that the future of individuals as well as societies that are national, religious or global in scope, are within human control. Therefore in the opinion of McHale (1969, p. 15), "The immediate and most necessary task is the exploration and methodical investigation of all avenues and approaches to the future." Operating within a technological society, the creation of a human future will demand decisive, comprehensive and collective actions based on clearly-made choices.

The first item of significance as to why study the future is that due to future shock situations and the demands to be placed on society, an expanded responsiveness by individuals in terms of developing alternatives, options, or possibilities must be fostered. Private and governmental "think tanks" have beeen organized to develop and prepare alternatives for policy decision-makers in government and business. Such an endeavor should be incorporated into education. It is pointed out (Kostelanetz, 1971, p. 20) that such speculation helps make human choices more considered and purposeful. Individuals and groups then develop a reservoir of articulated options to be implemented or adapted appropriate to their needs and problem solutions. Also, the choices possible may overwhelm an individual if the person is unable to classify information, view a problem from several possible viewpoints and determine their precision and appropriateness to their value system.

Shane (Toffler, 1974, p. 188) notes that an education for future living with possible alternatives should emphasize how to use what is learned in immediate and future situations.

The dispersion of the thought and expectation that the future is an on-rush of change, largely independent of man's intervention, which will terminate in doom or extinction is a second reason to study the future. The kinds of expectations that people have about the future that result in despair or that some great technological breakthrough will dramatically solve the problem, could develop the stress or apathy that Toffler termed "future shock."

Bell (1967, p. 968) calls for the assembly and establishment of trends or baselines which can be studied for the development of speculation as to plausible future occurrences.

A third reason for studying the future is to develop the ability to assess questions in terms of their theoretical and practical implications as issues face us in the future. There needs to exist the ability to recognize issues, their various viewpoints and implications, as well as the ability to move through the tangle of an issue to the crux of the question.

Another reason for studying the future is to identify and focus on the nature of social institutions. McDaniel (Toffler, 1974, p. 116) projects that changes in human society may be accompanied by changes in natural ecology, which in turn would impact societal movement. Bell has recognized the "knowledge society" as a concept and within that premise has detailed the social responsibility of the corporation (1973, p. 289). He further establishes the rationale by the character, functions and features of the corporation that will need to be altered.

Our society has been labeled as one which consists of massive activities promoted by big groups whose participation makes an impact on other massive groups. Thus, we experience super domes, conglomerates, megalopolises, massive federal programs affecting millions, mass communications and mass transit. Many futurists project that this dynamicism will continue. This massiveness syndrome means that even the smallest of errors can have an impact upon millions. An erroneous decision may well lead our entire society in an irreversible direction. This is perhaps the most important reason for studying the future: to determine the consequences of present day actions on our future society and environment.

We must, in our society, develop an attitude on the part of everyone that through their efforts they can exercise some control over their own destinies. If we do not, then natural change, change dictated by a few or accidental change will be the pattern and all of the ramifications of *1984* will occur. Again quoting from Richard Kostelanetz, our situation is summarized in the following statement:

> The crucial question confronting us now is not whether we can change the world but what kind of world do we want, as well as how to turn our choices into realities; for nearly everything even slightly credible is becoming possible, in both man and society, once we decide what and why it should be. As metamorphosis defines the character and drift of the times, the problem for those desiring a better life, for mankind and for themselves, becomes channeling and molding these increasingly rapid forces of change. 'All the trend curves we may examine,' writes Buckminister Fuller, 'show rates of acceleration which underline the unprecedented nature of things to come.' As autonomous as most of this change is, only man can impose degrees of direction and value upon history – create a willed, rather than a fated, future (Kostelanetz, 1971, p. 19).

All attempts to forecast plausible events are based upon certain conditions which may or may not exist. Futurists, thus, must make selections from possible courses of events or indicate various alternative possibilities. As Richard Kostelanetz states:

> Social speculations are, essentially, articulated options, options which may be realized by people both inside politics and out; for a vision both comprehensive and detailed helps make human choices more considered and purposeful. As knowledge is power, so foreknowledge can be even greater power; and speculations, at their most relevant, propose alternatives that most of us would not be likely to consider on our own. . . . The fundamental processes of social change today start with dreams (whose mother may well be necessity), for the desire for something impossible is the first step toward a vision of its realization. For that reason, generating a feasible vision is the most essential type of significant social action; because without the envisioned goal, nothing gets invented and/or change progresses uncontrolled. . . . Social speculations exist in the collective mind as a reservoir of alternatives that individuals and groups can appropriate to their needs, while a related repertoire includes scenarios of likely, but less attractive, futures. For both these reasons, 'impracticality' is simply not a valid objection to creating, considering, or remembering a serious social speculation (Kostelanetz, 1971, pp. 20-21).

Thus, the work of the futurist is to point out alternative futures that are plausible. It is their task to indicate to society the directions in which we are leading ourselves and to indicate some of the plausible final outcomes of our present actions. It becomes the role of planners, policysetters, and society to determine which of these alternative occurrences they wish to see happen and to make judgments which will either enhance or inhibit the plausible event from occurring. The ultimate and desired outcome of studying the future is to be made aware of what is possible, to determine its value, and to set policies and goals which either will assure its happening or eliminate the possibility of its happening. This must be a primary, if not the major, goal of education; if we are to prepare people for a time that does not yet exist, our role as futurists is inescapable. We can no longer tolerate a society that looks back on a time which no longer exists in our attempts to prepare people for a time period that may be radically different than the present or the past. Consider the words of Abraham Lincoln who believed that those who did not prepare for the future did not deserve to have one.

HISTORICAL PERSPECTIVES

Mankind's orientation toward the future should be viewed as a relatively new experience, although concern for the future as an attitude, a philosophy, a design or even as a goal to be achieved has been evident throughout previous societies. In some societies, the future was merely the continuation of the past; therefore, no need existed to consider the future. Heilbroner addressed this state of mind of earlier civilizations and their orientation,

> Indeed, until a few centuries ago in the West, and until relatively recent times in the East, it was the past and not the future which was the dominant orientation to historic time . . . Ancient Egypt, Greece, Rome, the vast Asiatic civilizations, even the Renaissance, did not look ahead for the ideals and inspirations of their existence, but sought them in their origins, in their ancient glories, their fabled heroes, their pristine virtues real or fancied (1960, 18-19).

Therefore, mankind in these earlier time periods dreamed of the world he left, the past. Such an orientation was a reflection of the dreary condition of despair and existence. "The ancients turned to the factor which was common . . ." according to Heilbroner (1960, p. 20), and that was human motivation in the form of heroes and their exploits. These ancient peoples could only console themselves in their visions of heaven while gratefully accepting any kindness or social amenities from their masters and rulers. For some, there was an anticipation that a life existed after death.

Influence of Religion

The splendor of religious images and beliefs have somehow been preserved. Clark (1969, p. 17) described the prejudice and willful destruction of such relics and art treasures. Stability was achieved by military might and the production of books to preserve ideas. Kings, emperors, bishops and other heroic figures came to treasure books and other types of documents. Each began to be concerned with what would happen when two armies or opposing forces took up their positions. Thus, the ancient soothsayers, magicians or medicine men became powerful figures. They claimed the ability to foretell, predict or prophesy favorable or unfavorable events. The soothsayers or religious prophets predicted natural catastrophies or those events caused by a god or gods.

Prophesy which relied on speculation thus developed into mythology and folklore, filled with fables and symbols which became portions of religious significance.

But the attitudes of people and ideas began to formulate through the Dark Ages, the Renaissance and the Enlightenment. The attitude was optimism, and it developed as a philosophy for life. The idea of human betterment began to be legitimatized, as did the idea of progress. The attitude of buoyant expectations and optimism began to assume a larger proportion of the state of mind. While "pre-modern man dreamed of the world he left," Heilbroner (1960, p. 19) informs us that modern man "dreams of the world he will make." This change may be measured in centuries.

Parkman (1972, p. 361) notes that Roger Friar "had written about great mechanically-propelled ships guided by one man, flying machines and submarines" in the thirteenth century. This project appears to be based on imagination with little or no logical basis.

The Bible may be recognized as an early effort to predict events or happenings according to signs or developed beliefs. As the events predicted in biblical accounts came to pass, great religious significance came to be recognized. These led to substantiate those beliefs and fostered that religious philosophy. Religious prophesies were superceded in time by science, because of its greater predictive accuracy based on observing and measuring phenomena.

Utopian Writers

During the twelfth century supernatural mysticism became enveloped into the religious symbolism that caused men to dream. These dreamers were scientists, men of letters and monks. Mumford (1962, p. 35) recognized Roger Bacon as "one of the first experimental scientists." Roger Bacon is also recognized as one of the early utopian writers. Other dreamers who fantasized scientific achievements were Albertus Magnus, Poliziano and Joseph Campanella. The discovery of the New World by Columbus was prophetically interpreted by Poliziano as heralding a beneficient change in the whole life of man. The leading utopia in the thirteenth century was *The City of the Sun* by Campanella that

> . . . pictured boats which would go over the waters without rowers or the force of the wind, but by some marvelous contrivance; and at the end of the account the Grand Master who rules this commonwealth says, 'Oh, if you knew what our astrologers say of the coming age, that it has more history within a hundred years than all the world has in four thousand years before' (1967, p. 283).

Parkman (1972, p. 361) notes that these projections were "probes of the imagination" possessing little or no real logical basis.

Appearing in the sixteenth century was the classic *Utopia* by Thomas More (Prehoda, 1967, p. 7). More's *Utopia* inspired many more literary explorations of the futue and subsequent descriptions of ideal societies. It appeared to be considered more as a political statement rather than a prophesy.

The most significant utopian writer to follow More was Francis Bacon in the seventeenth century. This century saw humanists, such as Francis Bacon, exemplifying the optimism that began to sweep through Europe. Such humanists felt that nothing was impossible and derived great pleasure in writing down their visions. Eurich portrayed the humanists of this period:

> Few claimed apocalyptical revelation; more were concerned with making their personal imprint, delivering their own message for man. Francis Bacon . . . imagined all sorts of technologies of the future, . . . (1974, p. 14).

About Francis Bacon writing in his literary utopia, *New Atlantis,* the work for which he is remembered, Eurich elaborated upon these projections,

> He foresaw a gigantic task – the collection and sifting of knowledge, a task in which multitudes would be engaged before we could learn to ape nature, and control its process. He not only helped shape the scientific method and imagined all sorts of technologies of the future, but set forth a plan for the world's first 'think tank' (1974, p. 14).

The *New Atlantis* was published in 1660 and ushered in the new system of scientific investigation which was just beginning. The use of science began to attract men of imagination. The power of their technical imagination was demonstrated by the lack of invention and the overburdened capacities of workmen and engineers.

As skills increasingly developed and enthusiasm began to grow throughout the seventeenth century, the tempo of discovery began a steady acceleration of inventions. By the eigthteenth century the major prophets were ingenious engineers, inventors, scientists and scholars. Their optimistic convictions were that the new science would progress toward an ideal society. Thus, it appears that they had a greater concern for projecting social and political systems than for predicting the future of technology.

With the eighteenth century drawing to a close, religious prophesy became less prevalent and began to be replaced by the frontiers of science fiction.

The real originators of prediction, according to Gilfillan (1968, p. 14), were the French publicists of the eighteenth century. Of these social theorists, Charles Castel de Saint-Pierre appears to be the first to suggest that man could control his future. This theme appeared in his *Observation on the Continual Progress of Universal Reason* published in 1737.

There follows a group of forecasters that historian Manuel calls the "Prophets of Paris." Their influence prevailed from the middle of the eighteenth century through the middle of the nineteenth century. This group of futurist thinkers contributing to the founding of social science were Abbe Turgot, Marquis de Condorcet, Comte de Saint-Simon, Charles Fourier and Auguste Comte.

Turgot, who became one of the great administrators of France, in 1750 was but twenty-three years old when he delivered in Latin a lecture on the philosophy of progress. Turgot, as described by Manuel, was "First among moderns he foretold the future of reason" (1962, p. 17). Gilfillan recognized Turgot in these terms:

> He partly appreciated the importance of technology, the cumulation of knowledge, and the fact that inventions depend both on the number of men trained to think and on the sporadic occurrence of genius in the artisan class. The independence of the Americas, many political reforms, and the doctrine of perfectibility were well foreseen (1968, p. 14).

Condorcet, philosopher, mathematician, and a leader in the French Revolution, wrote *Sketch for an Historical Picture of the Progress of the Human Spirit.* In it, Condorcet predicted a glorious advance of democracy in the future. Gilfillan summarized those prophetic accomplishments,

> the probability of obtaining truth by majority votes. (Perhaps the developers of the Delphi method could find something in that.) . . . Condorcet also foresaw statistical sampling and census taking; the developments of meteorology, including testing the air at different heights by unmanned balloons, and a climatology of health, eugenics; the emancipation of women; a time capsule; a universal language (Gilfillan, 1968, p. 16).

While Condorcet received particular attention from writers, Comte de Saint-Simon was little mentioned. However, Saint-Simon proposed plans for the administrative organization of the future commonwealth. This futuristic work was detailed in his book published in 1816.

Another Frenchman in this time period was J. L. Favier. Shane (1973, p. 3) refers to Favier as "one of the first practicing futurists." Favier was commissioned by Louis XV to prepare alternative futures based on the "reasoned conjectures" of Favier which the French monarch possibly would face. This report (Shane, 1973, p. 3) "was a comprehensive treatise with one major flaw: Favier failed to anticipate the French Revolution!" According to de Jouvenel, (1967, p. 15), Pierre-Louis Maupertius was the first in this period to acknowledge that anticipations of the future were related to knowledge of the past. Voltaire took issue with him for suggesting that the past and the future were so linked.

Science Fiction Writers

The latter portion of the eighteenth century and the early nineteenth century spawned the beginnings of science fiction. The influence of the social idealists and the religious writers began to decline in favor of efforts such as that of Louis Sebastien Mercier. In 1771 he wrote a description of Paris seven centuries in the future titled, *The Year 2440* (Parkman, 1972, p. 361). This work was basically a position against the abuses of the "ancient regime" but also described inextinguishable lamps, moving pictures, the phonograph and the swivel chair. Gilfillan attributes simple optimism to Mercier's predictions.

In 1846 Souvestre, in France, satirically predicted a socialist Utopia, "in which steam and electric machines would free the hands from working, the mind from thinking, and the heart from feeling (Gilfillan, 1968, p. 16)." It was further noted that other science fiction novels followed the same plan. Of other writers at this time, Pieter Harting, a Dutch physicist, wrote *A.D. 2071*; Robida's farcical prediction was an 1883 illustrated story of future war; and Max Plessner in 1892 predicted inventions such as a selenium cell to convert light into electric current, the optophone, and television by electric wire. Parkman (1972, p. 361) contended these early science fictions tended to be conservative while consistently underestimating the pace of change.

Jules Verne, described as the outstanding representative of the future fiction writers of this time, inspired and enthralled generations of readers. His predictions were wide-ranging and specific and demonstrated a sophisticated knowledge of the contemporary technology. The technological miracles he described in his novels were later realized. Many inventors and scientists did invent these Verne-described innovations and attributed their stimulation for their scientific investigations to the novels of Jules Verne. These vivid descriptions inspired the imaginations of scientists, geographers and inventors, and those technological wonders described by Verne became realities. This was pointed out by Born when he described the novel *Twenty Thousand Leagues Under the Sea* as

> . . . remarkable because it foreshadowed to an astonishing degree many inventions of the future such as diving chambers, air conditioning, oxygen tanks, electric measuring devices, and most fantastic of all, the *Nautilus* itself (1963, p. 9).

In another novel about the conquest of the North Pole, the details of that journey were developed in the imagination of Verne but in reality based on existing factual information. It became reality as scientific expeditions used Verne's preparations and projections as guidelines. That is why Born attributed to Jules Verne the distinction ". . . as the first author to write a type of believable fiction that was based on sound scientific research." (1963, p. 71) The comment by Born may also be recognized as a definition for science fiction.

Parkman also recognized Jules Verne as the leading science fiction writer of this time segment and duly attributed this to his intricate knowledge of the co-eval technology known to the world.

Another widely popular novel in 1888 was Edward Bellamy's *Looking Backward.* It was a socialist utopian novel of marvelous inventions, which according to Gilfillan (1968, p. 17) was the first American writing in this field. In this latter portion of the nineteenth century, new archeological and geological discoveries, coupled with biological events such as Darwin's theory and the social perspective, were dilated to infinity. Thus, the evolvement of science fiction into future fiction was set in motion. Franklin (1966, p. 402) points out that future fiction began to incorporate these elements into the technological possibilities of science fiction.

Then came H. G. Wells' greatest fiction novel, the *Time Machine,* in 1895 which projected ahead two or more centuries. A second work in 1899, *When the Sleeper Wakes,* was the same type of novel, great science fiction and great stories of the future but warning of certain political tendencies which occur at that time.

The turn of the century ushered in numerous prophetic forecasts by inventors, engineers and other minor predictors. Those indulging in the art began to develop extravagant claims while ignoring the technological and physical principles which brought recognition to Jules Verne, H. G. Wells and others.

H. G. Wells seemed to revive the limp form of prediction in the early twentieth century in two writings, *Anticipations* and *Discovery of the Future.* In the latter, Wells presented a strong plea to recognize prediction as a science:

> And now, it has been possible for men by picking out a number of suggestive and significant looking things in the present, by comparing them, criticizing them and discussing them with a perpetual insistence upon why? without any guiding tradition, and indeed in the teeth of established beliefs, to construct this amazing search-light of inference into the remoter past, is it really, after all, such an extravagant and hopeless thing to suggest that by seeking for operating causes instead of for fossils, and by criticizing them as persistently and thoroughly as the geological record has been criticized, it may be possible to throw a search-light of inference forward instead of backward, and to attain a knowledge of coming things as clear, as universally convincing, and infinitely more important to mankind than the clear vision of the past that geology has opened to us during the 19th century? (Gilfillan, 1968, p. 19).

In highlighting the career of H. G. Wells, Gilfillan portrayed it in these terms:

> His finest note was to sound the call for a science of the (future-lore or Futurology, one might call it) which would be equal to the sciences of the prehistoric past that a century of work had created. (1968, p. 4).

As the science fiction writers reached the pinnacle of prescience, Verne and Wells appeared to be their champions. As the predictors' backgrounds and interests moved to science, engineering, inventing and social affairs, at the beginning of the twentieth century, specialization began to evolve.

A Developing Science

In step with technology and geography, prediction and its supporters appeared to emanate from Britain and the United States in the early 1900's. In these years prediction passed into the third of Comte's three stages of prediction, that termed the positive or scientific. As the objective conclusions came from the evidence of such predictors as Charles Sewall, George Sutherland, B. F. S. Baden-Powell, Waldemar Kaempffert, and S. C. Gilfillan, prediction was on the way to becoming a science. A present extrapolator of technology, Arthur C. Clarke, indicated that the American inventor and editor, Hugo Gernsback, was among the notable predictors, since the range and accuracy of his predictions exceed those of Jules Verne. However, Jantsch (1967, p. 12) noted that Gilfillan pioneered technological forecastings in the U. S. since 1907. In 1910, the first symposium of the future (Gilfillan, 1968, p. 20) was held and termed well done and prescient.

The next noteworthy predictors were the inventors, Thomas A. Edison and Charles P. Steinmetz. Editors of various scientific journals and book writers proliferated during the 20's and 30's. The more notable were Archibald M. Low, *The Future* (1925); Aldous Huxley, *Brave New World* (1933); and J. N. Leonard, *Tools of Tomorrow* (1935). Gilfillan (1968, p. 24) cited the predictions of William J. Hale on chemistry (1926), Floyd W. Parsons on general invention (1926 and 1930) and General Electric's W. R. Whitney. Critics of predictors were Baxter, Edward Shanks, Nathan Israeli, and Roy Helton. Jantsch (1967) cited C. C. Furnas for the remarkable forecasts made in 1936 regarding television and color television.

A new futurology technique was introduced by G. E. Pendray of Westinghouse in 1939. The anonymous symposium, as it was termed, involved fifty outstanding scientists and engineers. They described new developments in their laboratories which were most likely to affect societal life in the next 25 years. Pendray then amalgamated their anonymous responses with his own judgments. Bruce Bliven modified the technique in a 1940 issue of the *New Republic* (Gilfillan, 1968, p. 26). It is possible that the anonymous symposium by Pendray is the basis for the later developed Delphi technique.

George Orwell's novel *1984* (1949), Huxley's *Brave New World,* and Kurt Vonnegut's *Player Piano* (1952) seem to present anti-utopian themes. Their dystopias presented man as an automaton in a technologically controlled state for reasons of happiness and subservience to the power of the state. These themes are in stark contrast to those of Jules Verne and H. G. Wells.

The Contemporary Scene

Ferdinand Foch, the French general, presented a prediction in 1926 of warfare twenty years in the future and, according to Gilfillan, was most accurate. Thus, the military entered futurology at this time, but their activities were virtually dormant until World War II. Futures research evolved into a special field of inquiry during the mid and later years of World War II. Basically, new planning techniques to develop innovative military tactics were involved. However, Theodor von Karman, the California Institute of Technology aerodynamicist, reported in 1944 on the future of aircraft propulsion. This work is recognized (Bell, 1973, p. 200) as the first modern technological forecast. After the war, the U. S. Air Force employed the RAND Corporation to provide analytical and documented futures advice. Research into policy planning produced systems analysis and technological forecasting was advanced by Nicholas Rescher and Olaf Helmer experimenting with the Delphi technique (Shane, 1973, p. 4). This innovative technique was described as "an orderly, planned methodological procedure in the elucidation and use of expert opinion." (Bell, 1973, p. 206) The technique (Dalkey, 1969) was developed by Norman Dalkey and Olaf Helmer at RAND. Then with Theodore Gordon, Helmer conducted a study in long-range forecasting to test the efficacy of the technique in 1964.

Sir George Thomson, in the 1955 book, *The Foreseeable Future*, presented a new insight in terms of scientific analysis. Prehoda (1967, p. 7) described this work as one of the best analyses to date of the broad capabilities and implications of future science. Also at this time Systems Development Corporation began to compete with RAND while other American business firms entered the science of futurology. Shane summarized this activity:

> The Bell Telephone Laboratories . . . originating the current interpretation of the systems approach, while General Electric created TEMPO, . . . for socioeconomic forecasting. Westinghouse and the major automotive corporations rapidly followed . . . business management consultants such as Booz, Allen, and Hamilton, Inc. began using PERT . . . a systematic method of planning and developing new products . . . (1973, p. 5).

Moving into the 1960's, great impetus was given technological forecasting when Ralph C. Lenz of the Air Force Systems Command published a 1962 monograph based on a ten year old investigation. This "is the work most frequently cited for its classification and ordering of technological forecasting techniques (Bell, 1973, p. 200)." Bright noted that this government monograph *Tech-*

nological Forecasting is a landmark in this field. Also in the decade of the Sixties, a positive and accepted change in the intellectual climate was fostered toward the future as advancements and refinements began to be adopted and accepted.

The morphological method for forecasting was developed by Fritz Zwicky while engaged in rocket research for Aerojet Engineering Corporation. The idea behind morphological charts, as Jantsch (1967, pp. 176-180) points out, is to order and classify various parameters by which ranges of possibilities could be identified. Another significant effort was that of Robert U. Ayers in 1966 as a proponent of envelope curve extrapolation. Herman Kahn founded Hudson Institute in 1961 as a research center to predict policy and strategy for decision-makers.

Also in this time period two Europeans are noted for their contributions, Erick Jantsch and Bertrand de Jouvenel. De Jouvenel headed a group of international scientists called the Futuribles and became known as an intellectual dean for futurists. In 1965, the Organization for Economic Cooperation and Development assigned Jantsch to study technological forecasting throughout the world. His findings were reported after surveying over 400 references from the literature and making some 250 visits to thirteen countries in one year. The breadth and depth of this work was impressive. In this comprehensive survey Jantsch summarized these activities:

> The bulk of technological forecasting today is done without the explicit use of special techniques . . . The need for formal techniques was not felt until a few years ago. While the beginning of systematic technological forecasting can be situated at around 1950, with forerunners since 1945, the existence of a more widespread interest in special techniques first made itself felt about a decade later, in 1960, with forerunners already experimenting in the late 1950's. Now, in the mid-1960's, a noticeable interest is developing in more elaborate multi-level techniques and integrated models that are amenable to computer programming. (1967, p. 176).

Some contemporary developments occuring in the late 1960's were outlined by Shane (1973, pp. 7-9). One was the Concept of Alternative Futures based on linear projections. Such a model could imply the influence of tomorrow. A second development is the further refinement of this concept and is termed Cross-Impact Matrix Analyses. This presents the interrelationships between and among disciplines and shows how one discipline may impact on another. In 1966 the World Future Society was founded and chartered as an educational and scientific organization, and by January, 1967, there were 200 members. It sponsored a journal, *The Futurist,* beginning in 1967. In December, 1974, its rolls numbered 17,300. The increase in WFS membership could be recognized as an indicator in the interest the future has attracted.

The current scene has developed into a proliferation of agencies, think-tanks, individuals, institutions, committees, business enterprises, courses, assemblies, conferences and forums, all involved in futures research, futurology or aspects of alternatives for tomorrow. Some examples are Institute for the Future; World Future Society; The Committee for the Future; The Futures Group; Hudson Institute; Resources for the Future, Inc.; Center for Futures Research, University of Southern California; Applied Urbanetics, Inc.; Aspin Institute for Humanistic Studies; Innotech Corporation; Forecasting International, Ltd.; National Council for Public Assessment of Technology; Institute for Energy Policy Analysis; RAND Corporation; American Academy for Arts and Sciences; Office of Technology Assessment; and Future Studies Teacher Education Program, University of Massachusetts. Names of persons writing books and articles or otherwise prominent in this area may be realized by counting the references listed in this yearbook.

In terms of higher education alone, the University of Houston offers 25 courses concerned with the future, forecasting methods and other futuristic dimensions (Fowles, 1975, p. 100). In the book *Learning for Tomorrow,* Rojas and Eldredge (1974, pp. 345-399) identify samples of fifteen college level and four precollege courses, about 200 courses offered at some 140 institutions and a listing of the 75 most frequently used books in futures courses.

Shane (1973, p. 5-7) attempted to describe the current scene and activities by identifying independent scholars, nonprofit organizations, private and public commissions, agencies to include governmental and business groups, and author-editor-publisher types of persons or groups.

Thus, the science of futurology, technology forecasting, prediction or prophecy has evolved over the centuries. The techniques of the ancients may have been simple while we view the contemporary sophistication as breathtaking. It will be interesting to review what future historians have to say about our "sophistication."

EDUCATION AS A FUTURISTIC ENTERPRISE

For centuries education has faced the challenge of trying to transmit the standards, values, skills, and attitudes that were appropriate in times past and were assumed to be appropriate in the future. When society remained relatively static, this was a reasonable assumption; and it would appear that the schools were comparatively successful in achieving that goal. They were in essence assuming an unchanged set of expectations and thus, were fairly capable of predicting the demands of society. Through the use of educational experiences, they were able to prepare young people to interact with a society and environment which was basically unchanged from the past.

The objective of preparing young people for the future remains basically the same. However, the assumption that the needs and past represent the challenges of tomorrow is unacceptable. We will find disagreement amongst theorists, educators, and scholars as to what the future will hold. However, most will agree that it will be changed and that there will be new expectations, new standards, and thus, new skills, understandings, and attitudes which will be necessary to exist in the world of tomorrow. This leaves education with a dilemma, since we have always assumed that the role of education is to prepare people for another time. We must now accept the challenge of preparing young people to have the competencies required to successfully interact with and to respond to as of yet unknown demands. It has been stated that forecasting the future draws attention to a serious risk — that today's view of the future may later be found to be inaccurate. This is a legitimate criticism, but it applies to all curriculum building whether forecasts are explicitly made or not. Educational programs involve assumptions about what students should and should not study in preparing for an unknown time. If no forecasts are made, the assumption is that present programs are ideally suited for preparing the individual. A forecast may lead to a conclusion that present programs are, in fact, optimal, but recognizing that such an outcome may exist is not the same as assuming that it does exist. The forecast must still be made to arrive at this conclusion.

Education for Change

The ultimate responsibility of education is to utilize but 10% of the individual's life in preparing him or her for their total life during a period of rapid change. The following quotation fairly states the problem:

> The most critical characteristic of our modern society from the standpoint of education is its rapid change. Education is expected to transmit between generations the culture of a society and skills for people to function in it, but culture and technological change has become so rapid, particularly over the last decade, that the usual means of transition may be inadequate The culture that is transmitted, and for which children are trained may be the one in which the new generation must live (Garment, 1970, p. 85).

In the 1960's the traditional capabilities of our education system underwent severe strain and criticism because of the increased rate of change in our society. The primary difference came in the increased emphasis upon the importance of the quality of life. The educational system was totally unprepared to respond to challenges posed by issues and concerns such as war, poverty, hunger, race discrimination, urban problems, ecology, and alienation. This was accompanied by an increased concern for accountability. Since schools could not adequately respond to the various social issues which were primary in the minds of most citizens, the taxpayers and the students both began to challenge whether or not the schools were really achieving their real purposes in meeting the needs of the society.

Today we find expansion of society's demand on the educational system to produce skilled citizens. We find an increased emphasis on the part of students as to whether or not they are developing skills which will lead to future employability. We find that the increased concern is emphasized through the career education movement. This has resulted in growing concern amongst many scholars and educators that it may well lead to the ultimate destruction of many, if not most, non-career-based educational programs. Some believe that there is the need for quick involvement in the study of society's problems, the teaching of broad skills and problem-solving capabilities, and the promotion of interdisciplinary research and service activities. On the other hand there is the desire of some to return the universities and education system to the search for knowledge for its own sake. Between these two there is a wide range of possibilities that must be considered as we shape the new role of education in a time of rapid change.

The ultimate challenge to education is whether or not there is a basic set of knowledges and skills which will carry the individual and society through a period of rapid change. Are the standards that are presently being maintained more important than the new ones that might be developed? What is the role of education in the setting of standards and, thus, determining the desirability of change versus the preparation of young people who will ultimately determine the direction of society. Presently, new values are evolving in which new standards are being set and new expectations are being shaped. Does the school actively participate in the development of these values and standards and expectations? How does it respond during this transition?

Education must be prepared to help young people see the transitions and the changes that are constantly occurring. They must help educate young people to understand change, to be able to see alternative courses of action, and the consequences of an alternative choice rather than trying to assume that they know what changes will occur, or even worse, to determine which are the most desirable changes and to actively participate in the value judgments which must be the collective decisions of all of our society. The schools, however, must be able to help young people evaluate the flood of information, data, and opinion that is being transmitted through mass communications, to be able to evaluate it, to sort it, to see the consequences of alternative actions, and then to participate actively to bring about desired changes.

Education in an Age of Leisure

Consider for a moment what some futurists have said are plausible characteristics of the future, and consider the role of the school if these forecasts are accurate. It has been proposed that we are slowly entering into an era of leisure, an era in which people can be totally engaged in leisure-time activities. Others have proposed that by the twenty-first century only 5% of the work force will be required to produce the material needs of the other 95%. The dramatic shift in the size of the labor force in agriculture is an obvious illustration of this trend. Leisure time requires freedom from time and from the necessity to work. With increased free time, it is usually enough to send a person home from work early; with recreation it is usually enough to give them some space in which to play, but this is not leisure. Free time may be a clever euphemism for unemployment; and if more and more free time is forced upon adults, dissatisfaction may spread. Forced free time may result in an elite who work on top policy tasks in many areas, citizens with free time who accept their docile status but are disenchanted and rebellious, while a class of people perform unpopular trades and services.

Thus, if a true era of leisure is to develop, all institutions must be prepared to help citizens adjust to such an era. Some have proposed that psychologically this will be difficult for many people lack sufficient guidance and sense of purpose to exist in an era of leisure. Leisure time for them is too difficult. They have neither the toughness nor the psychological security for it. Secondly, since those who lead the leisure life will have nothing to do with work, it necessitates a means of economic support. Who will provide for the needs of those who do not work? Will we have unemployment as we know it today? Will we develop new theories on other forms of productivity?

What will be the role of the school during an era of leisure? Some would suggest that the schools may well move towards an increased concern for what has been traditionally called the humanities. Certainly courses like philosophy, psychology, sociology will be necessary if people are going to spend more time together, more time in personal relationships, and more time disciplining themselves towards creative activities. If this should occur, what will become of our concept of vocational education? Will there even be a sharper distinction between those who prepare for careers versus those who will be preparing for the leisure life? Will vocational education and career education become less important to the majority? How and who will decide who will work and who will lead the life of leisure?

The Impact of Mobility in Education

Many have proposed that we are living and will continue to live in a time period of high mobility. What will this mean to the schools? We already know that many people change jobs six to eight times during a lifetime, but we also know that the individual may change his geographical location many more times. Throughout the United States we already find that about 25% of a community is constantly changing. How will the schools help youth who will find themselves moving every three to four years? Will this lead to a national curriculum in order to assure that young people throughout the nation receive an equivalent education? Would this be bad? We often assume all the bad features of a national curriculum without ever looking at the advantages. Most educators are thoroughly opposed to the principles, but why? There may be a series of needs that are common to the youth of the nation. Are we frightened that perhaps those who best prepare people to meet the needs of tomorrow may be given additional assistance? Are we concerned that the school system which does not develop the competencies such as those suggested as necessary for all youth might undergo some reprisals? What are our concerns and at whose expense?

Learning Through Non-educational Methods

Consider another set of plausible events. By the use of miniature computers we may well have access to all the information that people will need. What will be the role of the information-giving-type of teacher in this kind of a society? Assume still another feature — we are finding that it is possible to change behavior through electrical chemical stimulation. If we can assume that all human competencies are represented either chemically or electronically in the brain; and if we know that we can control chemical electrical reactions in the laboratory, does simple logic lead us to assume that we can also change chemically and electronically the reactions in the mind without people really going through the actual learning experience? In the future, if we wish to have young people understand French, perhaps there will be a French pill that can be taken. If they wish to understand mathematics, perhaps their brain cells can be stimulated by electronics to understand mathematics. Still a third dimension — we have noted that there are ways to increase some of people's competencies, such as their ability to learn and ability to solve problems through biological methods. Current research on molecular developing biologies suggests the possibility of increasing a person's problem-solving ability through the administration of growth hormones to the fetus during the period of neuron production. Since the problem-solving capacity in mammals appears to expand by increasing the number of neurons in the brain during that period, children with extraordinary learning capacities may result. Now, put these three characteristics together:

1. Immediate access to all information required
2. Possibility of learning through electronic chemical stimulation
3. The capability to increase human competencies required for learning.

We are faced with the overwhelming questions of should this be done; and if so, what is the role of the schools?

Hundreds of other plausible events that have been proposed as changes which may occur all have great implications for education. We must consider these and ask ourselves what the role of the school would be if this is the environment and society in which we will live. One can hardly argue with Toffler (1970) in his book, *Future Shock*. We must develop the capability in all students to cope with continuous change. It is no longer sufficient for them to understand the present, for the here and now environment will vanish. Jane and Johnny must learn to anticipate the direction or rate of change. They must learn technically to make repeated, probabilistic, increasingly long-range assumptions about the future. We in education must continue to develop a new attitude and stop assuming that every subject of the curriculum is taught for a reason and reverse the premise that nothing should be included in the required curriculum unless it is strongly justified by anticipated needs of the future. Everything in the curriculum should be forced through futuristic screens to determine if there is a relationship between the competencies that will be developed and what appears to be best estimations as to what will be required in the future. Problems of today and those anticipated in the future are symptomatic of the complex and rapid change which characterize our society. If balanced growth is to be achieved, if an educated citizenry is our goal, then the educational system faces the challenge of providing people with knowledges and skills necessary to manage complexity and change (Garment, 1970, p. 78).

Future-Oriented Needs:

It seems that within education there is a minimum of four pursuits which must be considered if education is going to serve as the futurist enterprise. They are as follows:

1. We must bring together as a society our best scholars to determine and develop a futuristic model of our society and

environment which will consist of numerous plausible, alternative futures which must be considered in the course of events.

2. We as a society must then decide which of these directions we are in a position to either enhance or inhibit and develop a strategy to achieve these ends. There must be goals that have been adopted and set through the best possible democratic methods of concensus achievement, which set the directions our society should attempt to achieve. Then and only then, can the schools be in a position to help develop the kinds of competencies which are in tune with the overall goals and directions of our society.
3. Once these decisions have been made by the total society, then we within education must attempt to develop conceptual maps of what the environment society may be like and what kinds of capabilities will be necessary for all people. Within the continuous explosion of knowledge, we must assume that the schools can only develop broad, conceptual, generalizable understandings within these areas, not total understandings of all of the knowledges which we possess.
4. We must be concerned with identifying those human competencies or processes which are the skills necessary to live in a dynamic, ever changing environment. Proponents of process education have proposed such skills as copability, corrigibility, the ability to solve problems, to relate, to communicate and similar kinds of human processes.

These kinds of capabilities must become direct educational goals in a society of constant change and in a society where knowledge transmission becomes an impossible task. It is further based upon the assumption that many of the requirements will be in the area of human capabilities and processes rather than the content or knowledge capabilities. We must develop educational experiences that will give the student the opportunity to develop these kinds of skills, understandings, or generalizable abilities to the same degree that we have in the past developed cognitive skills in the content areas.

A Challenge to the Classroom Teacher

The ultimate success of any enterprise is dependent upon the individual efforts of those who are the productive element of that enterprise. Thus, any consideration as to what directions education should take to become a futuristic enterprise must ultimately resolve themselves as to what can and should the teacher do in the classroom.

If one accepts the overall pursuits as outlined above, then it becomes apparent that the teacher should work towards developing more broadly conceived conceptual goals within whatever body of knowledge they are teaching. These more generalizable understandings, values, and possibly more broadly conceived skills must be applicable to plausible future conditions. Secondly, there is a rather massive amount of work that must be done by individual teachers in order to develop human competencies which are not neatly categorized by discipline or body of knowledge but which will require differing methodologies and activities by which such competencies can be developed. This is a major change in education which will require a massive rethinking on the part of all educators.

There is one major principle that would seem to apply to the work of every classroom teacher if education is to become futuristic in its orientation. Education must work toward the *development of understandings of the consequences of alternative actions and the impact of present day actions on future conditions.* If every teacher would take this principle and apply it towards every activity that they have developed, every lesson that they have planned, then we would be preparing a graduate who is ready to consider alternative courses of action and exercise influence upon a society that is more to his/her liking than the one which has been engineered by others.

It would seem that through the acceptance of these goals for education and for the classroom teacher, we can begin to prepare people for the twenty-first century. Remember our students will spend the rest of their lives in the future.

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Methods of Projection

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INTRODUCTION

The methods of forecasting utilized to project the future relative to technology and its resultant effect upon the industrial arts curriculum are commonly referred to as technological forecasting techniques. These techniques are presently being utilized to forecast technological developments; however, they have seen limited use in the areas of the social sciences. The implementation of the forecasting techniques by industrial arts educators will assist us in the understanding of the effect of technological developments upon the individual, society, and education. The use of these techniques will also allow us to study future developments in industrial arts education in a similar fashion as technologists study and project the future of technology.

A specific definition of technological forecasting has escaped even the identified experts in the area. A number of definitions have been put forth, although there is presently no universally accepted definition. One of the earliest writers on technological forecasting, James Bright (1968), defined it as "... a probabilistic prediction of future technological attributes, forms, or parameters reproducible according to a system of analysis resting on quantitative relationships or logic rather than on intuitive opinion (p. 55)." Another prominent author in the field, Erich Jantsch (1968), defined technological forecasting as "The probabilistic assessment, on a relatively high confidence level, of future technology transfer (p. 15)." A number of additional definitions can be cited, however the concern of this work is not with the definition of technological forecasting but rather the explanation and potential utilization of the forecasting technique.

Forecasts relative to the future of the individual, society, and education, as well as technology, can be accomplished through the use of the basic technological forecasting techniques. Therefore, the projection methods previously referred to as technological forecasting techniques will, from this point forward be referred to as simply forecasting techniques.

The acceptance of a specific definition of the concept forecasting is essential to the understanding of the techniques and examples delineated in this chapter. The concept, *"forecasting,"* is therefore defined as:

The process of developing probabilistic statements concerning the future. The statements must be founded in basic knowledge and be at a relatively high confidence level.

A similar concept which is often confused with forecasting is that of predicting. The two concepts can be differentiated through an examination of the definitions. The concept of predicting is defined as:

The act of foretelling the future, a prophesy not founded in basic knowledge and totally lacking in confidence level.

The major differentiating factors between the two concepts are that forecasting is a process while predicting is an act; forecasting is founded in basic knowledge and predicting is not; and lastly, forecasting must have a relatively high confidence level whereas predicting is generally lacking in confidence level. The projection techniques identified and explained in this chapter can be classified as forecasting rather than predicting techniques.

The commonly identified forecasting techniques can be classified in a number of different ways. The early writers (Lanford, 1969; Jantsch, 1967) classified the techniques into the categories of intuitive and analytical. The more current work of Lanford (1974) and others, has classified the techniques into the categories of exploratory and normative. Olenzak (1972) differentiated the techniques as follows:

In exploratory forecasting, we have a situation where the present is known and we are seeking to predict some unknown future event whereas in normative forecasting we know the existing situation but we also know or have assumed the future goal or event and are now seeking the best path to the goal; a path which is not yet known. (p. 31)

The two broad categories differ in technique, however, the purpose is the same, to arrive at a valid forecast of future occurrences. The two techniques are graphically displayed on the following figure.

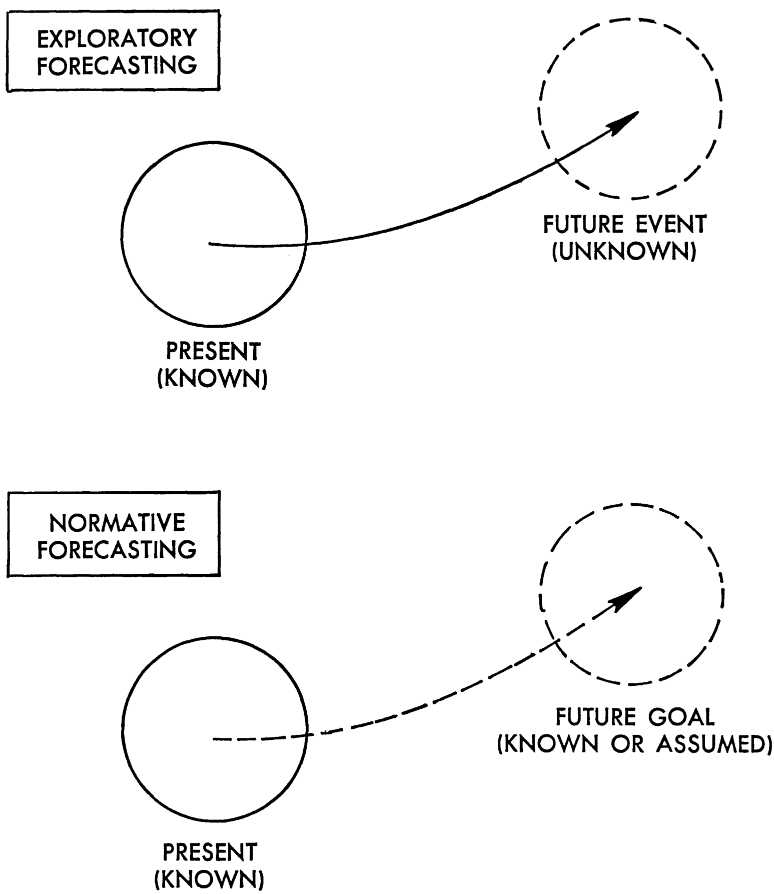


Figure 2.1. Comparison of Explcratory and Normative Forecasting (Reprinted from an article in the 6 June 1972 *Chemical Engineering Progress*. Vol. 6)

The exploratory forecasting techniques which deal with present situations and project growth by making assumptions relative to the continuation of past patterns or activities are all based upon the methodology of trend extrapolation. Other exploratory techniques include modeling, scenario development, Delphi, and individual genius.

A set of techniques which complement and in no way compete with the exploratory are the normative techniques. The normative techniques have their foundation in systems analysis. The technique requires that goals be set and a system of analysis chosen which directs the forecaster to the best path or solution to the specific goals. Some of the better known methods of normative forecasting are the Program Evaluation and Review Technique (PERT), Critical Path Analysis (CPA), mission flow analysis, relevance trees, and morphological analysis. Within the area of normative forecasting, as in exploratory, there are a number of minor methods which may be subsumed under one of the major categories.

The relationship between the forecasting techniques has been stated by Martino (1972) as follows:

> It must be clearly understood that exploratory and normative methods are not competitive with, or replacements for, one another. Both are essential, and both must be used together. Normally one does not bother to prepare an exploratory forecast of some technology unless there is a normative forecast (at least an implicit one) that the technology will be needed. Likewise, one does not normally prepare a normative forecast without some idea that it will be possible to meet the goals . . . (p. 287)

The techniques examined within this chapter are to be used in conjunction with each other rather than in place of one another. A valid forecast is dependent upon the proper use of specific forecasting techniques.

EXPLORATORY METHODS

The general classification of exploratory forecasting techniques is commonly defined as those techniques which develop a forecast of the future based upon present day and historical developments. The principle exploratory forecasting techniques are trend extrapolation, individual genius, Delphi, scenario development, and modeling.

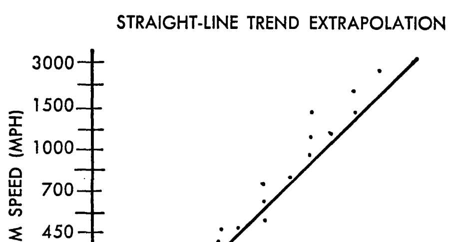
Trend Extrapolation

The technique of trend extrapolation is the foundation upon which all exploratory forecasting techniques are based. A trend extrapolation forecast is developed by means of a historical time line and is based upon the assumption that the developments or historical trends will remain constant throughout the future time frame of the forecast.

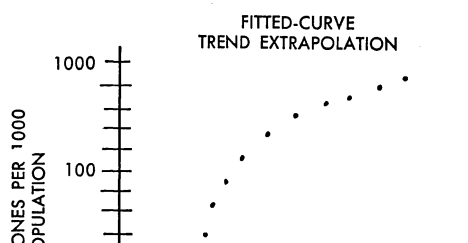
The initial step in the development of a trend extrapolation forecast is the collection of valid data over a specific length of time. The accuracy of the forecast is highly dependent upon the amount and validity of the information collected. With the data collected, a historical plot of the information can be developed from which trend forecasts can be made.

A number of short and long range forecasts are presently arrived at through the use of trend extrapolation. The economist uses trend extrapolation to forecast economic developments, the sociologist uses it to project population trends, and the educator uses it to project enrollment trends.

A number of variations of trend extrapolation have been developed to explain the historical progression and forecasts of events. The variations became necessary because all trends that were forecast were not on a straight line progression. Many factors for which forecasts were and are desired have varied trends during specific periods of time. Two examples of trend extrapolation, straight line and fitted curve, are illustrated in Figure 2-2.



Speed Trends of U. S. Military Aircraft (Reprinted from an article by Gordon and Breach, *Science Publishers,* 1973.)



Utilization of Telephones by Population of the U. S. (Reprinted from an article by Ralph C. Lenz in the June 1962 *Technological Forecasting* published by Aeronautical Systems Division, Air Force Systems Division, Air Force Systems Command, U.S. Air Force.)

Figure 2.2. Examples of Straight-Line and Fitted-Curve Trend Extrapolation

The speed trends of military aircraft can be determined by plotting the speeds of specific aircraft against the year that each was introduced. Straight-line trend extrapolation can be used to forecast future aircraft speed trends. In contrast a fitted-curve trend extrapolation (growth curve) must be used to forecast the future trends in telephone utilization in the United States. A straight-line extrapolation of telephone utilization would have forecast a telephone for every person in the United States by the year 1960. Statistics show that this did not happen and experts project that it is not likely to ever happen.

Individual Genius

The individual genius technique of exploratory forecasting is based upon the factors underlying trend extrapolation. The majority of genius forecasts are completed by individuals who have a broad knowledge and historical perspective of a specific area. The accuracy of the forecast is dependent upon the level of expertise of the individual. Forecasts can be achieved by individuals of less professional stature than the recognized expert; however, the accuracy of these forecasts is often in question.

The individual who chooses or is requested to forecast trends must begin by reviewing current and historical events which relate to the area of the forecast. The data collection may be either a physical or mental process resulting in the projection of trends rather than specific dates or times.

The technique of individual genius forecasting is being used at all levels of government, industry, and education. Major decisions relative to future directions of countries and organizations are achieved by means of individual genius forecasting.

Delphi

The Delphi technique is similar to the individual genius technique in that forecasts are generated from a base of individual expertise. The two methods differ, however, both in the procedure and the number of individuals identified as experts. The Delphi technique requires a number of experts and a specific procedure which must be followed to insure valid forecasts (Helmer, 1969).

The validity of forecasts through the use of the Delphi technique is dependent upon the selection process used to secure the panel of experts. The criteria must be established prior to the identification of potential experts to participate in the forecasting process. A minimal number of experts must be identified to insure accurate and valid forecasts. The exact number of experts chosen to participate in the Delphi process is dependent upon the complexity of the forecasting area and the number of individuals who can be considered as expert. The process is generally not used with less than eight identified experts.

The Delphi technique requires the identification of both experts and a source. The source is not necessarily an expert in the area of the forecast but rather an expert in the operation of the Delphi technique. The source individual compiles and dispenses information generated by the experts. The experts do not, therefore, communicate with each other but rather with the source individual.

The Delphi process is divided into four rounds. A round is defined as a single communication with each of the identified experts in which all experts respond to the same information and return the responses to the source. To initiate the Delphi process the source must secure a number of potential projections of specific events which may occur in the future. The potential projections can be generated through the identified experts or a compilation of projections from previous forecasting exercises. The experts can, however, add or delete projections at each step or round in the Delphi process. The four rounds of the process are generally identified as follows:

Round 1 – Each expert is asked to estimate the year in which a specific event will occur. Upon receipt of the estimates the source individual combines the responses and calculates the interquartile range (IQR), which consists of the interval containing the middle 50% of the responses, and the median for each event forecast.

Round 2 – The IQR and median for each forecast are returned to the experts and they are asked if they would like to revise their original forecast in light of the IQR and the median. If the new response does not lie within the IQR, the expert is asked to state the reasons why his response is diversely different from the majority. The IQR, median, and reasons for diverse responses are compiled by the source individual.

Round 3 – The IQR, median, and reasons for diverse responses from Round 2 are returned to the experts and they are asked if they would like to revise their Round 2 responses. For responses that remain outside the IQR, the expert must explain why he is not convinced of the majority's position. The IQR, median, and reasons for diverse responses are compiled by the source individual.

Round 4 – The IQR, median, and arguments for divergent positions from Round 3 are returned to the experts and they are asked to consider all arguments prior to making a final choice. The median of the final responses is taken as a consensus of the total group (Dalkey, 1969).

The utilization of the Delphi technique requires the input of a number of experts over an extended period of time. This process generally results in the forecasts of the experts becoming closer as the process proceeds from Round 1 to Round 4.

The Delphi technique has been utilized successfully in the development of forecasts by such diverse organizations as the Rand Corporation, TRW Systems, Utah State University, Educational Testing Service, and the United States government. These varied organizations have used the technique to assess changes in technology, economics, and educational curriculum.

Scenario Development

The term "scenario" has for many years been used in relationship to the theater and only recently has the term been used relative to forecasting. In the area of forecasting, a scenario is defined as a hypothetical sequence of events constructed for the purpose of focusing attention on decision points in the future (Kahn and Wiener, 1968, p. 6). A scenario, like the preceding forecasting techniques, is based upon trend extrapolation.

The development of a scenario can be completed in a number of different ways and with varying numbers of forecasters. A scenario developed by a number of experts or forecasters is generally considered to be more valid than a scenario developed by a single expert. Scenarios can, however, be developed by a single expert working specifically in his given area. Other scenarios developed by individuals, not necessarily identified as experts, are often classified as science fiction. It can, therefore, be seen that the choice of individual or individuals chosen to develop a scenario can greatly affect the validity. The most valid forecasts are generally achieved through the use of a number of experts and therefore the technique of using more than one expert is described here.

The initial step in the development of a scenario is to identify a single factor for which a forecast is desired. Upon the identification of the desired forecast, related areas must be identified which could influence the forecast. Having identified the major forecast area and related areas, a number of experts must be identified to assist in the scenario development process. The identification of experts is highly critical and parallels that of the Delphi process.

The scenario development process requires that the experts develop a forecast of potential occurrences in their particular area. The completion of this initial effort results in a scenario from each of the designated experts. The experts are then brought together for the purpose of relating their specific scenario to the scenarios developed by the others. This converging of expertise results in changes in individual scenarios based upon the effects of the related scenarios. This interaction and interrelation of scenarios results in a number of congruent scenarios.

The final step in the scenario development process requires that the experts in the major area of the forecast study the scenarios which were developed and develop a major scenario. Upon the completion of the major scenario the total body of experts once again interacts relative to the effect of the individual scenarios upon the major scenario. The result is a scenario based upon the input of a number of experts.

An example of the use of the scenario development process in industrial arts education is outlined as follows:

1. The problem is to forecast the developments in the area of industrial arts education through the year 2000.
2. The areas of education, technology, and society are identified as areas in which supporting scenarios are to be developed.
3. Experts are identified in the three supporting areas as well as in industrial arts education.
4. Scenarios are developed independently by the experts in the supporting areas.
5. The scenarios from the supporting areas are discussed and modified by the experts.
6. The experts in industrial arts education study the three scenarios on society, technology, and education and develop a scenario for industrial arts education through the year 2000.
7. All experts convene for the purpose of examining the scenario developed by the experts in industrial arts education.

8. A scenario for industrial arts education through the year 2000 emerges.

The scenario development process, or some modification of it, has been and continues to be used by the military to forecast the results of specific strategic decisions. The process allows the forecaster to observe alternative effects based upon specific decisions made on a time line. The process is most useful in circumstances where decisions relating to the major scenario or development can have a major effect on the forecast. Additional examples of scenarios developed by both individuals and groups of experts are illustrated in Chapter III.

Modeling

The modeling technique of forecasting has by some authors been identified as monitoring. The process of achieving a forecast by the two methods is the same and therefore the confusion in terminology. The technique of modeling can be defined as the process of developing representations which describe in simplified form the relationship of various aspects of the future, based upon historical and present data. The initial development of a model is intuitive (exploratory) and the completion of the forecast causes the model to change and become analytical (normative). Edward Roberts (1974) has actually classified the modeling process as a normative technique. The majority of the writers in the area of forecasting, however, identify modeling as an exploratory technique. Modeling is therefore a continuing process in which the model changes as additional data are collected.

The processes of modeling have been divided into two areas, static modeling and dynamic modeling. The techniques differ in the identification of the status of the parameters or factors within the model. The static technique requires that the parameters remain constant over time while dynamic modeling allows the parameters to change. The process of dynamic modeling can be compared to the development of a static model through the process of trial and error. Static modeling, therefore, requires more sophistication in the initial development of the model than does dynamic modeling.

The development of sophisticated models often requires the collection and manipulation of great quantities of information. The information collected must be in a numeric form in order to function as part of the developed model. The collection and manipulation of great quantities of data have been made easier through the developments in the area of computer technology. The application of models by means of computer manipulation is often referred to as a "computer simulation."

The modeling technique of forecasting requires that a descriptive model be developed that can be translated into mathematical relationships. The validity of a model, similar to other exploratory techniques, is dependent upon the expertise of the individuals chosen to assist in the forecast.

The following process is utilized in the development of a model:

1. Determine the area for which an ongoing forecast can be achieved.
2. Determine the assumptions which must be met to achieve a valid forecast.
3. Identify associated areas which will have an effect upon the forecast.
4. Search out historical evidence or analogous circumstances relating to the potential model.
5. State the model in descriptive form.
6. Have the model evaluated by a number of experts.
7. Determine mathematical relationships between the area to be forecast and the related areas.
8. Implement model in short-range forecasting.
9. Continue to collect data and update model.

Models have been developed in the areas of technological progress (Seamans, 1969), consumer goods consumption (Fontela, Gabus, Velay, 1965), and world issues of 1980 (Abt Associates, 1965). Jantsch (1968) cites more than 100 models that have been developed in his book entitled *Technological Forecasting in Perspective.*

NORMATIVE METHODS

The most common normative or goal-oriented methods of forecasting have been conceptually grouped in three areas: morphological models, relevance trees, and mission flow diagrams. Each area has its own form of analysis, yet all fulfill the same goal, which is the identification of the optimal solution to a problem. Within each of those general areas, there are specific designs which have been adapted for particular problems. Morphological analysis is used where the elements of the problem studied are not of a hierarchical nature and may be altered independently. Relevance trees are applied when the problem studied can be described in levels of hierarchy, complexity, or causation; and mission flow diagrams are used when the problem studied can be described in terms of alternative paths of sequential steps which could accomplish the task.

Morphological Analysis

Morphological analysis was developed by Fritz Zwicky, although the basis of the method is much older and can be traced to Ramon Lull, a Majorcan logician who lived from 1235 to 1315. Lull proposed that by combining a very small number of principles one could solve all the problems of philosophy and metaphysics. Zwicky has taken this idea and developed a system which can now be used for forecasting new technologies (Bright and Schoeman, 1973). In his approach, a system or problem is broken into parts which can then be treated independently, with the forecaster identifying as many solutions or approaches as possible for each part. The technological performance required for each solution is then found, and this is used as the goal for the technology involved.

Some form of notation for the elements of a morphological model is necessary and Zwicky identified a system which seems quite easy to use. In Zwicky's notation each of the possible solutions to a part of a problem is P_i^j. The subscript refers to the component or part of the problem, and the superscript *j* refers to the specific solution to the subscript i-th problem. If you will refer to Figure 2-3, "Automobile Propulsion Morphology," you will see that $P_1^2\ P_2^2\ P_3^2\ P_4^1\ P_5^4\ P_6^3$ describes a four-wheeled vehicle with two drive wheels, with two electric motors coupled directly to the driven wheels and with the power supplied by a secondary battery. P_1^2 refers to the first component, wheels, of which there are four, which is shown by the superscript *2* referring to that specific solution. In P_2^2 the subscript *2* references component 2 which is driven wheels, and the superscript *2* references the specific solution for driven wheels, which is two.

A morphological model of automobile propulsion which was described by Martino (1972, p. 305) is presented in Figure 2-3.

P_1	Wheels	3	4			
P_2	Driven Wheels	1	2	3	4	
P_3	Engines	1	2	3	4	
P_4	Transmission	None	Mechanical	Fluid		
P_5	Engine Type	Internal Combustion	External Combustion	Turbine	Electric	
P_6	Power Source	Hydrocarbon Fuel	Primary Battery	Secondary Battery	Fuel Cell	Third Rail

Figure 2.3. Automobile Propulsion Morphology

The elements of the model are: number of wheels, number of driven wheels, number of engines, transmission, engine type, and power source. Since we are concentrating attention on the automobile, which is presumably to be used mainly on prepared roads, the traction is assumed to be provided with wheels. An off-the-road vehicle might also use other mechanisms such as tractor treads, hence this element might be more inclusive for such vehicles. From considerations of stability and mechanical simplicity, the only choices for number of wheels seem to be three and four. Any number of wheels might be driven; hence this element can vary over the range one to four. There must be at least one engine, and there appears to be no point in having more engines than wheels, hence this element ranges over the numbers one to four. There are three possibilities for the transmission. It may be nonexistent (i.e., a direct mechanical coupling between engine and wheel(s) with no provision for clutch or torque conversion), or it may be a mechanical coupling including clutch or gears or both, or it may be a fluid coupling which may include either or both a disconnect mechanism serving as a clutch and a torque conversion mechanism. The possible engine types include internal combustion, external combustion, turbine, and electrical. The power source may be a hydrocarbon fuel, primary or secondary battery, a fuel cell, or an external third rail. This model provides a total of 2 x 4 x 4 x 3 x 4 x 5 (or) 1,920 possible automobile propulsion systems (Martino, 1972, p. 304).

The 1,920 possible solutions are arrived at by multiplying the number of solutions for component P_1 times the number of solutions for component P_2 times the number of solutions for component P_n.

It can be seen that some of the 1,920 possible solutions will be immediately ruled out as not feasible, such as the internal combustion automobile using a third rail as a power source.

Once the infeasible solutions are determined, the corrected realistic number of possible solutions can be analyzed. It is possible, of course, that this model could be greatly expanded to include vehicles requiring more than four wheels, other power sources, other engine types, etc. When one is designing a morphological forecast, his first task is to set realistic parameters.

The forecast utilization of morphological analysis begins to appear when we apply the required levels of functional capability which the components must attain. The levels of functional capability stand, at the minimum, as statements of performance, if the ultimate goal such as an electric car with certain performance characteristics is to be reached. They may also serve as guides to estimate possible time frames within which the necessary technologies must be developed if the ultimate goal is to be reached. In turn, a time frame for the ultimate goal (e.g. the electric car) can then be forecast (Ayers, 1969).

The preceding discussion has shown how morphological analysis can be useful in completely describing all elements within a system and how it can be used as a tool for organization, producing insights and forecasting new developments.

Morphological analysis can also be used to identify areas for invention which have been overlooked by the somewhat "less than systematic" nature of invention, as it is usually undertaken. Figure 2-4, as presented by Ayres (1969, p. 77) illustrates how invention opportunities which may have been previously overlooked can now be systematically identified.

The x's on the chart indicate those combinations of electric motors which are incapable of producing non-zero torque. Within the twelve plausible combinations shown in the matrix are described many familiar types of electric motors such as the "inductive squirrel cage" motor and the dc commutator motor. Ayres states, "One of the most interesting entries on the table corresponds to an ac 'homopolar' motor. Although it is hard to prove that something is really 'new', no previous reference to such a type has ever come to the attention of the author, at least." This possibility came to light only as a result of the use of a morphological approach (Ayres, 1969, p. 77).

The method of morphological analysis in our example was described using technical, hardware type subject matter. It is not that limited, however. Ignotovich has used the same morphological

ROTOR STATOR	Passive	Permanent magnet 2-pole	Electro-magnet dc, 1-pole	Electro-magnet dc, 2(N)-pole	Electro-magnet ac, 1-pole	Electro-magnet ac, 2(N)-pole
Passive	X	X	X	X	X	Inductive Conjugate?
Permanent magnet 2-pole	X	X	Homopolar (PM)	X	X	dc (PM) (with commutator)
Electro-magnet x, 1-pole	X	Homopolar Conjugate (PM)	X	Homopolar Conjugate (EM)	X	X
Electro-magnet x, 2(N)-pole	X	X	Homopolar (EM)	X	X	dc series/shunt (with commutator)
Electro-magnet x, 1-pole	X	X	X	X	X	ac homopolar conjugate
Electro-magnet x, 2(N)-pole	Inductive (squirrel cage)	Inductive syncro (PM)	X	Inductive syncro (EM) (slip rings)	ac Homopolar	X

Figure 2.4. Morphological Box for Identifying Areas of Invention

box, same assumptions and same notation and has examined the interface between colleges of education and the public school systems. He pointed out, "Awareness of the interface dysfunctions has been verbalized, analyzed, and eulogized," and that the college response to a field problem is usually the introduction of a course (Hencley and Yates, p. 214).

The application of morphological analysis to this problem does not attempt to make value judgments on the merits of a particular interface. It does, however, lead the investigator to determine all possible interfaces so that future value judgements can be made to determine which interface will be followed. With morphological analysis, Ignotovich identified 299 alternative purposive interfaces between a college of education and public schools. (Hencley and Yates, 1974, p. 214).

Educators at all levels and in all fields are continually examining their programs for appropriateness of purpose. Morphological analysis can assist in obtaining more complete answers to educational questions relating to curriculum, program organization, etc. This method of analysis minimizes the likelihood of a likely but unusual solution being overlooked.

Relevance Trees

The relevance tree is another widely used normative technique which was developed to guide the forecaster down a pathway toward his predetermined goal. The relevance tree owes its early beginnings to graph theory which developed during the 50's and 60's. The results of this graph theory led to Critical Path Analysis (CPA) and Program Evaluation and Review Technique (PERT) diagrams. CPA and PERT were capable of handling straightforward decision-making and have found extensive use in engineering projects. As research planning developed, a need was discovered for systems which could aid decision making in situations involving increased conditions of uncertainty. From this need for solving problems with increased conditions of uncertainty came PPRA (Project Planning Resource Allocation), decision trees, and relevance trees also based on the results of the 50's and 60's graph theory (Holroyd and Sculthorpe, 1974, p. 2).

Perhaps the most widely described, documented and tested approach to relevance tree analysis is Honeywell's (PATTERN) Planning Assistance Through Evaluation of Relevance Numbers.

Honeywell has used this system for more than eight years and has found it to be useful in selecting long range research and development investment programs (Bright and Schoeman, 1973, p. 147). A complete description of Honeywell's technique and some examples are presented by Maurice Esch in Bright and Schoeman's selected readings cited above.

The Rand Corporation and Battelle Institute have developed relevance tree techniques for application in government. Holroyd and Sculthorpe also reported that in England, the Programs Analysis Unit at Didcot and the post office have applied relevance tree techniques to some research and development planning. (Holroyd and Sculthorpe, 1974, p. 3).

The following text will present the procedures and requirements for establishing relevance trees, as well as examples of how they may be used as both descriptive and forecasting tools.

In order to describe or analyze a system or process with this method, one must determine that within the system or process there can be identified distinct levels of complexity or hierarchy. The levels of hierarchy are developed by the successive identification of increasingly finer components at progressively lower levels.

1. The branches extending downward (depending) from a point where a branch is subdivided (node), (Figure 2-5)

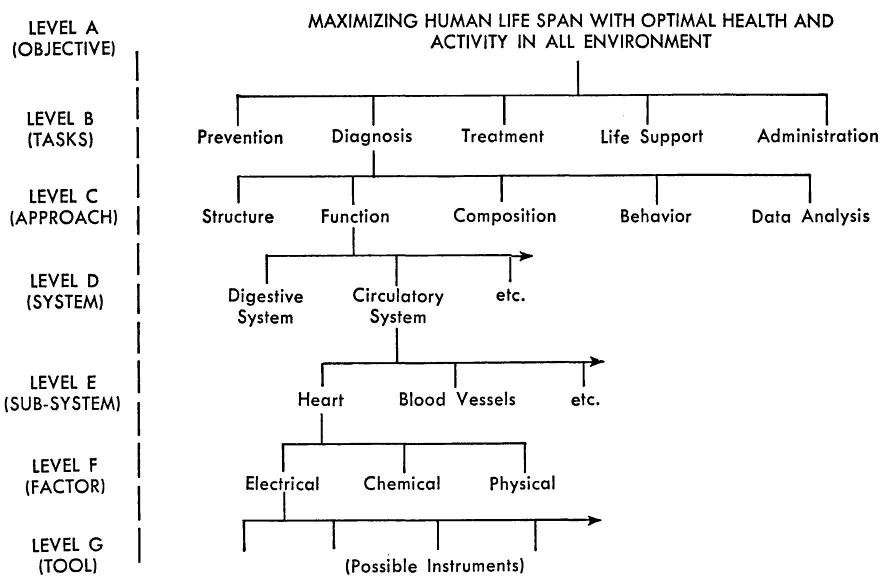


Figure 2.5. Relevance Tree Showing Areas for Study and Levels of Hierarchy

must be a closed set. When working with finite data as in a taxonomy, this is an exhaustive list. However, it is more common to simply find agreement among those involved that the important elements are included. Much care must be taken to assume that an important item is not overlooked.

2. The branches depending from the node must be mutually exclusive. There can be no overlap between or among branches.
3. When a relevance tree is used for normative purposes, it must be viewed as a set of goals and sub-goals. Each node becomes a goal for all the branches depending from it. The goal of level one is the broad overridding one (Martino, 1972, p. 288, and Hencley and Yates, 1974, p. 73).

Clear and skillful thinking must be conducted in order to make the relevance tree method, as well as all other forecasting methods, work. The forecast can be only as good as the insights brought to bear by the forecaster. The "garbage-in, garbage out" syndrome holds here as it does in the use of the computer.

The following relevance tree is based on the one prepared by the Delper Corporation to assist the National Institutes of Health in fulfilling the national biomedical objective of maximizing human life-span with optimal health and activity in all environments.

With this objective, the levels of the tree were established as shown in Figure 2-6.

The tree shown develops only one of the branches depending from each level. In a real situation there would be a similar set of branches from each of the six levels (Martino, 1972, p. 298; Bright, 1972, p. 7-23).

When the tree is complete, we have an exhaustive description of the possibilities for fulfilling our national objective in health. It is quite evident that there is a limited supply of resources available to allocate to any national program. How then does one decide which of the tasks at Level B is the most important and on which we should place the greatest emphasis? Value judgments begin to enter here. Is it wise to place all of our emphasis on the prevention of illness leaving the sick to die for lack of treatment?

It is with the application of relevance numbers that the tree is transformed from a descriptive device to a normative forecasting tool capable of giving us the "best" route to fulfill our objectives with the resources available.

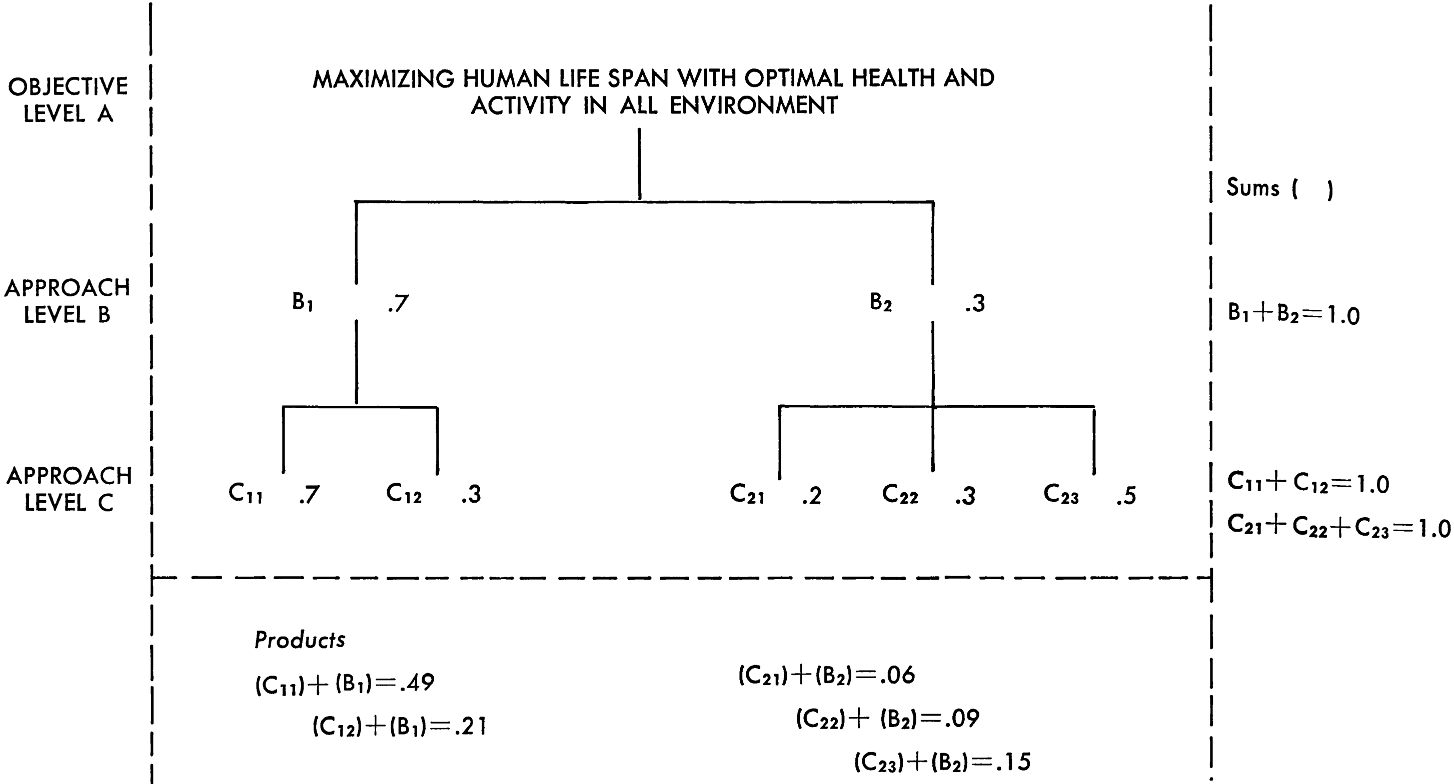


Figure 2.6. Relevance Tree Showing Relevance Numbers

The importance of each task is determined, along with the importance of each approach to each task, the importance of each system to each approach, the importance of each organ to each system, and the importance of each factor for indicating malfunction of each organ (Martino, 1972, p. 299).

Once the importance of each of the above levels is determined, one can then establish the performance levels of tools and instruments and determine where research and development efforts must be placed. The importance of each task, approach, and system is referenced with a "relevance number," with the sum of relevance numbers for each branch equal to "one," a process known as normalization.

Some form of notation is helpful when applying relevance numbers to your descriptive tree. Figure 2-6 shows a typical notation scheme for three levels of a tree. The three levels correspond to the levels in the National Biomedical Tree shown in Figure 2-5. In working an actual relevance tree you would consider all branches; however, the number of branches in Figure 2-6 has been reduced due to space limitations and to simplify explanation. Therefore, Figure 2-6 shows only two branches at level B (tasks), whereas the complete tree, Figure 2-5, shows five.

The objective (level A) in Figure 2-6 is identified with two tasks (level B), and the tasks are identified as B_1 and B_2. Task B_1 has two possible approaches to fulfilling the objectives C_{11} and C_{12}, and task B_2 has three possible approaches which might aid in fulfillment of the national objective. The diagram could then show level D (systems) having two branches depending from C_{11} and three barnches depending from C_{12}. This process would continue until the bottom level of the tree was reached.

You will now note that the relevance numbers for level B are .7 (B_1) and .3 B_1 indicating that task B_1 is considered to be slightly more than twice as important as B_2. Note that .7 and .3 add up to one as is required. In level C you will notice that C_{11} and C_{12} with relevance numbers of .7 and .3 add up to one and that C_{21}, C_{22} and C_{23} with relevance numbers of .3, .3 and .4 also add up to one. If the diagram were continued the same conditions would exist at level D and on to level X_n.

We must now follow the paths from the highest to the lowest level and compute the products of those paths. The path with a significantly higher product would be considered the path with the most need or promise for developing. The products of each path are shown at the bottom of Figure 2-6. You will also note that the sum of the products in the set shown is one and must always add up to one.

The relevance number for path B_1, C_{11} = .49 and for path B_1, C_{12} = .21 showing path B_1, C_{11} to be about twice as "relevant" as B_1, C_{12}.

In looking at the paths in branch B_2 we find the product of path B_2, C_{23} to be nearly three times as large as path B_2, C_{21}; yet there is not nearly the difference between B_2 C_{21} and B_2 C_{22}, particularly when one remembers that each of these products is less than .1. It is especially important to remember that we began using numbers good to one significant digit and we should not now attempt to discriminate between alternate paths when the only difference appears in the third place value. This could easily be the case in third and fourth levels of a tree.

The relevance tree may also be utilized as a research tool. The discipline to be studied is viewed as a relevance tree having two branches, a theoretical or rational branch, and an experimental or research branch. The theoretical branch contains statements about the discipline which are continually refined as research is carried out and the findings fed back. The experimental branch contains those elements which currently held concepts (Figure 2-7). Between the two branches there is an interplay where theory suggests research, and research findings cause theory revision. Quite often the research produces unexpected findings, which make theory revision even more significant. (Bright and Schoeman, 1973, p. 136; Hencley and Yates, 1974). Extensive application of the relevance tree as a research tool is presented by Gordon and Raffensperger using space-based astronomy as the discipline (Bright and Schoeman, 1973, p. 126-146).

Mission Flow Analysis

Mission flow analysis found its beginning in the military as did many of the forecasting techniques now used by industry and others. It was developed by Linstone at the Rand Corporation and was used by the military to analyze problems dealing with foreign policy decisions and national security. Several examples of mission flow analysis as used in the military are described by Linstone in *Technological Forecasting for Industry and Government* by Bright (1968, p. 223-241).

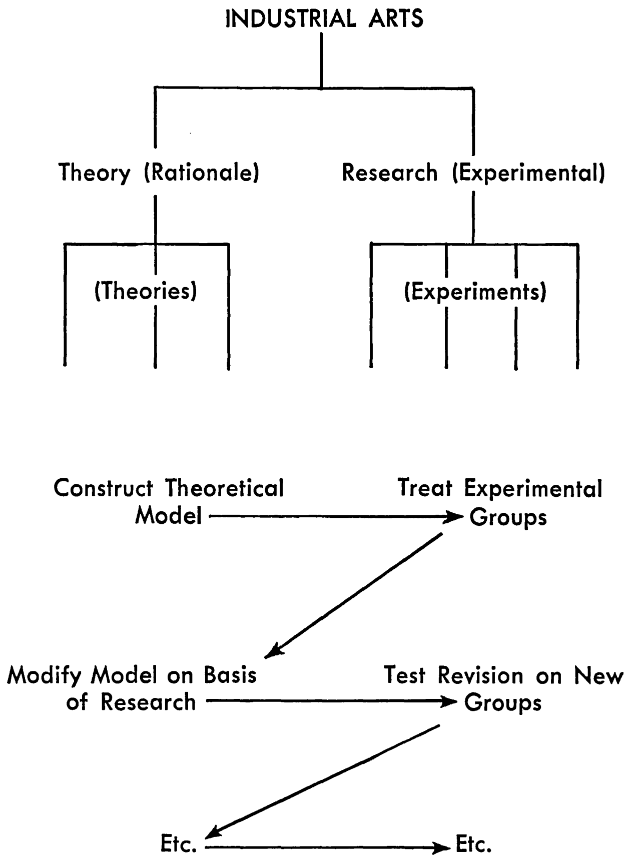


Figure 2.7. Relevance Tree as Research Tool

The principle of mission flow analysis is simply to identify a mission, map all possible ways to accomplish the mission, noting the advantages and disadvantages of each, so that the optimum way of accomplishing the mission can be selected.

Suppose the mission was to determine the best way of getting to and from work. The investigator must first map all possible routes and modes of transportation (Figure 2-8). Then he must identify the advantages and shortcomings of each of the route choices. (With a bus there are waits and transfers; walking is

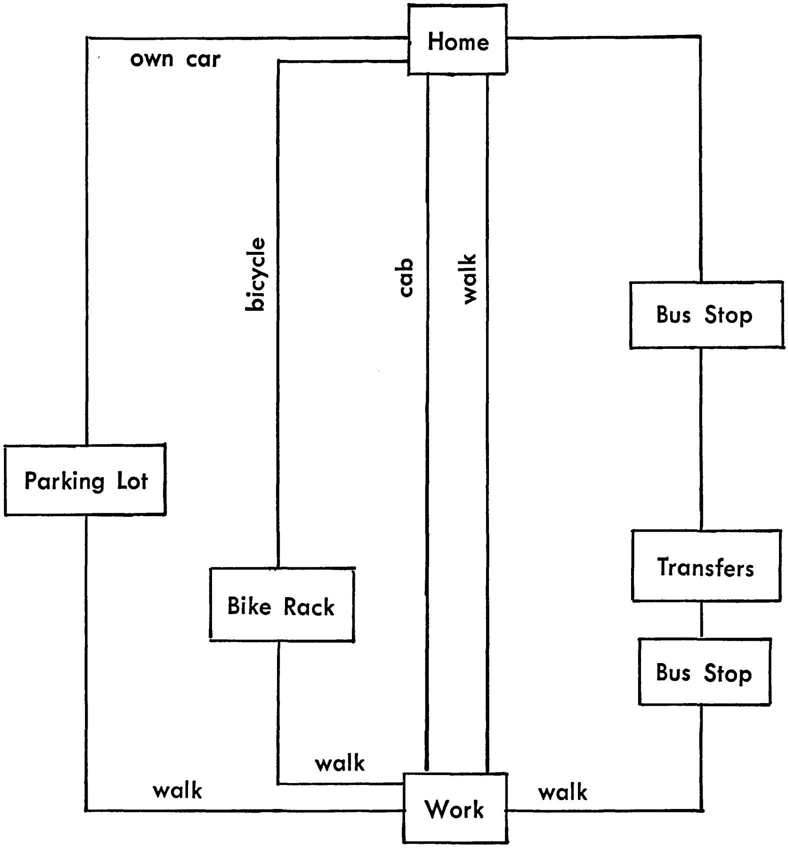


Figure 2.8. Mission Flow Diagram – Routes Home to Work (Martino, 1972, p. 317)

slow and possible only if the distance is short; it is also difficult in bad weather; taxi cabs are direct and fast but very expensive, etc.) The final step is to select the optimum route.

Quite often the mission flow analysis will cause the investigator to develop an alternate route not previously available or even thought of.

In a mission more complex than our example above, it is sometimes useful to apply relevance numbers to both the routes and bottlenecks encountered so that the levels of interference can be quantified.

Mission flow analysis can be used when planning for production of a manufactured product. The mission is to produce a certain product. There are many ways to reach that goal; many materials, numerous processes, and several personnel organizational schemes to use. All of the materials, processes, organizational schemes and their combinations are considered and mapped on a mission flow diagram. The multitude of possibilities is then studied, and comparisons are made which reveal the bottlenecks and the advantages and disadvantages of each route. With all of the data before him, the investigator can easily select the optimal route.

INTERACTIONS IN FORECASTING

When working with either exploratory or normative methods of forecasting, we must remember that technological change, whether minor or radical, does not happen in a vacuum. Factors such as cultural background, religious doctrine, theological and philosophical beliefs, political and international questions, as well as military and strategic postures all interact in ways that stimulate or hamper innovation. Bright specifically identifies five "environments" in which technological innovation takes place. They are the political environment, the technical environment, the economic environment, the ecological environment, and the social environment (Bright and Schoeman, 1973, p. 4). The effect these "environments" have on innovation is apparent when one considers such examples as the space program, high-speed passenger trains, urban renewal, DDT, automobile pollution controls, and the supersonic transport. All of these programs were stimulated from different concerns, many of them social; but when they were found to affect the ecological environment or to be politically questionable, they were either controlled, limited, or banned by governmental action. The action taken again reflects many different concerns or "environments."

It is with this somewhat unstable data base that the forecaster must begin his search for a reasonable timetable for predicting a new technology.

It has been learned that there are definite stages through which all innovations pass, and that they tend to pass through these stages at a predictable rate. The stages have been identified and codified by careful study of past technologies. Therefore, it is possible for the forecaster to firm up the data base upon which he will base his projection by using a categorization of the stages of invention as a tool in his work. One such categorization comprised of eight stages is suggested by James Bright (Bright and Schoeman, 1973, p. 7) and is summarized below.

Stage one is the starting point for all technological innovations. Innovations tend to emerge in one of three ways: by scientific suggestion, discovery, or recognition of a need or opportunity. Scientific suggestion is the speculation or hypothesis of the scientist; discovery is the identification of a new phenomenon; and recognition of need or opportunity, of course, is the realization of the need to solve a social or environmental problem, or the like.

Stage two is the proposal of the theory. At this stage, the technology concept is sufficiently developed to be made operational. Stage three is verification of the theory established in stage two through an experiment which confirms its validity. According to Bright, the progress of an innovation from stage one through stage three is the most time consuming step in the entire process. Stage four is the development of a laboratory demonstration which shows the application of the technological concept. Most production firms encounter innovations when they are at stage three or four in their development, and from that point it takes about ten years for production.

Stage five is the attempt at a field test or full-scale trial model. It should be recognized that failures in field test models are likely, and that the technological forecaster must identify which prototype is the one which will or did, as the case may be, become the production model. Commercial introduction is stage six, the first sale or first operational use, and stage seven occurs when there is wide adoption of the innovation or when the innovation has made a noticeable impact on society. Movement from stage six to seven takes upwards of five years. Stage eight is when proliferation of the original innovation occurs. Proliferation can appear as adaptations, such as radar to police work and also as adaptation of a principle such as radar microwave technology to cooking ovens.

The time frames suggested in Bright's scheme can be verified by looking at research on the development of innovations between 1787 and 1935 (Bright and Schoeman, 1973; Bright, 1964). There are innovations which have moved through the stages more quickly, such as the integrated circuit, which took only 12 years to go from stage one to seven; and the laser, which reached stage six in about five years. While it is possible that the time it takes for innovations to move through these stages is sometimes reduced, it seems that the steps taken must be the same.

It is the task of the forecaster to make predictions of future technologies on the basis of the best information available, and much of that information will come from his study of the events and patterns of technological history compiled with an understanding of the interactive effects of the cultural environments in which new innovation will occur.

SUMMARY

In this chapter we have discussed the basic forecasting techniques, all of which can be categorized as either exploratory or normative methods.

The exploratory methods: trend extrapolation, individual genius, Delphi, scenario, and modeling are focused on the determination of the most probable event; where as the normative methods: morphological analysis, relevance trees, and mission flow analysis focus on the determination of the optimal path to a predetermined goal or event.

The two methodological concepts are not in conflict but are complementary to each other and are used together. An exploratory probe might be undertaken to identify what event is most likely to occur and a normative probe would then be undertaken to determine the most appropriate path to follow in making the event happen.

The example given by Olenzak (1972) to explain the differences seems worthy of quotation:

> (an example of) . . . the difference between exploratory and normative techniques might be the conversion of coal to hydrocarbons. An exploratory forecast based on expected technological development for converting coal could indicate commercial liquidation before gasification. A normative forecast based on recent and expected environmental conservation developments, however, would probably be done with gasification as the goal (p. 29).

Trend extrapolation has been shown as an exploratory forecasting technique which is based on an accurate history of related events, an essential underlying factor in all forecasting. Studies in the process of innovation and invention have produced evidence which supports the notion that all technologies develop in a systematic way; that is, they tend to follow a sequence of steps and adhere to consistent time frames. There are exceptions, of course.

Individual genius and Delphi also depend on a strong understanding of past events but require experts to make judgments alone in the former method, and to make judgments and react to the judgments of others in the latter. Individual genius looks to the insight and expertise of an individual, whereas Delphi seeks a concensus among several experts. In both cases, in depth questioning about possible futures and their probable acceptance by society or by a particular group is the primary process.

The method which may possibly require the most creativity on the part of the forecaster is scenario development. The scenarios are based on knowledge of the development of past events or on recent breakthroughs. They can also be based on strictly hypothetical situations. An event is considered, and possible futures are written for the elements of society which might be affected by this event. The mini-scenarios are brought together and any number of more global scenarios can be developed from them. A most-probable-future scenario can be selected with the conditions specified under which they might occur.

When one moves into the normative methods, it is necessary to adhere to quite complex systems which are simply sophisticated ways of making lists of alternatives. The validity of any forecast is dependent in part on the objectivity of the forecaster as he makes the many decisions necessary to identify the *optimal solution.*

Both exploratory and normative methods depend on imagination, creativity and reliable data. The need for creativity and imagination in using exploratory methods is apparent, but this need tends to be obscured in the normative area. The normative methods are not a substitute for creativity, but rather they provide a system within which creativity and imagination can be effectively used to examine alternatives.

The system provided by morphological analysis allows one to solve a problem through a consideration of all combinations of the possible alternatives.

Relevance trees assist the forecaster in identifying the elements within a particular system and assist him in objectively deciding which part of that system should be emphasized for development.

Mission flow analysis will assist the forecaster in determining the best route by enabling him to identify possible bottlenecks in the alternative paths.

In order to make these methods useful tools, the forecaster must identify the problem and determine whether an exploratory or normative method is needed. He must then select from the array of methods the one which he feels is best suited to the task. Quite often the forecaster can modify or simplify the technique to better suit his needs.

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CHAPTER III

Some Projections

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INTRODUCTION

Projections of alternative futures come in many forms; forecasts, trends, predictions, speculations . . . In this chapter, short descriptive scenarios of alternative futures will be presented to project some possible futures. Basically, these scenarios have been developed and synthesized from the systematic application of a number of forecasting techniques.

Before plunging into visions of possible futures, it is constructive to first identify some of the current, operative functions within our society that are fanning the forces of change which are developing directions for the future.

MAJOR FORCES OF CHANGE

Operative today are numerous forces that, when extrapolated, cause the expectation for very different futures for society. In general, these forces will create many shifts and, for some, have little or no past precedence. The current forces operating to cause considerable future change are expected to impact heavily on industry and thus change industrial arts education, which must now be considered in projections of alternative futures. These projections are:

Explosive growth of cybernetic (computers and communications) technology.

1. Rapidly advancing technology — a millionfold technological advance in cybernetic technology is forecast to occur during the next 20 to 30 years.

2. Automation of industrial process and service industries.
3. National and multinational computer networks.
4. Incorporation of computer "intelligence" (smart devices) into factories, offices, homes, appliances, automobiles, etc.
5. Rapid transition toward "paperless" electronic communications for the capture, storage, and dissemination of information.
6. Economy of scale tipping away from centralized control towards distributed-function, local (individualized) control systems — allowing society to forecast futures without George Orwell's *1984* "Big Brother" controls.
7. Movements toward "electronic offices" and "automated factories."

Shifting geography of acquisition of resources.

1. Causing manufacturing to move to nations (or parts of countries) where resources are available, or where low-cost labor is available, forcing existing manufacturing to further automate to forestall such shifts.
2. Resulting in creating rich nations from poor and vice versa over a decade (or less) time frame.

Rapid and continued acceleration of change.

1. Rapid growth toward a multiplicity of crises (energy, material, paper, food, etc.).
2. Rapid growth of new opportunities resulting from advances in technology and use of new knowledge resulting from the "knowledge explosion."
3. Increasing scale of impact of change — causing the requirement for most institutions to adapt to the future.
4. Approaching limits in certain areas — especially energy and material resource usage.

Emergence and growth of multinational corporations.

1. Causing need to redefine public ownership.
2. Shifting the international competitive system and power structure.
3. Growth of world monetary system and world capital.
4. Emergence of international capital and ease of liquidity of world capital.

Shifting national policy patterns.

1. Push for steady-state economy with an environment of rapid shifts between inflation and economic slowdowns.

2. Visions of limiting growth in energy/material usage and population.

Over consumptive "throwaway society attitude" — forcing the search for:

1. Less "energy intensive" systems.
2. Less "material intensive" products.
3. Less "labor intensive" services.

Increasing social overheads.

1. Rapid increase in cost for community services (e.g., education, health delivery, etc.).
2. Demands for raising productivity in the service industries, resulting in a movement towards more automation.

Increasing leisure-time availability to individuals.

In the following scenarios the above forces,which are pushing society rapidly into futures very unlike our present, are used as background scenery in the development of the alternative futures they portray.

SCENARIO PROJECTIONS OF ALTERNATIVE FUTURES

In the study of futures, a scenario is defined as a comprehensive description (or descriptive story) of an alternative, possible future based upon the systematic application of forecasting tools (techniques for forecasting). Scenarios developed in this fashion help us to think about the future in terms of the future rather than just the past-present, and assist in our present reflections (decisions and actions) for bringing about the design of preferable futures.

Scenarios are an extremely useful forecasting method for examining, analyzing, and synthesizing alternative futures. Basically, a scenario is an abbreviated story or a description about a possible future. Scenarios describe qualitatively a future to be communicated; that is, the basic purpose of a scenario is to communicate a future possibility. Such scenarios are "future worlds" to wonder about, dream about, to study, and most importantly, to create. Imagination and innovation are initial means for dealing in various ways with the future, and the scenario is one of the best devices for stimulating and disciplining the imagination for shaping the future. Scenarios often plot chronologically how we could evolve from now to a desirable future, while others simply expound on a plausible future. Scenarios are "pre-history" cast in the as-yet-to-happen future rather than the heretofore past.

Brief scenarios can be quite useful for initiating futures studies and for triggering interest in such studies. They are very useful as course aids and/or directives to fan a student's interest in discovering (using other forecasting tools) change, trends and alternatives and to assist in their further study.

Tied with anchors to the present, scenarios forcefully illustrate the future possibilities of their focus. They can be used as artificial "case histories" to compensate to some degree for the actualities of our complex, real world. By so doing, scenarios divorce the present from the future and force us to work with the dynamics and details of the "might be's" of possible futures.

Part of a scenario is the investigation and prophecy of alternative futures which form a webwork of the alternative future history. The result can be a reworking of the same future period over and over again, from the point of reference of each prophetic alternative, until a pattern for the era under investigation emerges. In the process, the roles of the various proposed alternatives are exposable in a correlated bas-relief of the future historical period, thereby providing many landmarks for tomorrow.

Formal models are often developed from scenarios. These analogue transformations formalize the scenario into complex (but accurately concise), symbolic mathematical models for the purpose of simulation. They are models of the future portrayed in a detailed, iconic structure amenable for analysis — usually by a computer. They allow a "simulated game" to be played, faster than real-time, taking the analyst from the present to the future under study in a fraction of the actual time. In this fashion, the proposed future can be operationally and dynamically analyzed in detail. Inevitably, simulations develop new questions and alternatives which modify the model and scenario. To this end, the models and their simulation are important tools for developing scenarios. Sometimes it is sufficient just to state the formal model, without its simulation, as an aid for further developing scenarios — or for gaining understanding about the future being investigated. A further end-use for simulating the future is to give society a needed tool to examine the future, that is, an important tool which allows society to test a decision, or a future, before it is decided. This is accomplished by asking the simulation technique, "what if" type questions. The simulator then plays a "game" about the future, much faster than real-time (time-compressing years, decades and many generations into minutes) to achieve some probable answers. Likewise, the scenario, by itself, compresses the future it evolves into the time required to read or view it.

Often times, such alternative futures, analyzed in a scenario, expose the foundations and bridges that the current era, or a future society, must construct to arrive at a desirable future. The scenario places the present into a state of suspension while images of the future unfold.

To a great extent, the image of the future that a current society holds becomes the most likely future to be realized, since to a large and growing extent mankind shapes the future. Thus, society today drastically needs a proliferation of utopian scenarios as the keys for unlocking the pathways leading to desirable futures.

Many utopian images of the futures, once communicated, could come about — since the future tends to be invented by our capacity for imagining the future. Today we are primarily preoccupied with image expectations of negative futures leading society to disaster. Is this the type of future that should be invented? Certainly not — thus our task is to create desirable and utopian-type projections.

The following scenarios have been developed from a synthesis of numerous trend extrapolations and trade-off analyses of alternatives resulting from a number of Delphi and cross-impact studies. These scenarios of alternative futures describe possible directions in which society could be moving along the pathways leading to the year 2000, together with some implications for education. It is important to realize that these scenarios are not predictions of actual futures to unfold, but rather they are forecasts of alternative possibilities for the purpose of discussion and analysis, or for further design efforts to bring into fruition.

In all probability, the actual future to unfold will not be exactly like any of the following scenarios. However, it is also highly possible that the actual future will include major elements from a number of these sketches of possible futures.

Society in the United States is today at the transition stage, moving out of the industrial era into a new era of the post-industrial age. The impact on education in this new era is just now beginning to be perceived, and the expectations for the future are now being mapped. The following scenarios[1] are indicative of the studies of alternative possible futures that are expected to have a drastic impact on society, industrial arts, and education in general.

Scenario 1: A non-throwaway Society

It is virtually certain that society will be forced to change its approach in its use of the earth's energy and material resources. To put this requirement into focus, consider our present situation.

World population today exceeds 4 billion and the United States represents less than 6% of this population. As a nation, we consume more than one-third of the world's available resources. As to the rest of the world, their vision of the future is to achieve materially a quality-of-life equivalent to ours. Obviously it is a foolish goal, both for us and the world, to continue to work towards such high rates of consumption. For example, if only two other nations (each equivalent to the U.S. population) achieve such a goal, and with the same consumption value system, then less than 20% of the world's population would consume about 100% of the world's resources — leaving nothing for the other 80% of the world's population! Thus, there is no doubt that in the future we must change our consumption habits from the "throwaway society" attitude towards a "non-throwaway society" attitude. The basic characteristics of a "non-throwaway society" scenario of the future consists in using the knowledge we have amassed so far, which could allow:

Designing, building, and manufacturing things to last a long time.

1. Buildings and structures using an architectural technology and materials in their construction, designed to last thousands of years, which are modular, flexible and adaptable to changing needs, self-repairable, piecemeal updateable, etc., such that they are useful and desirable structures throughout their existence.

[1]NOTE: The scenarios presented represent only a few of the areas that could be explored. It is hoped that enough interest can be generated for the reader to draw up scenarios in many other areas. Also, these scenarios are in capsule form. Their intent is only to present the concept, not to detail it. Again, the desire is to create an interest such that the scenario can be expanded to meet the specific needs of the reader.

2. Electrical and mechanical devices, like automobiles and household appliances, designed using long-lasting materials as well as self-repairing technologies and piecemeal updating designs which allow them to be useful for hundreds of years.
3. Clothes designed and manufactured using materials which would last for at least five decades, and which are self-cleaning, self-pressing and self-deodorizing. Clothes which expand with us as we grow taller, fatter, skinnier, etc. Clothes that incorporate technology for allowing style changes, as new fads develop, to occur in existing clothes without producing new clothes.

Designing most consumables (other than food) for recycling.

The feasibility of this scenario is simply a matter of putting into practice our scientific know-how and evolving the designs for doing so — turning society toward humanizing technology. The real question is: Is it economically feasible? Today, society's economic value system works best when we can speed up the process of getting products out of the factory doors to the scrap heap. That is, the faster this process works, the more that is sold, and thus, more profit. However, one of the more profitable corporations is AT&T, the telephone company, yet we don't own our telephone. This industry has an economic incentive to design and manufacture the telephone to last a long time because they receive their profit from renting it rather than from selling it, that is, they provide community service. Therefore, one alternative for achieving a non-throwaway societal incentive requires only a single law to be enacted; that is, a law preventing individuals from owning the vast majority of things that we now consume. The results from such an economic system based on achieving profits (dollar) from providing services rather than from the sale of products could/would be:

Vastly reducing the use of materials and energy per-person — elevating the need to constantly remake things — along with a reduction in pollution from manufacturing and mining process.

Giving the entire world the ability to achieve a much higher material quality-of-life, making longer use of finished products and reducing the number of items manufactured per person.

Allowing more materials and energy resources to become available for the subsistence items such as food production.

There is no doubt that some form of this scenario for the future will become a way of life — and perhaps soon. When it does, the impact on education will demand considerable changes — especially in the industrial arts. Some changes are:

Reducing requirements for mining and manufacturing vocations as society moves into this future.

Reducing requirements for mined and manufactured products.

Elevating the importance of repair and recycling – and their second-order usage.

Implementing higher quality control techniques in manufacturing processes.

Scenario 2: The Post-Industrial Society

Our society is in the midst of a major transition. The United States is leaving the industrial age culture and entering a new sociotechnical age of a post-industrial era. The foundations of the industrial/machine age consisted basically of the science of *reductionalism* which gave rise to the *analytical* way of thinking for discovering and seeking increased understanding of the nature of the universe. In this age of analysis, the basic ideas lead to the present disciplinary approach to science: decomposition analysis (dividing things into parts), problem-solution science ethics, technology and management ethics, cause-effect relationships, the deterministic world approach, as closed-system schemes. Mute testimony to this machine age now resides in science museums, and our current educational programs which contain the thrust which spawned vocational-technical education. The end-product of mechanization in the industrial age resulted in automation: in particular, the automating away of production-oriented occupations which ushered in the new age of a service-based economy characteristic of the post-industrial era. The new intellectual framework now developing to replace the mechanistic and reductionist doctrines of the analytical modes of thought is being supplemented by the doctrines of *teleology* and *synthesis*. These concepts include the frameworks of choice (alternatives), purpose (goals), cybernetics, planned futures, functional systems, synergism[1], symbiotics[2], and evolutionary synthesis. The primary

[1]Synergism is the process by which a variety of discrete agencies combine their efforts such that the result is greater than the sum total of the individual efforts.

[2]Symbiotics is the union of two or more dissimiliar organisms in a fashion which is mutually beneficial to all.

mode of thinking tends toward the fusion of the sciences, arts and humanities, and quickly evolves into a multidisciplinary, interdisciplinary, and transdisciplinary system. That is, the effective study of future, large-scale social systems, world models, and the like, now requires synthesis throughout the sciences, humanities, arts, and technology in order to organize them into a total system of thought.

The face and character of science, industry, institutions and society in general constantly change and appear to be accelerating at an extremely rapid pace. It is taking us into this new era which is quite unlike any era of the past, even the very recent past. The new post-industrial era into which we are embarking has many ramifications and characteristics that are already visible. It has variously been referred to as the:

Cybernetic Age
World Community
Wired World
Knowledge Society
Communications Revolution
Computer Revolution
Sociotechnological Age
Age of Responsibility
Systems Age
Space Age
Temporary Society

A common thread through each characterization, however, is one in which automation, to a large extent, will take over the task of physical labor. This will allow more free time for humans to socialize and will lead to more leisure. The new work roles for people in this post-industrial age appear to be *elevated away from* laborious tasks, tasks of monotony and rote, traditional crafts, tasks which enslave people to machines, unsafe and unhealthy tasks, and the like. Future vocations and professions (work) will thus be directed more and more toward tasks that require the handling of information and providing services rather than for applying human energy in classical production activities.

Efforts to make machines more humanistic and to mechanize humans represent cross-trends that are occurring at present, and will certainly evolve and expand in the future. The extent to which man-machine symbiosis will (could) be united is almost unlimited in a service-oriented future.

The post-industrial society will undoubtedly spawn new forms of educational systems just as the industrial age created vocational-technical schools, science museums and a multitude of related spin-offs.

In the post-industrial era, automated offices and factories could sneak up on us more rapidly than most realize according to recent forecasts. Common to these future systems is the automation of materials and information handling, operations, production, and management control functions.

Due to such increases in automation via computerized adjuncts to machines, the nature and definition of "work" will undergo considerable change. "Work" could thus become less laborious and require fewer "artisan" type skills. Therefore, vocational activities could become more important, and in some cases could approach that which we now call the traditional professional career. A growing portion of the work force will be engaged in professions requiring a high degree of training and specialization. Therefore, faced with rapid advances in all fields, much of the work force will quickly and continuously become obsolete. Thus, most people will have a multiplicity of careers throughout their lifetime requiring a life-long approach and dedication to education. This will expand the need for future vocational-technical education. The concept of life-long learning will, of necessity, be merged and incorporated into the realms of both work and leisure-time activities. Thus, education may well become an integral part of everyone's life style.

John McHale writing in "The Plastic Parthenon" (Toeffler, 1972) has brought up an interesting concept regarding automation, products and human effort. His thesis is that society, in general, has passed from a survival society where humans are now the dominant force and the provider, rather than the dependent of nature. In previous eras, material objects were dominant; humans were expendable. Today, through science, technology and automation, the material object can be produced in vast quantities more or less automatically. Today objects are expendable and humans are paramount, with their vocations becoming expendable. Thus, education may well evolve toward a multiple focus encompassing life-long preparation for leisure and changing vocations as an end-result, rather than just "end-point" vocational preparation.

Thus, an ultimate possible scenario resulting from automation in the post-industrial era could be a society based upon leisure rather than work.

Scenario 3: The Communications Revolution Extrapolated

Since the dawn of humankind our ability to communicate has steadily evolved and advanced. During the last century, the speed and capacity at which we are capable of communicating grew by more than a millionfold. To put the impact of this millionfold increase into focus, consider the time it took to communicate Columbus's landing in the Americas versus the moon landing by Neil Armstrong. The average person in the known-world in Columbus's day did not find out about his discovery during their lifetime since it took until almost the 1600s, or about 100 years later, before knowledge of his discovery traversed Europe. The first man to walk on the moon, however, was viewed in real-time by two-thirds of the world. This millionfold increase in communicability speed brought to humans the ability to communicate worldwide, literally, instantly in the real-time of the occurrence of events. Another millionfold increase in our ability to communicate is forecast to occur in much less than 100 years from now, perhaps by the year 2000. What new things and abilities will this projection of another millionfold increase in the speed of communication bring for the future? Some possibilities resulting from trends of current, extrapolated communication advances leading to a new communications revolution are:

Information Dialoguing
Global Electronic Libraries — Instant access to humankind's total stored knowledge
"Cashless Society" — Computer networks for finance
"Paperless" Society/Communications
Two-Way TV — "Talk-Back TV"
Shopping at Home
Health Delivery into Home
Education at Home
Individualized Learning Systems
Simulated "Experience" Systems
Error-Free Systems (e.g., Problem Prevention Systems)
3-Dimensional Imaging
Computer Voice Reply and Speech Recognition

"Window-on-the-World" Systems
"Window-on-the-Future" Systems
"Instant Expert" Systems
Interactive Communication Systems
"Mind Amplifiers"
"Intelligent Adjuncts"
People-to-Machine Communications
Robotic Information Services (e.g., Clerks, Teachers, etc.)
Current Awareness Sensing
"Silent Language" Reading Systems
Information Transfers Substituting for People and Thing Tranfers

In this scenario of the future, from the extrapolations of communication trends, we can assume that the prime media for future students participating in formal educational systems would be electronic in nature, and that they could "attend" remotely via such electronic medias. Further, the "electronic educational system" could become available for use twenty-four hours a day. Throughout one's total life it would act as a real-time "intelligence amplifier" (adjunct) to assist in everything that we do as well as for learning in real-time.

In this future communications era of wired cities/nations/world, society would tend to substitute information transfers (telecommunications) for the transfer of people and things via imaging . . . This would result in community service information systems, allowing:

1. Working at home.
2. Education in the home.
3. Shopping from home.
4. Remote health delivery into the home.
5. Electronic delivery of paperless newspapers, books, and magazines.
6. Electronic money.
7. Reducing the need to travel for necessary tasks in order to reduce society's use of energy.

The major features of this scenario are the introduction of humane technology to allow society to do more with less use of the earth's energy and material resources through the use of future computerized communications technology. Since this scenario assumes a rapid growth in the automation of the processes involved, the need for industrial arts as we know it today could well decline; that is, they indicate that the number of people required in the classical industrial arts areas could decline. However, the professional level of industrial arts could well tend to be elevated beyond a "craft" status, and thus, when coupled with a "non-throwaway" attitude, society could need considerably more people in such "vocational professions" than are required today.

Scenario 4: Potable Water

Americans are consuming fresh water at an alarming rate. It has been estimated that water from underground sources is being used at twice the rate that the normal hydrological cycle can replace it. Other areas of the world, such as Europe, are at a higher rate. At the present rate of increasing consumption, it is projected that Americans will require 700-billion gallons of water per year by 1980. The alarming fact is that only 650-billion gallons may be available.

The normal hydrological cycle cannot operate normally because of the increased amounts of pollutants. Water is being consumed, after purification, before natural recycling can occur. Who are the villains of water pollution as it now exists? The largest offenders are producers of paper, organic chemicals, petroleum products and steel, which represents 65% of the total water pollutants. Municipal wastes, composed primarily of improperly treated sewage, comprises 20% of the total. The remaining 15% comes from agriculture in the form of fertilizers and animal waste.

Most individuals are not aware of the amount of animal waste; for example, one cow is equivalent to 16 people, one hog is equivalent to two people and seven chickens produce as much waste as one person. The runoff from feedlots and other similar factors represents a serious threat to streams and lakes. There is legislation pending for the control of feedlot runoff.

Approximately two-thirds of the United States have enacted water quality regulations of varying degrees. The recent federal government Water Quality Act of 1972 will assist in cleaning up the streams and lakes. Yet, only 20% of the states have laws which regulate antidegradation. Recent development in biodegradable products will greatly enhance water quality.

U. S. industry is using about 20-trillion gallons of water annually. This water is generally not potable, but less than one-third of the discharged water is treated. This, in fact, means that the hydrological cycle is again retarded.

What might it cost to clean up the water in order that the natural cycle can operate adequately and Americans could enjoy sufficient, pure water during the coming decades? A $50-billion price tag has been placed on this monumental task. Of this amount, about $20 billion would be allocated for municipal waste treatment, $15 billion for industrial wastes, $10 billion for municipal storm sewers, $8 billion for agricultural-mining drainage abatement and the remainder for such factors as oil spills, flood control, soil erosion and miscellaneous contaminants.

If the technology, which is presently available, is not employed to halt the decline in water quality what are the alternatives?

1. Water rationing.
2. Restricted Water Use. i.e.,: Use all the water necessary for home or commercial needs. Place irrigation of lawns, gardens, golf courses, washing automobiles on a restricted basis.
3. Multiple Water Lines. i.e.,: Potable water only for human consumption and cooking. A special water line for irrigation, washing cars, toilet bowls, and other such uses which do not require purified water.
4. Closed System. Communities and industries in the arid sections of the U.S. are considering "closed" water systems. In effect, this means that the effluent generated by the municipality and/or industry would be treated and returned to the water mains. The only pure water necessary would be that which was lost within the system by evaporation or not returned to the sewage system.
5. Distillation.

Fortunately, the downward spiral of general water pollution appears to be arrested and indications point to better days ahead. Yet, it will take strong commitment from the citizens, strong laws and enforcement, and continued positive attitudes by all concerned.

Scenario 5: Air Quality

Air quality is poor and is daily becoming more polluted. All one has to do is be in a metropolitan area, industrial area, or similar situation on a calm day and air pollution is visibly evident.

Major metropolitan areas, such as New York, Chicago, Philadelphia, and others, will have difficulty meeting the air-quality standards established by the EPA. The most difficult pollutants to remove will be sulfur oxides and carbon monoxide.

Americans are experiencing an increasing death rate due to respiratory disorders. Lung cancer has increased 2½ times in the last 20 years, and emphysema, which was relatively rare 35 years ago, has increased. In general, deaths from respiratory disorders have increased by 50% over recent years, and are much higher in polluted areas.

Air pollutants are indirectly costing Americans considerable money, even though they do not realize it. Approximately $400/year is expended by an average family for increased health care, deterioration of homes, and deterioration of general material and vegetation. This cost, when computed on a national scale, can run into the billions of dollars.

Other effects, of greater magnitude and longer range, are changes in climate. Some say the climatic changes are normal cycles, while others state they are due to pollutants. Yet, the changes are evident: (1) winter temperatures are climbing, as much as 2 degrees; (2) general cloudiness, fog and precipitation are increasing, as much as 10%; and (3) wind speeds necessary for dispersing pollutants are down, as much as 25%. These changes are most noticeable in metropolitan and highly industrialized areas. One has only to examine the air inversions that have recently occurred in New York and other areas to comprehend the magnitude and immediacy of the situation.

The primary generators of air pollutants are: (1) automobiles; (2) industry; (3) electric-generation plants; and (4) petrochemicals.

Recent EPA regulations regarding auto emissions have and will continue to lower pollutants. However, with the cleaner 1975 models, there are still over 100 million older cars on the nation's highways. Therefore, it will take several years before the "cleaner" automobiles comprise the majority of those in use.

The pollutants caused by other agencies represent an enigma. In order to clean up the "smoke stacks", it is recommended that coal-burning industries convert to natural gas. Yet, it is projected that with known supplies only 12-15 years of natural gas is available. Another suggestion is to convert from coal to fuel oil. The situation is similar; projections regarding oil are that in about 30 to 35 years the last barrel will be pumped. That leaves coal as the only future fossil fuel source of any significance. Experts feel that there may be enough to last for 400 years provided energy demands do not increase significantly.

What then are solutions and alternatives to enhance the air quality of the United States and ultimately the world?

1. Cleaner automobiles.
2. Mass transit.
3. PRT (Personal Rapid Transit Systems).
4. Stronger air pollution laws at all levels — local, state and national.
5. Enforcement of the laws.
6. Non-polluting source of electrical power, such as solar, wind, hydro, tidal, geothermal, etc.
7. A firm commitment of individuals for cleaner air.

Air quality must improve because all are affected. This is not a "*they*" situation, it is an "*I*" because if everyone does not become involved, all will suffer the consequences.

Scenario 6: Population

Population growth may well be the "sleeping giant" that the world will have to contend with in the near future. Granted, population growth has slowed dramatically during recent years in the U.S. and a few other countries, yet the population time bomb is still ticking for the world.

The majority of the world's increase in population has occurred in Asia, Africa, and Latin America, and these countries will continue to be primarily responsible for the population increase during the next 35 years.

The population growth of humans can be explained in a variety of ways, yet when one examines the technological reasons for growth, the situation becomes more visible. Granted there are religious, moral, economic and many other reasons for the growth over the years, however technologically, population growth can be explained by: (1) Medical Developments. In recent years the field of medicine has made rapid advances in all aspects of disease prevention, disease cures, drugs, surgical techniques, life-support systems, life-sustaining systems, transplants, and related areas. A time has been reached in developed nations where a new-born child has a very excellent chance of living to a ripe old age, whereas, in underdeveloped nations, and in ours not too many years ago, infant mortality was extremely high. Today, surgery such as an appendectomy, is considered routine, when only a few years ago it may have been fatal. Just think for a moment of the various surgical procedures, chemical therapy, mechanical devices and physical therapy which allow people to live and be functioning, contributing individuals, who a few years ago would likely have died. The general health is improving and life expectancy is being extended by advancing medical technology. (2) Increased Food Production. Increased food production capability has allowed population growth, especially during the last 100 years. Advances in agricultural technology in areas such as improved seeds, fertilizers, herbicides, pesticides, and machinery have made more food available, yet, population growth is essentially geometric and food production is linear. However, the "stork-passed-the-plow" during the 1950s and now many millions of the world face malnutrition and/or starvation. It now appears to be an unrelenting disparity between food production, its distribution, and population growth. One has only to examine the current situation occurring in India, Bangledesh, Africa, and other starving nations of the world. (3) Improved Sanitation. The developed countries of the world have forgotten about the plagues of Europe that almost wiped out entire countries, the pestilence of infectious diseases which were devastating, dysentery and related disorders which occur because of no or poor sanitary facilities.

The single publication which seems to be responsible for the general awareness of the population problem is Dr. Paul Ehrlich's *The Population Bomb* (1968). Since that publication, literally hundreds of books have been published and countless articles written on the topic.

As Ehrlich (1968, p. 18) states, there is an avalanche of population and growth. Yet, the most significant model to follow may well be population doubling-times.

The population of the world was estimated to be five million in the year 6000 B.C., taking as much as a million years to double. By 1650 A.D., the world's population had grown to 500 million. During this 7650 years the growth was slow, but steady, doubling about every 1000 years. A billion was reached by 1850, or doubling in 200 years. By 1930, or 80 years later, the members had grown to two billion. The world has now reached 4 billion. This represents a doubling-time of roughly 40 years. Projections now place the doubling-rate at 35-40 years.

A doubling-rate at 37 years is also indicated as a 2% growth rate/year. Another interesting statistic regarding percentage growth is to compare developed and underdeveloped countries. The developed countries (DC) are increasing at an average rate of 1%/year while the underdeveloped countries (UDC) are increasing 3%/year. At 1%/year, the doubling-time is about 75 years, where 3%/year is about 25 years.

When examining the future in regard to what might happen, one has only to look at one basic fact. Currently, 40% of the population of the underdeveloped countries of the world is comprised of individuals under 15 years of age. As this massive group reaches its reproductive cycle, there could be the most unbelievable growth the world has ever witnessed. They are the "gunpowder" for the ticking population time bomb (Ehrlich, 1968, p. 28).

It would seem as though the die has been cast. Look around the world — starvation is already at the doorstep. Recently, the leaders of the world met to attempt to solve the situation. However, when facing reality, the immediacy looks bleak, even at best. It appears that the question of *"if"* is now *"when?"*

Ultimately, almost all of the problems of the world, quality of life, consumption, pollution, and whatever one wishes to consider, are drawn directly from population. What then are the action options to this problem? Consider the following:

1. Birth Control.
2. Conception Control.
3. Family Planning.
4. Increased Food and its more Equitable Distribution.
5. Share the "Wealth."
6. Share the "Technology."
7. Realize the Situation.
8. Individual Commitments.

There is one thing certain: population will be controlled. The only question is, "Will man control his own kind or will "Mother Nature?"

MINI-SCENARIOS OF DESIRABLE FUTURES

It is hoped that by the 21st Century the following desirable futures will have been realized, or at least be achievable within a reasonable time frame. When examining the following, consider for a moment the magnitude of the future and the changes that will occur, both physically and attitudinally, by the 21st Century.

1. *Politics.* Politicians have become literate in technology, economics, and societal management relative to the future, rather than "rear-view mirror" leaders, such that we can eliminate pollution, hunger, corruption, discrimination and develop society toward an ideal state of peace, tranquility and leisure.
2. *Leisure.* Individuals, families and groups have matured in their response to increased free-time such that they (1) have lessened consuming non-renewables in their leisure pursuits, (2) are appreciative of a participation in arts and crafts and, (3) have reached the understanding that free-time is a spin-off of an affluent, technological society and are giving abundantly of their time to the social services of the country — i.e., participating citizens.
3. *Transportation.* Americans are now moving from place to place in the least-consumptive fashion possible, by using mass transit systems, more efficient private vehicles, and more importantly, traveling only when necessary — or by replacing the need for energy-intensive and pollution-intensive travel via the expanded use of, for example, telecommunications.
4. *Population.* The United States has achieved Zero Population Growth (ZPG) and other nations of the world realize that ZPG is an attainable goal and are working to that end.
5. *Food.* Hunger is abolished throughout the world. This has been achieved by population control, better distribution technologies; agricultural countries of the world have shared their productivity, and the developed nations have shared their technologies.
6. *Housing.* All citizens of the world are housed in desirably adequate facilities according to their individual needs.
7. *Employment.* All willing and capable Americans are gainfully employed. Those who, for a variety of reasons, are outside the labor force are guaranteed a livable and desirable life-style.
8. *Futures.* Americans are now futures-oriented and have established goals which are attainable and are living a life-

style such that desirable futures will be realized. We have replaced tunnel vision with a more holistic view.

9. *Education.* All Americans are educated to the fullest extent of their capabilities and that education is viewed as a life-long activity.
10. *Violence.* Crime and violence are now controlled such that fear for one's life and possessions have been minimized.
11. *War.* A world Congress has agreed upon peace among all nations.
12. *Energy.* Recently developed sources of energy — solar, geothermal, fusion — insure sufficient energy for all necessary needs.
13. *Waste.* Recycling methods have been perfected and all wastes are converted into useful products or energy.
14. *Design.* The innovators and managers of technological advance are responsible for their actions and they are aware of impacts and are planning accordingly.
15. *Attitude.* We have made a shift in values from those of a basically selfish society to those of a society in which the public interest is becoming a matter of more than rhetorical concern.
16. *Innovation.* The generators and managers of technological innovation have considered flexibility as the most desirable goal and as the most practical attitude for future action. Those technological innovations that leave maximum room for maneuvering in the future should be favored, the reversibility of an action is considered as a benefit; irreversibility a major cost.

FUTURE EDUCATION IMPACTS

Society has now amassed many new visions of possible futures as illustrated by the foregoing scenarios, which demand that education change to meet the needs and expectations that we can now foresee. Some expected impacts on education are:
Futurizing society.

1. Providing a learning environment for students to become literate of possible futures and perceptions of trends, change, alternatives, preferable futures, etc.
2. Producing students who have the capability of visualizing, designing/shaping, planning, and maintaining desirable futures — skills for synthesizing preferable futures.

Humanizing society.

1. Providing an educational system to allow students to learn to make constructive use of leisure time.
2. Raising literacy levels of values (individual and societal) for a future pluralistic world society.
3. Humanizing technology.

Democratizing society.

1. Thomas Jefferson felt that we needed mandatory public education if we desired a democracy which was capable of producing citizens literate enough to tell whether or not politicians were lying. Have we been successful? To achieve this goal education must change and be extended toward a life-long and a real-time (a part of everyday life) process in eras of accelerated change.
2. Developing (and studying) scenarios of preferable democratic futures for each of our institutions (educational, business, technology, health delivery, government, etc.) — in terms of the future.

Life-long learning.

1. Adult education — in an era of accelerated change, obviously the most needed students in future education systems must be the adults — the decision makers and implementers in society.
2. Reversing the trend toward an illiterate and uniformed society — if we plot the trend of education through the years we get a curve that shows that education is continually improving. However, when we plot the knowledge explosion, we arrive at a curve indicating that although we are more literate, we are also less knowledgeable relative to what we need to know — thus, we are now in society which is less and less informed, and less aware of the total environment in which we function.

Non-lock step education.

1. Individualized education.
2. Multiplicity of learning alternatives.

Moving industrial arts education towards forecasting future needs and curriculum changes in order to better prepare students capable of meeting future society needs, rather than only preparing students who are "experts" in coping with the past (the current-present).

To achieve these mandates for future education, obviously it would be far too costly for society to continue to deliver education as we do today and in the past. Thus, to achieve desirable futures by implementing these mandates, education must turn towards the use of technology to automate much of the educational delivery process.

CONCLUSION

Today, society is writing the scenarios, making the decisions, and taking the actions for building the new worlds of the future. Compelling arguments now exist for educational institutions to become involved and to prepare students for their future. The creative use of the past to aid scientifically based forecasts for the purpose of creating more desirable futures must now certainly become a part of the educational process.

There is no doubt in our minds that education will play a key and desirable role in future societies. Part of this role is the shaping of minds in unique ways that can only occur through systematic studies. In doing so, educational systems become part of the social process for shaping the world for the years that lie ahead. Such a role implies considerable responsibility for these institutions for taking society into the future. The modern school is thus challenged by the need to assure both its own future and society's future.

The strengthening of the role of industrial-vocational arts education by adding new dimensions, spurred by the awareness of the future possibilities made visible through scenarios, will allow society to better capitalize on the opportunities offered by the future from emerging technological, social, political and cultural changes, new medias, new needs, and new knowledge. Anyone researching futures can scarcely help becoming tremendously excited about what society can become.

It is true that there are many alternative directions for society and education to go in the future than those outlined in this chapter. Additional research will make many more such alternatives visible.

Alvin Toffler states that the future (concern for and development of) is now everyone's business. Therefore, all of us must now be in the business of making projections, or at least be literate of the process to be able to determine the worth of projections made by others.

The primary purpose of projections into the future is to identify trends and alternatives which are usable for present decisions. Their use is to add to our knowledge base the dimensions of possible futures for the purpose of weighing them with data from the past-present.

When we identify, from projections, a trend to change or a new alternative to implement, we tend to make such forecasts self-fulfilling. In the process, we put the future under our control (from readable signals of possible futures) for bringing about more desirable tomorrows.

Therefore, the primary uses of projections is for establishing policy goals and plans, providing inputs for decisions and designs, and for controlling and managing the future.

Today, most of the projections that society uses are made by experts (professional futurists). However, the users of such projections are the decision makers and doers in society — which encompasses everyone.

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CHAPTER IV

Implications for Education

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The power of futures research is that it provides us means to explore with greater confidence the possible options and consequences for intermediate and long-range planning. For education, an enterprise ultimately concerned about long-range consequences, the value of futures research is self-evident. However, future studies serve us only to the extent that we choose to examine and act on the possible implications derived from them. This choice to act assumes that education is a dynamic enterprise; and that those concerned about education are capable of making decisions in a proactive rather than a reactive mode. Unfortunately, public schooling, the dominant instance of institutionalized education, is not noted for its proactive stance. As several of its critics suggest, school professionals tend to be unaware that a future tense exists. However harsh we may feel that criticism to be, the evidence is growing that schools are not, in far too many ways, meeting the expectations or needs of today, let alone tomorrow. Review of the futurists' literature leads us to believe that education is, and will continue to be, in great trouble if those who make decisions about education choose not to acknowledge the emerging priorities and projections for the near future.

In this chapter we attempt to set forth some implications for education stemming primarily from the discussions in the previous three chapters. We employ a framework of key educational decisions for purposes of translating the discussions about social, technological and biological futures into implications for education in general and schooling in particular. We also attempt to make evident our perspective as we analyze the scenarios and translate them into educational possibilities. The intent is to illustrate both the options and consequences for education by examining these key decision areas. Accordingly, our treatment is not comprehensive of all possibilities. Finally, we attempt to underscore that choices and consequences do and will exist. Whether those who are and will be involved in educational decision-making will make wise decisions is not so much a function of the data that emerge from futures studies as it is a willingness on the part of educational decision makers to explore and act on the possibilities.

KEY EDUCATIONAL DECISION AREAS

Ozbekhan (1974) speaks of three basic types of planning or decision-making; normative, strategic and tactical.

Normative planning reveals what ought to be done. Normative planning determines whether consequences are ultimately "good" or "bad" for the object of planning. It is value and ideal oriented. Educational policy decisions are normative.

Strategic planning determines what can be done in a time framework and with normative direction. Strategic planning translates general policy into specific purposeful activity which is oriented to the achievement or articulated objectives. The many administrative decisions that implement established policies are strategic in nature.

Tactical or Operational Planning implements the decisions that have been formulated at a higher level. Most decisions made by teachers are tactical or operational.

Our attention here is directed toward both normative and strategic educational decision-making. We have selected five key decision areas deemed central in determining the directions and characteristics of future forms of education.

1. How will decisions about education be made?
2. Who will be involved as educational decision-makers?
3. Who will be the clients of educational efforts?
4. What might be the purposes and substance of education?
5. What might be the forms and delivery systems of education?

In the following pages each of these decision areas is defined and discussed. We then offer a synopsis of three scenarios presented by Ryan and Joseph in Chapter III and examine the educational implications of each in terms of these five decision areas.

The translation of data and forecasts about the social, political and technological futures into normative or strategic planning is not simply a matter of logical reduction or extrapolation. The beliefs or values of those who interpret data influence directly the nature of the implications they posit. Carl Rogers and B. F. Skinner would very likely, indeed, have set forth distinctly divergent interpretations of what education should be about in the intermediate range future. The psychological and value constructs of each of these scholars necessarily lead them to interpret the same phenomena differently. Accordingly, you may find that you emerge at a quite different point than we when you take your interpretations of Ryan's and Joseph's three scenarios through the decision framework.

DECISION POINTS

How will decisions about education be made? The models we choose to guide our educational decision making influence directly the nature of the decisions we make. For example, if we use a technical-economic model, our primary criteria will reflect efficiency and cost effectiveness. We will attempt to determine the pay-off of education in such terms as income earned by persons who have completed a given educational program.

Another approach is a rational learning-based model that asserts that educational planning is goal-oriented in terms of behavioral changes in persons. A basic assumption is that we can define in specific and observable terms what is to be learned, match persons with measured learning characteristics with particular activities and materials, and measure the extent to which the person attained the objectives.

A third approach could be called an environmental model. It addresses the problem of creating contexts that are rich in possibilities for human growth. While concerned with learning, this approach is equally committed to providing a quality of life in education that is of worth for humans in the here and now.

Many other approaches could be discussed to illustrate that how we approach making educational decisions is of great consequence. Eisner and Valence (1975) present an excellent analysis of five different approaches to curriculum development that could be adopted as educational decision-making models. These or other approaches are available to the student of the future of schooling. The perspective assumed, however, will affect significantly how we will make our educational decisions.

Who Will Be Involved as Educational Decision-Makers?

Subsumed in this question are more specific ones: To what extent will federal agencies and government be involved? State and/or regional government? The community? Professional organizations? Special interest groups? Students?

There is good reason to believe that a different policy for educational decision-making is and will continue to emerge. A fundamental reason is fiscal — as local monies are less available to meet the growing costs of education, new formulae for state and regional funding are developed. A simplistic yet realistic expectation is that as sources of monies change, power bases will change.

A second source of consideration becomes evident as we witness the occurrence of community control in school decision-making (Fantini, Gittel, and Magat, 1970). While in apparent contradiction of the fiscal-power movement from a local to regional scope, it is very likely that broad-based involvement of community persons will be required in order to receive funding, similar to current guidelines of Model City efforts.

A third major reason for anticipating changes in the make-up of educational decision-making groups is found in the growing power of professional organizations. As bread and butter issues become less and less a central concern, curriculum and instructional matters will receive more and more attention from the professional staff.

Clearly, the nature of educational decisions will be directly influenced by who the decision-makers will be, what they see as priorities and by whom they will be held accountable. As we examine the three scenarios we will explore the implications about who might be involved as educational decision-makers and the possible consequences emerging.

Who Will Be the Clients of Education?

It has been only during the past few decades that we have observed the educational system in the United States attempt to address itself to serving all persons regardless of age, sex, race, class, religion or capacity. While lacking an explicit federal constitutional mandate, we have seen accessibility to education shift from the metaphoric state of "an opportunity" for each person to a right each can expect to be met.

However, to say that all persons have open access to education does not make it so. To what extent will women, in fact, have access to typically male-dominated areas of study such as architecture? To what extent will persons in mental or penal institutions be able to pursue any educational effort? To what extent will adult education continue to grow and reassert the belief that education is a life-long enterprise?

As our clientele become redefined, what are the implications for education? The three scenarios hold different implications as we attempt to respond to these questions.

What Might Be the Purposes and Content of Education?

Because the centrality and meaning of this question is self-evident we see little need to define it further here. That each of the three scenarios posit different directions and substance for education is clear and will be discussed accordingly.

What Might Be the Forms and Delivery Systems of Education?

The decisions within this area revolve around the physical identity of places in which educational efforts are to be housed; the use of time and space; the deployment and organization of people; the use of media, books, instructional technology; and the role of persons typically identified as educators.

In the next section of this chapter we will present our interpretations of the scenarios of possible futures for education in terms of the five decision areas. We encourage you to consider the options and consequences embedded in the discussion not as the way education should or necessarily will be — rather as a catalyst for your own priority setting as an educational decision-maker.

As an aid to help you consider the options and consequences of the three scenarios and their related schooling models, a graphic diagram is presented in Fig. 4-1 that shows the perspective taken in the interpretation of the scenarios. Each scenario is analyzed in reference to the five decision points as they are viewed through the belief screens of the authors. The product of this analysis is a set of implications and consequences.

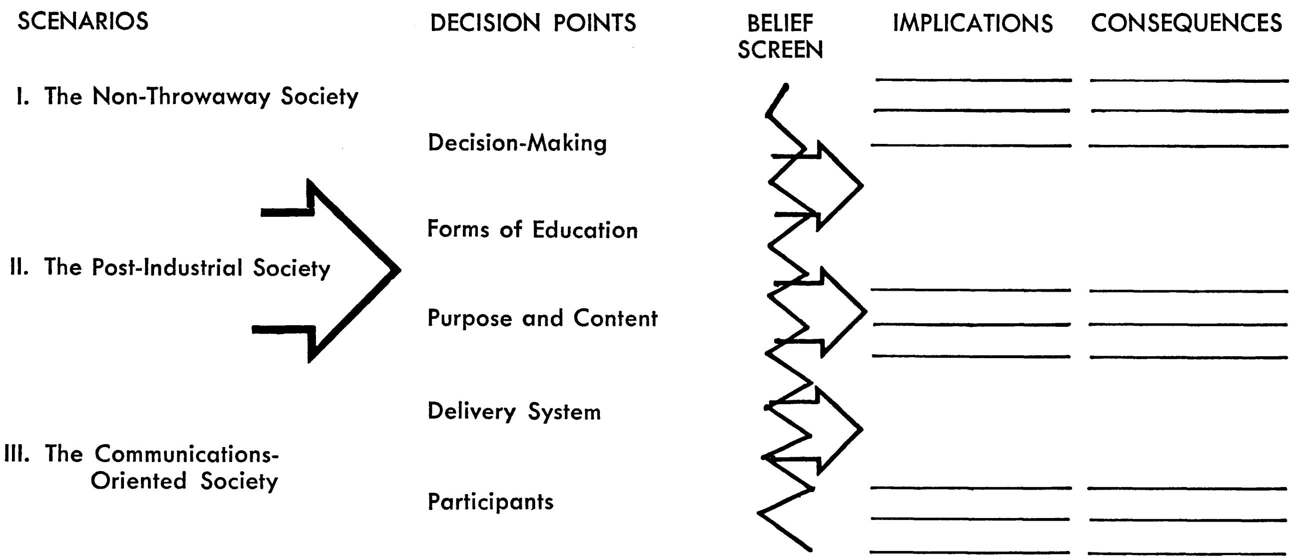

Figure 4-1. The Perspective for Analysis and Interpretation of Scenarios

Prerequisites	*Major Changes*	*Key Elements*	*Implications*
Shift of national thought to internationalism	Large systems planning	Lasting buildings Flexible Adaptive Self-repairable Updatable	Less use of energy and materials
New philosophy of sharing	Stability with flexibility	Products Self-repairing Recyclable Self-cleaning Self-maintaining	More people sharing available materials
	Profit through service not sales	People Self-determined retirement to other productive efforts, Maximizing of resources of minorities, women, et al.	More resources left over for the production of necessities
	Reduction of material wants of those who "have" to share with "have nots"		Change in focus of national and local political concerns
			Amalgam of socio-political systems in the world

Figure 4-2. Scenario I – The Non-Throwaway Society

NON-THROWAWAY SCHOOLING

In Fig. 4-2 is a synopsis of the scenario of the Non-Throwaway Society and some implications for the Non-Throwaway School. The prerequisites, key elements, major changes, implication and consequences for education are identified in outline form. It is within this context that the Non-Throwaway School will exist.

Decision-Making Model

The approach to educational decision-making within a non-throwaway context will be of the rational systems type in which efficiency and reusability will be the prime criteria. Educational decisions will be considered in relation to measurable outcomes, cost effectiveness, and controllability. Specific time-frames will be established and those educational means that bring students to a desired state within the shortest time will be used. A behavioristic prospective on learning is most amenable to this approach and would influence decision-making accordingly. For example, a detailed analysis of concepts and skills will spell out the components and sequence in which they are to be learned — much like a Gagné learning hierarchy, (Gagné, 1965). Overlap of content across curricular areas will be held to a minimum and systematic evaluation will be a constant.

Decision-makers. In the non-throwaway form of education, a major portion of the decisions will necessarily be made at the societal level. Both normative and strategic decisions will be made at national and transnational levels to set direction and establish implementation plans. Decisions will be required at these levels because the ultimate goal of conservation and efficient use of materials will be national and transnational in scope. Community decision-making will be possible only insofar as their decisions fit within and support higher level policy. All other groups known to and including the learners, will answer in some form to the national and possible transnational regulatory body.

Purpose and Content

The purposes and content of non-throwaway education will be derived from the ecological and consequence-oriented goals of society. Knowledge, skills and attitudes related to maximizing the use of materials, recycling and other modes of conservation will be embedded in instructional activities. The basics, reading, writing and mathematics, will not be deemed as critical for meeting our needs. More efficient means of information sharing will be employed that utilize our other senses. Success in schooling, bound now in one's ability to read, will shift to success in learning and living by making greater use of our other human resources. The study of other cultures, nations, economic systems, world food production, etc. will no longer be electives but imperatives as we move away from ethnocentrism toward a world view. Survival techniques will be our consummate concerns as we attempt to meet the basic needs of all persons.

Forms of Education

Schooling will not be thrown away nor will places called schools likely disappear. The physical identity of schools in the non-throwaway society may take several forms as we use the factories, museums, stores and apartment houses as educative environments. Refurbished existing school structures and newly designed ones will be built to last with a minimum amount of maintenance and will be largely self-supporting in terms of energy requirements.

Both internally and externally the structures will be highly flexible allowing for maximum use of space and a resultant increase in efficiency. Serving other populations in addition to youth, the buildings will serve many educative functions; schools will become multi-service in scope with walk-in social, psychological and medical capabilities. A non-throwaway perspective will not allow us to construct or use a building for a single purpose.

Delivery Systems

The most notable change in instruction will be the differentiated modes through which students will have access to the curricula. The inefficiency of total class instruction will give way to a wide array of alternative forms deemed most appropriate for a given student. Data about the student's learning style (i.e. aural, visual, tactile, interactive, independent, etc.) will be used as we help match a student with an instructional approach. A teacher will be less an instructor and more a diagnostician and environmental manager. Group activities will be used only when deemed most efficient for certain types of learning: for example, small group decision-making and problem-solving, developing interpersonal relations, and team or community building activities. Computer-assisted instruction, educational television, and other mediated forms will — to the extent energy resources allow — be a primary medium for the delivery of educational programs.

Students will have access to experts from the field of systems management, ecology, futurology, and technology in person and via media. Much of the input of these individuals will be guided by the stated and desired goals of the envisioned society.

Non-throwaway schooling will be characterized by a behavioristic orientation and ends-means perspective for planning and knowledge, skills and attitudes directed toward survival of all people throughout the world. Efficiency will remain the prime criterion for all decision-making.

Mastery of basic skills and knowledge will replace the time spent in a grade as a criterion. We will not require each person to spend 180 days in a grade to "cover" a given subject, rather each will proceed toward mastery and once attained will move on to new arenas. Again, efficient use of educational methods will be both the medium and the message.

Educational Participants

Learners of all ages, but primarily young students, will be taught by experienced and trained personnel. Much of the knowledge and skills for a conservationism-oriented school will go beyond the realm of the typical teacher and will require the input of experts in diverse fields that are related to a non-throwaway system.

POST-INDUSTRIAL SCHOOLING

An overview of the scenario of the post-industrial society is presented in Fig. 4-3. Major prerequisites, key elements, major changes and implications are identified and described in outline form to set the context for post-industrial schooling.

Decision-Making Model

Possibilities for a neo-romantic era in education are sparked by the post-industrial scenario. With the human search for meaning and expression no longer controlled by the work-related identity of a person, and with knowledge moving toward a holistic and interrelated posture, the approach to educational decision-

Prerequisites	*Key Elements*	*Major Changes*	*Implications*
Change in prevailing thought from mechanistic and reductionism to synthesis and synergistic thinking	Increase in automation Less physical labor More free time More leisure	Increased automation of Production Operations Material handling Information handling Management control	New forms of specialization
	Change in work roles Less monotonous work Move away from traditional crafts	Change in the concept of work	Higher levels of vocational training required
	Increased importance of information More jobs involved in handling information World-wide sharing of information	Quick obsolescence of work and jobs	Life-long learning
		Multiple careers and retraining in individual's work life	Leisure becoming more important than work

Figure 4-3. Scenario II – The Post-Industrial Society

making will be in stark contrast to contemporary practices. Having met the basic survival and maintenance needs of all people, self-actualization needs will be of paramount influence as we choose what is to be learned, how, when and under what conditions. The research and theories of perceptual and existential psychology promoted by Maslow, Rogers, Combs, et al, will be used to justify strategic decisions. Existential thought will serve decision-makers at the normative level as they set directions and generate policies within various educative agencies.

An ends-means rationality will not be as dominant as currently experienced. Rather, a more heuristic model for educational decision-making will emerge that allows more options, multiple entry points in systems, and goal-free rather than goal-based evaluation systems.

Decision-Makers

While state and national policy making will be needed in order to provide funding for educational agencies, more normative and all strategic decisions will be made at the local and personal level. Access to a multiplicity of educative settings will reinforce the decision-making or choice-making of each person. Self-constructed curricula will be the mode.

Forms of Education

Variety will be the theme in post-industrial forms of education. While places called schools will exist, schooling as a socialization process will not. Since group instruction of 25-45 persons at a time will be inconsistent with an existential posture, the egg-crate design for schools will be disfunctional. Special forms will reflect the need for computerized instruction, small group dialogue, problem-solving, and simulations of inaccessible phenomena that allow for multidisciplinary inquiry such as a mini-Indian village accurately portrayed. Computerized instructional capability will focus on drill, information retrieval and problem-solving strategies that in turn free "teachers" to function as active participants in the inquiry with "students." Grades will be unnecessary — how do you grade a person's own becoming? Time considerations will assume a different form as education will be a lifetime enterprise, intertwined and indiscernible from living.

Purposes and Content

Content and purposes of the post-industrial school will reflect the influences of cybernetics, systems management and futurics. Emphasis will move away from an analysis of parts to synthesis of part-whole relationships. Personal and societal value clarification will emerge as greater attention is given to the humanities.

Both content and purposes will deal with an increase of choice-making on the part of students and teachers. A major theme will be with providing options and alternatives from which specific selections can be made; choice-making will be seen as a set of skills to be acquired and a purpose to be attained. Rather than reading, mathematics, science, social sciences, languages, etc., as separate entities, an interrelated curriculum will be present. Focusing more on the why and how rather than what, who and when, the programs will be directed toward personal knowing rather than accumulating culture.

Delivery System

Instructional programs will be interdisciplinary and multidisciplinary. Emphasis will be given to methods, equipment and settings that show how different fields of knowledge fit together. Basics will not be treated atomistically as is done now (with reading, for example, being defined as hundreds of separate skills). Basics will be integrated with other studies, with computers being a supportive instructional means.

Educational Participants

Besides the standard participants of student, teacher, curriculum worker, administrator and community representatives, one participant stands out significantly in this school. The teacher agent as a machine-oriented educational technology form will be pervasive throughout. These machine and media teacher agents will have the capability to take over many of the rote duties performed by teachers just as the machine counterparts of these machines took over the rote duties of the production worker and data handler.

New found time and a desire for meaningful work will bring participants into the schools from groups of individuals not directly involved with the production of goods and services. Some of these individuals will be between jobs, others will have officially reached the age of retirement, which will increasingly approach fifty years of age for many individuals.

Major characteristics of post-industrial schooling will be portrayed as a dual focus on the individual in the process of becoming and on knowledge as personal knowledge rather than a cultural accumulation. Planning will assume an option oriented perspective to deliver a goal-free heuristic setting in the personal search for meaning. Educational decision-making will be directed by the concern for supporting personal choice-making.

COMMUNICATION-ORIENTED SCHOOLING

The scenario of the communication revolution extrapolated society is presented in Figure 4-4. An outline of some of the prerequisites, key elements, major changes, and implications are described to set the context within which this form of schooling will be found.

Decision-Making Model

No particular approach to educational decision-making is embedded in the communications scenario. A very rational ends-means model could apply as readily as a heuristic model. With access to vast information resources at one's fingertips, the criteria for choosing what to focus on becomes a matter of concern to individual students.

Decision-Makers

The information retrieval and dissemination capabilities of a communications-oriented educational system will allow decision-making at all levels. Of particular import will be the decision-making potential at the individual student level. The wealth of available data in forms appropriate for student learning will provide a wide range of unique student-determined objectives.

Individual students will be able to determine specific knowledge related goals that they desire to pursue and achieve. Thus, the student could make both the normative and strategic decisions in relation to information utilization. How to catalogue and retrieve information becomes a national and transnational strategic problem. Who will have access to what information and why emerges as a basic normative decision to be made at the broadest level of concerns.

Prerequisites	*Key Elements*	*Major Changes*	*Implications*
Individual independence	Increased information flow Electronic newspapers Electronic books World-wide communications	Increased home-centered activities	World-wide awareness Demand for decision-making involvement Less travel — less use of energy Increased contact with people of the world Increased detachment via electronic substitutes
Acceptance of diversity	Extension of use of information Electronic money Electronic business transactions Transmitted education	Expansion of individual capability by intelligence amplification	
Acceptance of education as worthwhile substitute for work	Individual-oriented information system Shopping at home Working at home Learning at home Remote health delivery	Increased importance of use and understanding of the concept of "symbol"	

Figure 4-4. – Scenario III – The Communications-Based Society

Forms of Education

Communications-oriented schools will not be like those we now know. Decentralization with a move away from schools as buildings or specific places will be evident. Varying degrees of home-based learnings will also be found. The variations will depend largely on the style and desires of the individual learner. Sophisticated, on-person technology, that may well be worn as an article of clothing, will allow individuals to find those places most conducive to learning for them.

The major forms of schooling in this model will be electronics oriented. Printed forms will be used less and less as they are found to be less suitable to transmission. Information transmission that bypasses the standard senses will be in use and will allow for massive direct consumption of information by individual students.

Purposes and Content

Purposes and content will be marked by diversity. Individually oriented programs of learning will follow, to a large extent, the desires of the student. Individual interest supported by available and usable knowledge on a massive scale will do little to generate similar experiences and overlapping studies. Consequently, highly egocentric patterns of learning and knowledge accumulation will evolve.

By the sheer weight of the information system, knowledge of an informational type will be paramount. Knowledge of an effective and manipulative nature will assume a secondary role.

Delivery System

As described above the delivery system of this form of schooling will be electronically sophisticated technology of impressive capabilities. The maturation achieved by that time, with the resultant minimal requirements for power, will allow information receiving and sending devices to be installed almost anywhere. On-person systems, integrated into watches, clothes or built into the individual's body to include visual displays that bypass the eyes, will become common.

Two-way transmission systems will allow individuals to receive data from central sources and at the same time will extract data concerning learning rate and interest from the individual. The system will be able to detect the unusually gifted early in life. Such a system will maximize the knowledge of identified geniuses by recording and making their thoughts available beyond their lifetime. With a built-in translation capability it would be of little matter if the mother languages were different between the learner and a participating genius.

Educational Participants

As in the participants of the post-industrial model, the teacher-agent (in the form of the components of the communication system) will be an active participant in this communication-oriented school. Additionally, the individual student will also be a primary participant. The final selection of specific activities from a wide range of possibilities will reside with the learner. Consequently, with the reduction in the importance of the teacher, the learner assumes even more power in making decisions about what will be learned.

Other anonymous individuals will be participants. Researchers, script writers, and programers will be active in providing knowledge in usable forms for students. Although these participants may be remote from the learner in a geographic sense, from an impact perspective they could be viewed as in direct contact with the individual. Participants, such as teachers and administrators at the local level, may well lose much of their impact in this school model.

The nature of communication-oriented schooling will depend almost entirely on the perspective taken on the function and purposes of communications. If communication is viewed narrowly as an end in itself, then schooling will be seen as symbolic experience and symbol acquisition. If, however, communications is seen as a means rather than an end, then the potential of this form of schooling may well be unlimited. Educational decision-making will be hampered, if not made inoperative, when the ultimate values of the envisioned and desired society are articulated as direction-setting purposes.

POSSIBLE CONSEQUENCES OF THE THREE MODELS

In this section we discuss and, to some extent, compare possible consequences of instituting the Non-Throwaway, the Post-Industrial and the Communications-Based Models. We will explore both the intended and unintended consequences of establishing such models.

Non-Throwaway Schooling

The uniqueness of this model is that it has an over-reaching mission that goes well beyond educating its clientele. That mission is instituting a life-style in the society within which it exists. For purposes of discussion, it will be assumed that a system of schooling attaining the non-throwaway goals could, in fact, be implemented although some persons question the capability of schools to attain such a system. (Derr, 1973).

The following are some of the consequences that might emerge from establishing such a model:

1. There will, by necessity, be a change in the emphasis from competition to cooperation with resultant changes in grading practices, recognition based primarly on individual accomplishment, and a reassessment of practices of the free enterprise system and the capitalistic society.
2. There will be a change in the focus of content which reflects more concern for the world condition and seeks to raise awareness about individual rights and the rights of other countries with resultant rethinking of the problems of nationalism versus transnationalism, consumption versus conservation, and sole ownership versus societal proprietorship.
3. There will be increased sophistication and complexity involved in the design and development of buildings, equipment and instructional materials with a concurrent demand for more and higher quality of facility design and program development.
4. There will be increased attention to the primary goal of conservation with a resultant lessening of attention given to other concerns and purposes such as mathematics.

Post-Industrial Education

The uniqueness of this model is that it is multipurpose in the sense that it must simultaneously implement complex and potentially conflicting goals. Schooling in the post-industrial society, for example, will have to pursue goals related to increased specialization of job preparation while at the same time prepare individuals for leisure-oriented living.

1. There will be continued increases in the role, responsibilities and performance of teachers. This will result in demand for

(1) more training of teachers that goes beyond subject specilization, (2) more flexibility and resiliency, and (3) brighter people to work in schooling endeavors.

2. There will be major shifts in the role of work, the forms of work, and the importance of work with resultant changes in roles that schooling will play in (1) preparation of highly specialized workers, (2) preparation of individuals for leisure-oriented lives, (3) accommodation of workers to prepare for new work or leisure roles, and (4) accommodation of those individuals who find work an indispensable part of their lives.
3. There will be world-wide sharing of information with resultant increased dissatisfaction of have-not countries and individuals over the disparity of their own lot with that of the haves. There will also be conflict between the competition mode with its attendant high production and resource consumption — and the need for international sharing, interdependence and conservation in order for all to survive.
4. There will be increased importance in synergistic and synthesis oriented thinking with a resultant increase of activities of schooling designed to develop these higher order types of thinking on the part of students.

Communications-based Schooling

The uniqueness of this model is that it operates with a high degree of individual independence and consequently lacks specific purpose direction. The multiplicity of potential purposes coupled with individual learner choices of purposes, in essence, make this model purposeless, in the sense that anything goes and nothing receives major priority. The following are some of the consequences that might emerge from establishing such a model of schooling.

1. There will be increased individual selection of what will be learned as well as where, when, and how it will be learned, with a possible demise in schooling as we now know it. This will be represented by a move away from centralized buildings and organization of resources, and an increase of individually controlled information-providing devices. This in turn will result in capability of brain-wave monitoring and

direct data input to the brain and an attendant increased concern about machine-controlled and big-brother society.

2. There will be continued growth in electronic media with a resultant increase in the importance of the symbol. The symbol will result in reforming reality and will take on a reality of its own à la McLuhan. Schooling will also become more symbol-oriented to prepare learners to deal with this important building block of communications and education.
3. There will be increased sophistication of data transmission to include three-dimensional forms, data for the senses other than sight and hearing such as feelings, both tactile and emotional, with a resultant increase in vicarious experience. Simultations for reconstructions of environments will lead to a decrease in travel but an increase in long-range and indirect contact with people in other lands and other times.

Comparison of the Schooling Models

In all three of the models described above, there are specific recurring similarities: the increased importance of teaching, achievement of higher level thinking and problem solving skills, the increased importance of human relations and communication skills, and the increased importance of leisure.

The major differences between the three models are related to the purposes of each. The non-throwaway model is single purpose or at least has one paramount purpose. The post-industrial model is multipurpose with many ambiguous and conflicting purposes competing for attention. The communications-based model, having many potential purposes but no set purposes, could be termed purposeless.

Normative and strategic types of decision-making vary across the three models in terms of who will have the responsibility for making those decisions. For example, in the non-throwaway model, purpose decisions must be made at the transnational level. These same decisions of purpose for the post-industrial model will most likely be made at the organizational level and lower. In the communications-oriented model, purpose decision-making could emerge at any or all levels; the societal, the organizational or the individual.

Although the above represents an oversimplification of what each model might be about, these descriptions help underscore what these forms might become. It is understood, therefore, that a pure version of any of the three models is quite unlikely. Rather some conglomeration of facets from all three will most likely occur in the future.

SUMMARY

Undergirding the thoughts presented in this chapter is our perspective that planned change is mandatory if schooling is to survive in any productive form. Planned change places high value on decision-making, articulated values, usable data, and considered possibilities and consequences. Our look at some possible future forms of schooling has been tempered and directed by these concerns. Because of the centrality of decision-making to action-taking, we have interpreted three scenarios presented in an earlier chapter in terms of five decision points that deal with how decisions are made, who will make the decisions, who will be the clientele of schooling, what might be the purposes of content, and what might be the delivery systems and forms of schooling.

We underscore again the important position which one's beliefs and values play both in interpreting what might be the nature of schooling in the future and in determining what decisions one will make about schooling. Consequently, it is understandable that your own beliefs of what this society should become and the values you hold will lead you to interpret differently the data included in the three scenarios.

For example, if one assumes that capitalism will persist, then world-wide sharing and the non-throwaway model and, to a large extent, the post-industrial model will be unattainable. Another type of assumption, namely that the potential of control embedded in the communicated-oriented model, may lead us to decide that the potential consequences are far more peril laden than we care to consider. Consequently, although such a model could be implemented, the probable consequences persuade us that it ought not be.

Differences in interpretation are to be expected and desired for it is these differences that dictate options and choices. In all cases, however, the final consideration becomes the consequence of the proposed choices and actions. Future studies can be of considerable service to us only to the extent that we choose to *examine* and *act* on the possible implications derived and consequences emerging from those studies.

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CHAPTER V

Implications for Industrial Arts

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To foresee future objective alternatives and to be able by deliberation to choose one of them and thereby weigh its chance in the struggle for future existence, measures our freedom. It is assumed sometimes that if it can be shown that deliberation determines choice and deliberation is determined by character and conditions, there is no freedom. This is like saying that because a flower comes from root and stem it cannot bear fruit. The question is not what are the antecedents of deliberation and choice, but what are their consequences. What do they do that is distinctive? The answer is that they give us the control of future possibilities which is open to us. And this control is the crux of our freedom. Without it we are pushed from behind. With it we walk in the light.

John Dewey

INTRODUCTION

At the time when this yearbook is being written, the study of the future, or futurology, is at a very early stage of development. Even though educators have given attention to providing experiences which will enable students to be more self-sustaining, our education system lags far behind the rationale suggested by futuristic thinking. We have been groping through crisis after crisis, seemingly trying to keep pace with the past. The temporal lag has left education with cumulative tensions and irrelevant curricula. The field of industrial arts has not escaped this seemingly insurmountable problem.

Any book which deals with the future involves itself in expectations. What follows in this chapter is not a step-by-step procedure for forcing industrial arts teachers into a futuristic mode of doing. It will hopefully, provide the profession with options for the future. The preceding chapters have called attention to the need for the industrial arts profession to consider future alternatives. A cursory review of these chapters reveals that not only industrial arts education, but literally every discipline, must make radical changes in order to cope with the inevitable future. The five questions posed in Chapter IV are also relevant for industrial arts.

The prologue raised the question of "Will industrial arts exist during the year 2000?" To many this question may seem superfluous or threatening to a discipline which has made so many vital contributions to education throughout the decades of its existence. Those who feel threatened by futuristic data must ask themselves two fundamental questions. These questions are not new, only the context in which they are asked is new. Number one is "For what type of society are you preparing the children you teach?" Number two is, "What contribution is your program making toward that end?" In 1973 there were over 45 million students in the public school in grades K-12. Of this amount, 31 million were in grades K-8 (National Center for Education Statistics, p. 1). In the year 2000 these youngsters will range in age from 30 to 40 years. By today's standards these are the prime productive years of a person's life. As the technical knowledge doubles every decade, it is obvious that today's tools will not meet the needs of tomorrow's world.

The new discipline of futurology – a term created by Ossip K. Flechtheim – has erased the concept of linear growth and provided new options for humankind. Futurology creates new options for the educational system also. Hawthorne and Todd (Chapter IV) have illustrated several options worthy of consideration. No longer can the discipline of industrial arts disregard the information provided by the futurist movement.

In defense of the field of industrial arts, it is interesting to note that the profession did respond to the challenge of futurism shortly after it became popular in the 1960's. Monograph 3 of the ACIATE, for example was devoted to *Teacher Competencies for the Cybernated Age*. The 20th Yearbook of the ACIATE specifically called for a look at the future. Streichler and Ray in that yearbook stated that the determination of industrial arts content should not be rooted in the past, but should develop fresh green stems to search out needs, tools, patterns of thoughts, and future-oriented values (Ray, pp. 27-28). Monograph 5 of the ACIATE was devoted entirely to the future and probably represents the first comprehensive overview of the impact of the future on industrial arts (Lauda and Smalley). It appears, however, that it was the 33rd AIAA convention which prompted our profession to look consciously toward futures research. At that convention it was suggested that the ACIATE establish a committee on the future (Hahn, p. 24). Such a committee was formed and is still active within the profession. It was the leadership of these people that generated the yearbook you are now reading.

This chapter is integrated by a number of fundamental assumptions. These are:

1. That the cumulative impact of rapid technological growth has had and will continue to have serious implications for all basic institutions and society.
2. That a human can intervene and influence the course of events which affect his life.
3. That today's youth do not have a "future-focused role image."
4. That institutions are organized to maximize the probability of their survival. It is likely, therefore, that formal educational institutions will exist through the next generation.
5. That students utilizing the methodology of the futurist movement will find their experiences meaningful and practical. These experiences will be beneficial in developing a future outlook.
6. That the discipline of industrial arts can make a vital contribution to the preparation of students for the future.
7. That if humankind does not consider alternatives to the future, it will become a continuation and reproduction of the present, and largely unpredictable.
8. Since the future is technologically based, the discipline of industrial arts is in an opportune position to be a prime mode of the futuristic movement.

The authors are in agreement also with the assumptions made by Alvin Toffler in his book *Learning for Tomorrow* (1974, pp. xxiv-xxv):

1. Today's schools and universities are too past and present bound.

2. Technological and social change is (sic) outracing the educational system, and social reality is transforming itself more rapidly than our educational images of that reality.
3. The concept of the future is closely bound up with the motivation of the learner and our failure to recognize this paralyzes our programs and mutilates our children.
4. The future is not merely a "subject" but a perspective as well, and in urging its introduction into learning, they are also arguing for a new organization of knowledge.
5. A focus on the future is relevant to all learners, regardless of age.

With these assumptions in mind, implications for industrial arts education have been derived. Undoubtedly, certain biases will accrue in the statements that follow but hopefully, once in writing, the material will serve as a basis for professional discussion and debate. The reader is encouraged to continue to the final chapter and learn of the vast array of resources available for the derivation of the implications and the study of the future.

IMPLICATIONS

Before attempting to state implications for industrial arts education, one must first come to grips with the place of industrial arts in the educational system. A number of professional educators have suggested that this area of study should not be a part of the educational system if the current philosophical thrust is maintained. This thrust can be described best as the "study of American industry." For years this philosophy has provided the curriculum base for industrial arts in the public schools. However, current knowledge about our technological society mandates that change is needed, perhaps drastic change. A philosophical myopia could cause the demise of the discipline.

It is difficult to argue with Daniel Bell's (1968, p. 4) proposition that the primary variable affecting society today is *technology*. Bertrand de Jouvenel (1966, p. 33) refuses to think of technological progress as the *cause* of change but thinks of it as the chief *means* of such change. Technology multiplies the number of possibilities for mastering nature and transforming resources, time, and space. Joseph and Ryan (Ch. III) have called attention to the fact that millionfold technological advance in cybernetic technology during the next 20 to 30 years can be expected. This will bring with it a multiplicity of crises and opportunities and will mandate changes in lifestyles. Assisting humans to live satisfying lives within the context of a highly technological society is the role of education. Every human has the right and even a responsibility to respond to the future by intensifying his planning and elaborating his alternatives, even at the expense of the present. To believe that time, without planned change, will take care of our societal problems, is sheer nonsense.

Since our educational process is an enculturation process, we cannot escape the responsibility of delving into a study of technology. By its very nature technology is multidisciplinary. No discipline can remain unscathed by the concepts inherent in a study of the technological society. Industrial arts education, as an integral part of the public schools cannot remain aloof from the evident trends. The enculturation process should assist students with identifying their self-image for today and tomorrow. Singer (Toffler, 1974, p. 21) has referred to the fact that identity and time perspectives are derived from the social system in which one exisits. The resultant role, conditioned by time, can be called the "Future-Focused Role Image." The FFRI is one's self-image projected into the future. It lends meaning to much of what we do in the present. Children constantly fantasize future roles which are linked to aspirations for future living. However, without relevant data about the future, these feelings may be totally unrealistic. As a result, the child finds that his/her concept of the real world was not real at all, or at best, relevant only for the present. For example, preparing youngsters for future occupations may be an exercise in futility since 75% of the occupations of the 21st century have not yet been conceived. If we provide training for the present, the student has no other choice but to make compromises in the future for survival.

Unfortunately, what has emerged from most disciplines is outdated curricula linked to the past rather than the future. The discipline of industrial arts has not escaped this dilemma. At the same time, however, industrial arts is in an opportune position to alter its philosophical thrust and meet the challenge of a technological society. The goal of this chapter was to determine the implications which the study of the future has for industrial arts education. Perhaps these implications, together with supporting rationale, will provide direction for educators committed to providing appropriate educational experiences.

Implication Number 1

If industrial arts is to contribute to the study of the future, then the most appropriate discipline base is the study of technology.

One overriding theme permeates each chapter of this yearbook. We live in a technological society. Reference is made by the previous authors to the post-industrial society, the cybernetic era, the leisure age and similar concepts. The writers continually reiterate the plea for the profession to re-examine its discipline base. This re-examination most assuredly will lead to a discussion of the technological society.

Indeed, technology is a part of all cultures. It is not a natural phenomena since it exists only where humans have developed it. Although it existed in primitive cultures, the beginning of technology as we know it today had it roots in the 18th century. During this era tools and techniques were the main elements of economic growth. This growth was initiated by the development of large industries, especially in the last twenty years. Industrial arts education capitalized on this phenomena and generated a viable curriculum for *that period.* The "interpretation of American industry" theme became the focal point for most curriculum projects.

Since the 1950's, a period of time which the authors call the modern technology period, the accumulation of scientific data and innovation launched society into a totally new system of thinking and doing. New products and new principles were the result of the systematic and purposeful collection and synthesization of organized information. This manipulation of knowledge became the dominant resource for continued technological growth. It is no wonder that many writers refer to workers today as *knowledge workers* as contrasted to production workers. Likewise the term *knowledge industries* has entered our vocabulary. Knowledge has become the foundation for productivity in many societies throughout the world. The human has become dependent upon accumulated knowledge and resources. This dependence relies on three critical elements(Drucker, pp. 345-346):

1. The collection and organization of existing knowledge.
2. Systematic analysis of the knowledge.
3. Publication of the knowledge.

This brings us to the concept of the post-industrial society which was mentioned by previous authors. The concept *post-in-*

dustrial society emphasizes the centrality of theoretical knowledge as the axis around which new technology, economic growth and stratification of society will be organized (Bell, 1973, p. 112). This concept deals with changes in our social structure, the transformation of the economy, changing occupational patterns and new relationships among the disciplines.

Since this concept is so complex and has so many significant implications for industrial arts education, five components are identified below:

1. *Economic sector*: change from a goods-producing to a service economy.
   Today the United States is the only nation in the world in which the service sector accounts for more than half the total employment and more than half the GNP. It is the first service economy, the first nation in which the major portion of the population is engaged in neither agrarian nor industrial pursuits. Today about 60% of the United States labor force is engaged in services; by 1980, the figure will have risen to 70%.
2. *Occupational distribution*: pre-eminence of the professional and technical class.
   In the United States, by 1956, the number of white-collar workers, for the first time in the history of industrial civilization outnumbered the blue collar workers by more than five to four.
3. *Axial principle*: the centrality of theoretical knowledge as the source of innovation and of policy formation for the society.
   The advances in society become increasingly dependent upon the primacy of theoretical work. The university, research organizations and intellectual institutions, where theoretical knowledge is codified and enriched, become the axial structure of the emergent society.
4. *Future orientation*: the control of technology and technology assessment.
   Technological advance has deleterious side effects in many instances with second-order and third-order consequences that are often overlooked. The mechanisms for control are available and feasible. What is required is a political mechanism which will establish regulation of the new technologies.
5. *Decision-making:* the creation of a new "intellectual technology."
   Intellectual technology is the substitution of algorithms (problem-solving rules) for intuitive judgments. Today these may be embodied in a computer program or similar retrieval systems. The desirable action is a strategy that leads to the optimal solution i.e., one which either maximizes the outcome or, tries to minimize the losses (Bell, 1973, pp. 14-31).

It is evident from this information that work in the future will be knowledge based. The productivity of the employees will be knowledge based. The productivity of the employees will depend upon their ability to utilize concepts, ideas, theories and to synthesize data. Such skills will be gained through new and unique forms of education, rather than through the interpretation of industry approach or through apprenticeships.

The industrial arts profession is in an opportune position to make this transition from the study of American industry to the study of technology. Industrial arts is a well-established discipline in the schools of America. However, at this time the profession is only remotely involved with the study of technology. The study of technology requires not only the study of materials, processes, and their use, but also must include implications for the social and technical systems of the future. The authors do not want to minimize the task that lies ahead once such a study of technology is accepted as the base. Moving into current and future technologies will require drastic changes in the structure and content of industrial arts education.

It is recommended that industrial arts focus on the study of technology. Implied is the study of the technical and socio-cultural elements of our present and future technological society.

Implication Number 2

The name industrial arts is no longer a valid description of a discipline involved in the study of technology.

The name industrial arts has been current for over 70 years and represents that area of general education which deals with interpreting our industrial society. Throughout that period practitioners in the discipline have strengthened the stature of industrial arts through research and practical application. The 1960's produced a large number of funded research projects which made significant contributions to industrial arts education. It would be difficult, if not impossible, to refute *in toto* any single research project undertaken. Yet, as society moves into the post-industrial era, it is time to reassess the discipline base and to determine whether or not the field of industrial arts education is facing the challenge of technological reality.

It was suggested in the prologue of this yearbook that a new name should be created for the educational area known as "industrial arts." Reference was made to our profession which seeks to interpret the many aspects of technology and the post-industrial society. This same plea was made in 1973 (DeVore, p. 484) at which time a new name was suggested for the American Industrial Arts Association. The name technology education is most appropriate based on the data presented in support of implication number one.

The term industrial with arts implies the study of the arts and crafts of industry. The continued use of the term industrial arts disregards the fact that our society is now moving into the post-industrial era. In Chapters III and IV the authors note that the post-industrial revolution is based on knowledge and that automated and cybernated systems now produce most of the goods and services. To dwell on the production of "things," as the sole instructional content, limits the contribution of industrial arts to the education of young men and women for the future and ignores the present and future realities.

The term "technology" is used in everyday conversation with many interpretations. It has been popularized by such people as Alvin Toffler and almost every form of media. Members of the industrial arts profession utilize the term repeatedly in their writings. The term is not totally new. Therefore, utilizing it to bring a field of education into line with cultural reality should not create a serious problem.

It is recommended that the industrial arts profession change its name to technology education to reflect cultural reality.

Implication Number 3

The discipline of technology education must change its content and structure to reflect our technological society.

In a period of history when technology has created rapid social change, it is ironic that curriculum change in industrial arts has been almost nil. Too many educators consider the past, present and future as synonymous. These individuals view change as unnecessary. However, for people living in a period of constant change such as that of the present, the future promises to be different from the past and immediate present. In some cases, change is coming so fast that even the present seems to lose reality. One thing can be assured. The status quo will not endure and historically never has. Herein lies the opportunity for technology education. The prime factor in altering the present is technology which was the base for the industrial society of the past and will be the basis for the post-industrial era of the future.

In the past industrial arts education made a significant contribution to the education of young men and women. The relationship of the industrial arts curriculum to the society of the past was compatible. Not so today. A significant gap exists. If one were to construct a profile of the typical industrial arts curriculum of today and compare it with the society of today the mismatch would be evident. Yet, there seems to be no other subject in the public schools better prepared to engage the study of technology than is industrial arts.

Historically the record is positive. Industrial arts has adapted to past challenges and can do so now. One need only review the names used to describe the field in the past to note that change has been accepted, that the field of education known as industrial arts has changed over time, not only in name but in scope, sequence, and content.

Today analysis of the evidence favors not only a name change but curricular change as well. Once our profession accepts the *study of technology* as its discipline base, it has no other alternative but to up-date its content to reflect the realities of the present and the future. The study of technology, as an organized body of knowledge, can aid in the solution of significant problems of human-kind and society.

What knowledge is of most worth, in the final analysis, is that which has potential for future application. Determining that which will have future applicability is difficult. Opinions regarding developments in the technologies are often confusing and contradictory. The efforts in the field of industrial arts are no exception to this dilemma. DeVore put it this way:

> The continual devlopment of technology has resulted also in an increasing tendency toward specialization with the resulting loss of communication among practitioners in education attempting to derive meaningful curricula. This occurs at a time when the growing complexity of technology and education requires the cooperation of larger groups or teams composed of multifarious specialists on a regional, national or even inter-

national basis. As teachers in the technologies meet to consider curriculum problems, the lack of a common frame of reference with respect to content and knowledge structure is apparent. It is recognized that change is necessary. However, lacking is a common base established upon agreed and verifiable principles (1972, p. 28).

The fact that content has been handed down through the years does not necessarily make it valid for today or tomorrow. The new technologies are continually altering many of the concepts valid just a few years ago. Utilization of out-dated concepts distorts one's perspective of the present and alters the potential of the future becoming a viable period of history.

Content in any discipline should be congruent with the future and should involve knowledge for use rather than possession. Education for living inalternative futures should emphasize how to use what one has learned. Therefore, the learner himself should become a resource.

Most writers who discuss education and the future are of the opinion that it is possible to identify content which represents the present and the future. The study of technology does have an identifiable body of content. The most common approach for such identification is to identify broad themes that permeate the global society. Previous writers in this yearbook have challenged the profession by identifying central themes (i.e., post-industrial society, communications, revolution, throwaway society), themes which suggest alternative content and structure for the industrial arts curricula of today and tomorrow.

Many writers begin their efforts by identifying issues brought about by the technology. The reader is encouraged to investigate many of these ideas. Futuristic writers suggested include: Flechtheim, Bell, and Shane. In all cases students of the future have identified a number of central themes as viable areas for study. They are viable because they had had and will have a tremendous impact upon the present and the future of every human. They are viable for our profession because they are affected by and will affect the developing technologies. A number of these major themes are indicated below:

Global View. While occupying themselves with the study of American industry, practitioners in the field of industrial arts have lost sight of the fact that technology, as developed by man today, has provided man with the means to create global systems. The goal of a technological society should be to achieve global harmony and maintain a survival mode. These are critical issues which must be faced if this is the goal. One is the issue of "finite resources and infinite demands." As the earth reaches the level of population density when natural resources disappear, critical decisions will be required if survival is to be guaranteed. Education then has a crucial role to play. All students must have the opportunity to study the term interdependence in three areas. These are:

1. *Technological interdependence*: Today the new technologies used in any country originate more and more outside of that country. Buying and selling technology throughout the world has become big business. This has given rise to a new concept, the "technological balance of payments." Interestingly, the most technologically advanced countries are the biggest importers of technology.
   Two other concepts that are intrinsically a part of technological interdependence are multinational corporations and industrial complementation agreements. By 1980 it is anticipated that 300 large corporations will control 75% of the world's manufacturing assets. This is furthered by industrial complementation agreements which reflect decisions made by a group of countries to permit free trade in the products of a certain industry. The basic principle underlying these agreements is the enlargement of a market beyond the national market in exchange for the sharing of production among countries involved. It seems, therefore, illogical to study American industry as a single entity when society is tied together globally.
2. *Mineral interdependence*: Four aspects of mineral interdependence stand-out: (1) the consumption of virtually all critical minerals; (2) known reserves are concentrated in a few locations throughout the world; (3) global distribution bears little relationship to areas of consumption; and (4) rich countries are becoming increasingly dependent upon poor countries for mineral supplies (Brown, 1973, pp. 192-193).
3. *Energy interdependence*: Only a small fraction of the world's 160 nation-states are self sufficient in energy fuels. Today's high technology societies consume enormous amounts of energy due to their demand for consumer goods. This very

demand makes each society vulnerable to disruptions in the international scene as evidenced by the energy crisis of the 1970's.

As technology is distributed throughout the world in the remaining 25 years of this century, all people will be involved in resolving a number of value-laden problems. For example, how will global production be organized so as to maintain harmony with nature? Can prices be lowered? Should they? How can the problem of unemployment be solved? Even more importantly, who will bear the cost for making these adjustments? We must remember that all major problems are now world problems. Many are not amenable to national solutions.

No one can escape the growing interdependence among nations occurring throughout the world. Most occupational modes, every economy, and every government will be affected. Economic and political integration will result. Industrial arts education can make a vital contribution in helping students understand and relate to this fact. Technological systems are based on high production systems. It is this system that must be understood on a global basis.

Technical innovation and invention. It has been estimated that most categories of technical knowledge double every eight years. Trying to cope with this expansion of knowledge seems to be an insurmountable task. One need only visit a technological library or a research center to realize the significance of the problem. The corporate research and development center is one of the potentialities and realities of the post-industrial revolution. With this development has come an entirely new system of innovation and invention. The chances of an individual generating a new technology without access to the resources of today's multinational corporation is becoming more and more remote. Attempting to cope with this accumulation of technical data within the context of the public school seems impossible. Exactly what technologies should be studied and to what depth has plagued students of industrial arts for years.

The identification of content within the context of rapid technological growth requires a system of classification. This system must identify "what is" and "what will be." The system must also have parameters so that those teaching the discipline of technology can interpret the content for students at all levels. Human activities throughout history have been carried out in three identifiable areas: communication, production and transportation. These activities are basic to every society. These three categories are sub-systems of the larger technological system and each subsystem has a definite function within each society. Production systems are maintained to provide goods and services of economic value. Communication systems are maintained to provide for information dissemination, storage, retrieval and use. Transportation systems provide for the movement of humans, materials, products and services.

Currently, some industrial arts programs have begun to function by studying these systems, but at a very primitive level in most cases. Primarily programs are, for the most part, based on restrictive units which represent the past. By studying metalworking and woodworking out of context, that is without reference to global systems, students cannot hope to be able to conceptualize the true nature of technological societies in existence today and projected for tomorrow. Research must be undertaken to identify the central themes of technology together with the problems and issues which impact on all high technology societies. Research should be carried out by as many members of our discipline as possible. To meet this need the national association, the AIAA, should take a leadership role.

Social innovation and invention. The importance of mechanical inventions is generally recognized by society. By contrast social innovations receive little recognition. Social innovations are illustrated by Conger (1973, p. 150) as new laws, organizations, or procedures that change the ways in which people relate to each other and how they perceive themselves either individually or collectively. Therefore, social inventions include both organizations and procedures.

Technological societies undergo continual change. These changes alter social structures and natural environments. They alter the structure of basic institutions. In the process values are questioned and one's perception of the future becomes confused. Recently a number of new social inventions, designed to cope with the new technology, have been designed. These are positive events. All people must understand the new social inventions as well as consider other means for coping with technology and resulting social change. Therefore, it is recommended that as the technology of the post-industrial society be studied in the laboratory or classroom, that socio-cultural factors related to the changing technology be considered simultaneously. To assume that other disciplines will fill this role is mere speculation. In fact, all disciplines should be involved in the study of the social factors related to technology. The study of technology should be problem- and issue-oriented, thus presenting opportunities for every discipline in the school system to engage the problems and issues.

Technology Assessment is a social innovation created to cope with social problems resulting from changing technologies. This procedure lends itself to evaluating the potential social/cultural effects of technological change. Technology Assessment represents a systematic, comprehensive, and value-free analysis of possible consequences resulting from the introduction, extension, or modification of a technology (Lauda, 1974, p. 227).

Work and leisure. Industrial arts has always touted the importance of work and leisure and has advocated education about each. In recent years the movement of career education has re-emphasized the need for addressing the issues involved in work and leisure. Previously in this yearbook, it was recommended that the concept of work must be re-defined in view of predictions about work. In the future it has been predicted that humans will have a multiplicity of careers throughout their lifetime and that education will become an integrated part of everyone's lifestyle. Every scenario presented in this yearbook cited this prediction. A review of scenarios from other sources will reveal similar predictions. There is no denying that technology will and, in fact, always has transformed the work and leisure components of society.

In order to investigate these anticipated transitions, it is suggested that "purposeful activity" be substituted for the terms "work" or "leisure." We know that all humans need purposeful activity for self-satisfaction. A future-focused role image should therefore incorporate a comprehension of what this means in one's lifestyle. Normally practitioners in the field of industrial arts have defined work as an activity through which one earns money. In the future, it may be that not working will be socially accepted. Then what? What if economic gain is not the sole criterion for a successful life? Perhaps Ellul, (1964) is right, technology will continue to provide the basis for the disemployment of humans.

Therefore those involved in technology education and education about technology must turn their attention toward helping students understand the role of work and jobs in the future. Within this context, the public school will be remiss if the focus is on occupational training rather than programs which assist students in utilizing knowledge in many contexts. Locating information, synthesizing information and learning to make rational decisions should be the goals. Techniques for accomplishing these goals are many and varied. However, most classrooms and laboratories have been designed to be utilized for curricula oriented to the past.

Industrial arts can, however, make a vital contribution to the future if students develop proper understanding, (including values and attitudes) of work, occupations, and technological change. The goal should be individuals who perceive themselves as fully functioning individuals with identified potential rather than individuals waiting for others to identify their potential. Introducing students to new technologies and projecting the potential futures will assist them in gaining a more valid perspective of the future.

It is recommended that the study of technology be utilized as the base for technology education at all levels of education.

Implication Number 4

The study of technology requires a learning environment different from traditional industrial arts laboratories.

The common approach to instruction in industrial arts is through laboratories. Designing facilities for the study of technology and the future can best be studied if placed in the context of learning environments.

All human beings live in some level of technological environment. These environments should be utilized as learning environments for the study of technology. Most educational systems are locked into thinking that teaching and learning should be limited to what we call schools. New perspectives are needed, however, if teachers and students are to comprehend the technology of today and tomorrow.

Physical changes must take place within the public schools if present schools are to serve the needs of the future. Unit laboratories must give way to open-space concepts which allow for flexibility in a variety of learning situations. Open-space designs are well suited to problem-and-issue-oriented programs. For the study of technology it is recommended that three open-space facilities be designed. These areas would serve the study of transportation, production and communication technologies. Each should be designed to teach technological concepts, both technical and socio-cultural. These facilities do not need to be exact duplicates of technology in the real world. Obviously this would be impossible and very impractical. Appropriate instruction can take place through the use of models, games, simulations and audiovisual means. Each laboratory can be designed to enhance the development of problem-solving skills through the use of individual and group activities, all directed toward the prime function, the study of technology. Each technology education facility should be supported by a resource center for student and faculty use. This resource center should provide ready access to both print and non-print materials and individualized learning areas. Provision for group dialogue and interaction should also be part of the design. The center should be operated and maintained by a person trained in the utilization of technological resources.

The total social environment should become a learning environment. Immediately the question of budgets, staff and student problems are evident. These constraints are real and are recognized as a predicament by every teacher and administrator. However, experience has shown that changes are possible and can take place within the most limited of facilities. Once teachers and administrators realize that concepts about technology can be taught without the use of full-sized equipment, entire new doors are opened to future instructional programs. It is a rare public school that has a computer terminal in each and every classroom. However, every school and classroom can be provided with a simulated computer for developing concepts about computers. Also access to a computer may be possible through other channels, such as the school computer or computers in the community.

Experience has shown that laboratories can be re-designed for the study of technology with a little effort and imagination. Research at West Virginia University has proved this in a number of public school programs. The key is to focus on a study of technology rather than on pre-vocational or vocational education; education which requires expensive pieces of equipment, soon outdated. Those who have designed programs for the study of technology for the public schools have found that principals and other budgetary officers are more amenable to proposed curriculum revisions when costs are within reason.

At the same time, technology education teachers should remain cognizant of anticipated changes in learning modes suggested in the previous chapters. Specific attention must be directed to the electronic means of education projected for the future. As leaders in the study of technology, technology education should be the first to test and evaluate the use of new innovations for the improvement of instruction.

It is recommended that learning environments designed for students in technology education provide the potential for utilizing a broad array of experiences for the study of technology (technical and socio-cultural).

Implication Number 5

New instructional strategies must be designed which are compatible with the modes of inquiry required for the study of technology.

Most schooling in the past has tended to preserve traditions and maintain the status quo in both content and the methods of teaching. The project method still remains dominant as a method of instruction at all levels of industrial arts. In the study of technology the content and contexts are entirely different requiring that new instructional strategies be developed and utilized. The design of new and alternative strategies provide the potential for the student to develop a self-image compatible with the future.

Educators often confuse content and instructional strategy. The instructional strategy is the means for reaching the goals of the curriculum. Compatibility between the content of technology and the instructional strategies designed to teach the content and processes of the discipline is crucial. By way of example it becomes obvious that unique methods will be required to cope with the two main goals identified by Shane (Toffler, 1974, p. 191). These are 1) developing the ability to cope with change and (2) learning to future-plan; to deploy time, energy and resources. Shane reminds us that coping and planning skills are not acquired through lecturing or telling. They are absorbed through future-focused experiences. In fact, it may be that the greatest opportunity for such learning exists outside of the school.

Above all else students must be provided learning experiences which will require them to gather information, analyze it and utilize it to solve problems. The research and development mode of instruction serves this approach adequately. Students can identify problems, research the problem by utilizing individual and group activities and present solutions. The teacher's role in this process is one of facilitator rather than lecturer or demonstrator of machine operations.

It is recommended that instructional strategies for the study of technology be designed to be compatible with the nature of the discipline of technology and the goals of technology education.

Implication Number 6

If the industrial arts profession is to contribute to the study of technology in the future, teacher education institutions must alter programs and prepare teachers capable of teaching the new content and utilizing appropriate instructional strategies.

If industrial arts education is to move into a study of technology, much of the leadership must come from institutions of higher learning. Public schools are not designed for research. They must rely on the expertise of those in teacher education institutions for basic research and development. If current public school teachers do not meet the expectations required by the new curricula, teacher educators should take a hard and long look at their programs. For instance, continuation of unit shops at the public school levels. Models are followed irrespective of what university personnel profess and recommend.

Those who teach about technology and those who want to maximize the potential of every student for the future need special skills. Currently many of these skills are not being taught in contemporary teacher education programs. The following needs appear to exist in most programs:

1. Experiences which deal with the structure of technology.
2. Understanding of the socio-cultural elements inherent in a technological society.

3. Understanding of the global-technological order.
4. Understanding of the interdisciplinary nature of technology.
5. Understanding of processes and materials which represent the latest in technological innovation and invention.
6. Ability to identify and retrieve technical information necessary to solve problems.
7. Study of the future in which students will live.
8. Ability to work with new instructional modes which will prepare people to function effectively within a technological society.
9. The study of technology as a part of the core curriculum or general education of all students throughout their educational careers.

Solutions to these problems will require drastic changes in most education systems. Most importantly, teacher education programs must be redesigned to study technology, not industry and industrial occupations. The craft-oriented unit shop method of organizing instructional programs is no longer valid. Instead, facilities must be modified to provide instruction in technological systems such as communications, transportation, and production.

Considerable research has already been done in course development and the design of experiences for the study of a technological society including the structure, the mandates, the future. At the end of this chapter is a bibliography which will provide the reader with information on systems and educational program development. Specific recommendations for programs preparing students as technology education teachers include: (1) placing students immediately in environments which encourage and permit them to question their society and culture; (2) provision of laboratory experiences which reflect the high technology. The latter may be accomplished through the use of real equipment and simulated equipment and by students taking courses in other disciplines. Consideration should be given to the use of the entire educational and social community for the development of learning experiences and the utilization of resources. There seems to be no reason why learning should be restricted to the university. In fact, there are many reasons why this should not be so. Opportunity to study and learn at research centers, and technical museums, as well as foreign travel are only a few of the options. The central theme, *understanding the technological society*, can be used as a guide in the determination of the most valid strategy or learning experience.

Finally it seems evident that students in the new technology education teacher education programs must be provided experiences in the public schools early in their programs. This will enhance the understanding of the complexities of the teaching-learning process.

It is recommended that all future teachers of technology education become educated as teacher-scholars in the discipline of technology in order to provide the profession with teachers who comprehend the structure of the discipline, the social/cultural relations and the interdisciplinary nature of technology and have the competencies in the skills and tools necessary to engage the problems and issues of the educational future.

Implication Number 7

In-service education in the study of technology must be provided current teachers if they are to keep pace with the growing technology and contribute to changing the present out-dated system.

Once a teacher begins a teaching career there are several options for self-renewal. There are graduate programs, inservice education, and self study. With the rate of technological growth reaching exponential proportions the teacher and students have almost a daily need for new and up-to-date information. Inservice education can serve a vital role in providing this education. However, inservice education as commonly conceived cannot be expected to provide the model required. DeVore (1971, p. 1) in his study of the *Variables Affecting Change in Inservice Teacher Education* reported that inservice education is generally designed by administrators. Teachers find these programs inadequate for their needs. Perloff (1970) identified three major variables affecting change in inservice education which can guide the design of future programs:

1. Training programs must always be sensitive to the interests and needs of the participants.
2. Training programs should be relevant to a major and significant part of what the participant's themselves teach.

3. The training should be practical in orientation.

The redesign of inservice education can meet the following objectives for industrial arts educators already in service.

4. Up-date teachers who have not had the opportunity to study about a technological society.
5. Provide technical and social/cultural knowledge essential for the study of technology.
6. Assist teachers with the identification, design and delivery of new learning units.
7. Serve as an outside force for aiding teachers in implementing new content and methodology.

One approach to inservice education is the development of a new delivery system called a *teacher center*. There are many teacher centers throughout the country, but few provide inservice programs for the field of technology. Some teacher centers were initiated by a task force of the NDEA National Institute for Advanced Study in Teaching Disadvantaged Youth. As a result, our profession has one teacher center which has been in existence for five years and now serves as a model for other institutions. This center has been described in detail by DeVore and McCrory in a paper presented at the 1975 AIAA Conference in Cincinnati, Ohio.

It is recommended that teacher education institutions develop technology education teacher centers designed to provide inservice education programs in the study of technology. It is also recommended that public school administrators be encouraged to solicit actively inservice programs designed specifically to assist their teachers in developing new programs for the study of technology for their teachers.

Implication Number 8

If technology education is to become a viable program of study in the public schools, then the American Industrial Arts Association must be encouraged to assume a leadership role in bringing about this development.

Industrial arts, as a field of education, is fortunate in having active professional organizations which provide leadership for all levels of education. If these organizations are to continue to provide support to meet the needs of the future, then they must establish procedures to reflect on the implications presented previously. Each member of these organizations has the right to expect from the elected leadership plans for action which base their support on sound philosophical ground. Therefore,

It is recommended that professional organizations:

1. **Generate mission statements which reflect the need for the study of technology.**
2. **Initiate the publication of journals which reflect the study of technology and the future.**
3. **Develop relationships with other disciplines for the purpose of perpetuating the study of technology.**
4. **Develop procedures which will assure that each organization will remain responsive to the changes in society and the resultant impacts on education.**

CONCLUSION

Writers in this yearbook have presented convincing arguments that society will be much different in the future than it is today. Technology has been identified as the force behind continual social change, change with which all humans must cope. As a result, many needed changes have become apparent for the educational system. Industrial arts, of course, cannot escape these changes and resultant implications.

While looking at the future, one inevitably looks at the present and even the past. These perspectives reveal that the field of industrial arts education has responded in varying degrees to changes in society and technology in the past. The last decade, however, has witnessed a doubling of technical knowledge together with widespread social change. The result has been that industrial arts and education in general no longer serve the present appropriately or the future at all.

This dilemma presents crises and opportunities for the profession, a profession which has responded to change many times throughout its rich history. Crisis situations exist primarily because of the rapid explosion of technological growth since the 1950's. For many, society has passed them by. Practitioners in the field of industrial arts should accept this challenge as an opportunity and make a conscious effort to reflect the new technologies in their programs, laboratories and classrooms. There are a number of changes which become apparent immediately. These are:

1. Accept technology as the discipline base and the study of technology as the base for curriculum and instructional design.
2. The name of the discipline must be changed to reflect cultural reality, therefore the name "technology education" is suggested.
3. The content of the discipline must move from the interpretation of American industry to a study of technology and society and the content apparent in this context.
4. New learning environments must be designed to provide for authenticity in the study of technology.
5. New instructional strategies must be designed to provide for authenticity in the study of technology.
6. Teacher education institutions must alter their programs and take the lead in preparing new teachers and providing inservice education for current teachers.
7. Professional organizations must provide leadership to advance the study of technology.

The future will be quite unlike today so changes can be anticipated. Therefore, the concept of the process of change and the future can be introduced to students as new realities. Those who study the future can help identify new content and appropriate instructional strategies, a factor which should not be overlooked. In fact, the one implication implicit throughout this exploration of industrial arts and the future is that the study of technology is future oriented and the adoption of technology as the discipline base can provide the field of industrial arts with a future-focused educational role rather than the present, past-focused role. It becomes apparent then, that we should all be concerned about the future because we will spend the rest of our lives there.

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Resources for a Futurist

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INTRODUCTION

There is very little literature that is universally shared for its importance by futurists. There are no universal books, articles or materials lists. The "major writers" of futurism materials do not agree on a universal list of anything. Ideas and values can be emphasized and clarified, adopted and rejected, but the one who is best able to make a decision on merit is the reader. He must make this decision based on his philosophy, background, perspective, and expectations and the use to which the new insight is to be placed. The analysis of content from an individual perspective of wide reading is mandated.

New and noteworthy documents and materials appear daily. An immersion in futuristics brings one to reading or at least scanning regularly daily newspapers and many different periodicals with an occasional in-depth survey of the *Readers Guide* and *Books in Print*. At the same time the presses roll regularly over endless sheets of paper to bring us hundreds of relevant books each year. How does one keep up? We must be aware of our frames of reference, constructing and reconstructing them from moment to moment. The pace of information generation points us to the alternative futures that are tomorrow.

There is no known method that would lead one to the "best" list of futuristic materials. Thus, the references furnished in this chapter are no exception. The list is biased toward material of interest to industrial education teachers, is not complete, and is far from comprehensive. It is an attempt to save time for the person interested in futuristics and to help him plant his feet solidly on the ground in the study of the future.

Presented here first is "A Selected Bibliography to Get You Started." These are general materials that should get you interested in further exploration. The next section, "Selected Articles and Periodicals," should provide you with not only some references that may prove helpful, but they will reinforce the idea that there is a wide variety of materials in a wide variety of periodicals available to the reader. The "Books" section concentrates on material that would be of most interest to industrial education teachers. Obviously, there is much more available, but that will become more visible as an individual pursues his own interest and specialty. Lastly, the section on "Some Alternative Materials" provides references for audiovisual/simulation; materials which should prove valuable for those who are involved in teaching future courses.

The materials listed are not the final answers. They will be suggestions and not definitions of what is available. If one is to really immerse himself into the study of the future, he must "specialize," so to speak, in the study of the future. As he prepares himself for this specialty, he will become far more of a generalist than those who specialize in any subject matter area. The study of the future is the most far reaching of inter-disciplinary studies one can imagine. The alternatives in one area tend to advance or retard the activities in another. All are inter-related, just as they are in the study of technology.

If the reader finds the list too incomplete for his liking, additional resources and materials can be found in one or more of the listed bibliographies. It is of special note that the *Advent Futures Studies* series by Miller and Hunt is informative and among the most recent of the many bibliographies. Further information on current books, periodicals and materials can be obtained from the World Future Society, 4916 St. Elmo Avenue (Bethesda), Washington, D. C. 20014. There is no global comprehensive futures information network or center, but the World Future Society will probably come the closest to that kind of service.

This is a very exciting time for life. We know so little about the world of Cleve Baxter's plant communication system and Uri Geller's outside consciousness. Will the world of Psi force us to a new physical science, a new vision of the basic concepts of energy, time, space, mind and life? What about the possibility of technology and all the changes it can bring? What about scraping the bones of Peking man or the ancient dinosaurs to return them to walk the face of the earth through incubation and the appropriate technology?

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SOME ALTERNATIVE MATERIALS

This section of the chapter is brief, yet lists materials that will aid the beginning futurist in establishing a course in futuristics and in teaching the course with some modest degree of success. It is presumed that the individual will have read very widely from the bibliography that was listed earlier.

Of all the materials listed in this section, there is one place to start and that is by acquiring the *Advent Futures Studies and Research Curriculum Guide* and the *Advent Futures Studies and Research Learning Resources Guide* (two volumes) by David C. Miller and Dr. Ronald L. Hunt. The DCM Associates, 908 Fox Plaza, San Francisco, California 94102, is the publisher (also distributed by the World Future Society).

These two volumes contain just about everything that a person would want to plan a course in the study of the future. The series was two years in development and testing under a grant from the U. S. Office of Education. It is intended as a modular, introductory approach designed for class instruction or self-study at the undergraduate, graduate and adult levels, and the two volumes are to be used in conjunction with each other. The learning resources guide is extremely appropriate for this section because it contains references to 256 books, 41 reports and monographs, 52 futures research articles, 114 films, 587 popular records (some of which may be useful for futures studies), and 786 poems. For industrial education teachers the poems may be of the least use, but they are listed and may be of some value.

Marie Martin, in conjunction with World Future Society, has published the most complete compendium of films on the future. The mimeographed compilation is called *Films on the Future, A Selective Listing.* It was copyrighted by the society in 1973 and has been widely circulated by the society. The address has been listed earlier.

The listing is comprised of sixteen sections, including the introduction and rental sources with complete addresses. In the planned use of the films, it is extremely desirable to order them as much as a year in advance of use unless you have local sources. It is also interesting to note that the fourteen film categories begin with atomic energy and end with science fiction films. The categories are not clear-cut and they overlap. This is essential in the study of the future and is known as an interdisciplinary approach. The categories cover the normal futuristic headings as biomedical, ecology, future life styles and technology.

If anyone is going to teach a course in the study of the future, it is extremely important to acquire the *Selective Listing* and study it thoroughly. To list the films and sources would be a mere duplication of effort. However, if titles are a clue to the message of the films, a sample is listed here for your encouragement to order the complete listing:

Atoms in the Market Place
Computers: Challenging Man's Supremacy
Genetics: Man the Creator
Assault on Life
Education: No More Teachers, No More Books
Games Futurists Play

The Center for Cassette Studies has a voluminous 5000 tape listing catalog. Some of these have relevance to the study of the future. They also have a bulletin number 3040E-1975 entitled *2000 A. D.*, which lists 24 different titles. The percentage is higher for relevant futuristic tapes from this brochure. Order the brochure from:

The Center for Cassette Studies, Inc.
8110 Webb Avenue
North Hollywood, California 91605

A sample of the listed tapes follows:

"Self-Made Humankind?" Dr. James Bonner discusses genetic engineering.

"Manipulating People." Dr. Willard Gaylan talks about biological revolution and social control.

"The World of Tomorrow – Toward 1984." Is the Orwellian nightmare coming true?

"Is Anybody Out There?" The film discusses locating and contacting extraterrestrial beings.

"Man, the Planets and the Future." This is a lecture on the course of human development.

The World Future Society has an extensive series of tape recordings dealing with singularly future-related topics. These tape recordings are an excellent method to become acquainted with specific topics from authorities in the subject. Most of the topics under discussion have been taken from the radio programs presented by the World Future Society. Other recordings are presentations of speakers at the society's conferences and sponsored meetings.

The tapes are presented in broadcast or lecture form on C-60 cassette tapes. Each tape contains two half-hour presentations or interviews.

A sampling of the recordings is listed here for your perusal.

"The Future of the Fine Arts"
"The Future of Dentistry"
"The Future of Control of Human Behavior"
"The Future of the Wired City"
"Computers and Cybernetics – Citizen-Oriented Computers"

The topics discussed in the tape recordings are as diverse as the films and books listed earlier. This is another indication of the inter-relatedness that is futuristics.

Futurists are often considered "far-out" for their thinking and to be "far-out" in teaching is to play games to get concepts across. A book that will help anyone to begin to see the value in playing games in futuristics is listed here and not in the bibliography, because it is a different type of reference.

Zuckerman, D. W., and Horn, R. E. *The guide to simulations/games for education and training.* Lexington, Massachusetts: Information Resources. ($15.00)

This book, available from the World Future Society, contains descriptions to more than 600 games, how to play them and where to get them. It is a treasury of information including directions on how to make up your own games. The following are a few of the games:

"Futuribles." This is a game created by George E. Koehler of the World Future Society. It has 288 project cards which are designed to help people get acquainted with the future and its possibilities, probabilities and preferabilities.

"New Town." This educational game originated at Cornell University for professional planners. The object of the game is to build a "New Town" on the game board with the furnished blocks, dice, cards and money.

"Cope." In this simulation game participants actually experience future shock brought about by the communications explosion.

The participants must learn a new language and undergo job retraining every time the computer demands it. The author is Jerry Ward, and this game (a four-week teaching unit) can be purchased from Interact, P. O. Box 262, Lakeside, California 92040.

"Utopia Game." Another "beyond game," the play runs into an ongoing course in futuristics. It may last a short time or go on forever. The length depends on the climate of the environment, teacher and students. The author is Ken Davis, 1116 McIntyre, Ann Arbor, Michigan 48105.

"Future Decision: The I.Q. Game." A realistic and positive approach to the study of the future is offered here. The game, authored by Betty Barclay Franks, introduces students to the need for and the how to of futuristics. The cost of the game is $4.95 and can be purchased from Simulation and Gaming Association, 4833 Greentree Road, Lebanon, Ohio 45036.

"Global Futures Game." This one was authored by Bill Bruck and costs $5.00 for eight players, or $10.00 for up to 48 players. It is based on Bucky Fuller's "World Game" and uses four variables in eight different world regions. The object is to stay away from oblivion in ten easy rounds. You can buy it from Earthrise, P. O. 120, Annex Station, Providence, Rhode Island 02901.

"Futura City" is a part of the 2000 A. D. series by *Newsweek* Education Department, 444 Madison Avenue, New York, New York 10022. The cost is $49.95 with cassette tape. The kit actually contains some ditto masters which can be run off for distribution to your classes and is a real time saver. The simulation introduces students to Toffler's concept of "Constituent Assemblies." The students role-play various lobbying special interest groups and find that their suggested roles sometimes conflict with their values in life.

"The Game of Future Shock" is another board game where students become familiar with reality by organized chance. It is similar to an elementary school game, but the vocabulary is higher. The object of the game is to finish with the most stability cards. It costs $6.50, was invented by James and Margaret Adams in 1974, and can be purchased from the World Future Society.

There are other aids that can be had for a variety of situations that may arise from time to time. The idea, of course, is not to try to have a whole closet full of hardware or software as the case may be, but to get into the reality that is the future. You can help your students gain a futuristic mind set and avoid future shock, if you try a few of these alternative materials.

Epilogue

Lee H. Smalley
University of Wisconsin-Stout
Menomonie, Wisconsin

My first acknowledgement will have to be to all of the authors you have just read. They are the ones who helped to shape the yearbook, and to put pencil to paper in order to put flesh on the bare bones of an idea. Next are all of the people, students, teachers, colleagues and friends, who helped challenge and encourage me to do something other than read and talk about possible futures. This yearbook is the first step in my answer to their challenge. Last are the founders of the yearbook series and all of the people who have kept this idea and practice alive for 25 years, including the people of McKnight Publishing Company. May all of us be involved in the next steps.

If you have read all of the preceeding copy, as I have, it may be time for a bit of reflection on the question, What is the future of industrial arts? To say that it all depends upon what we want it to be is a bit trite and does not really respond to the question. One is reminded of the two methods of change – innovations or breakthroughs. Most everyone would opt for the more gradual change brought about by innovations. This is more controlled, predictable and causes less traumatic changes. However, there are events and conditions which demand greater and quicker changes. These events are usually from outside, rather than inside, and put great stress on people, institutions, policies and procedures to change to a greater degree than they would normally do.

Industrial arts classes in schools are generally well received by students, parents and school administrators, so the press for change from within the system does not seem to be great. But, if one looks out into society, its problems, changes and challenges, one may come up with a different view of the need for change.

Robert Pirsig, in *Zen and the Art of Motorcycle Maintenance*, says:

Our current modes of rationality are not moving society forward into a better world. They are taking it further from that better world. Since the Renaissance these modes have worked. As long as the need for food, clothing and shelter is dominant, they will continue to work. But now that for huge masses of people these needs no longer overwhelm everything else, the whole structure of reason, handed down to us from ancient times, is no longer adequate. It begins to be seen for what it really is — emotionally hollow, esthetically meaningless and spiritually empty. That, today, is where it is at, and will continue to be at for a long time to come (p. 110).

All of this translates into the question of the perception of the industrial arts teacher toward change. Who wants change? Of what magnitude and in what direction? A review of the data collected by Starkweather for the Prologue will give you some feeling as to the perceptions of ten "experts" in industrial arts. But who are the change agents — the teacher educators or the industrial arts teachers in the field (K-12)? A recent study[1], undertaken at the request of the author, by Robert Gelina (co-author of Chapter II) compared some responses of the "experts" with a sample of 49 secondary school industrial arts teachers. Gelina selected 38 questions from Starkweather's questionnaire and asked them if these particular statements will occur in the future of industrial arts, and if "yes," in what year will at least 50% of the programs be involved. Without any exceptions, the secondary school teachers felt that the event would occur in half of the programs earlier than the "experts" did. In fact, the mean was eight years earlier! As an example, statement number one said:

The name of industrial arts will be dropped in favor of some more relevant title for an era dominated by a technology and social problems interface.

Sixty-nine percent of the secondary school teachers said that this would happen to half of the programs by 1981. Starkweather's group of teacher educators said this would happen by 1987. This survey may not be enough evidence to conclude some definitive propositions, but it would lead one to ask, "What group is being most resistant to change?"

I am convinced that a breakthrough is necessary in industrial arts, and that it can come through our focus on the future. There would seem to be enough signs to support this position. Obviously,

[1]More information available from Dr. Robert Gelina, Iowa State University, Ames, Iowa.

much more work needs to be done, and any success we have with this yearbook will be measured in the events that follow to implement some of the ideas expressed by the authors. Kenneth Clark in his book, *Civilization*, concludes his look into civilizations with a chapter on "Heroic Materialism" and sums up this work with, "One may be optimistic, but one can't exactly be joyful at the prospects before us" (1969, p. 347). After reading this yearbook, I hope you can share my thoughts toward the future, not Clark's, as I am not only optimistic but joyful at the prospects before us.

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APPENDIX

Fifth Round Delphi Items From*

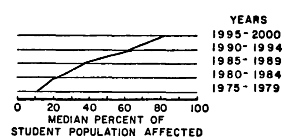
A Study of Potential Directions for Industrial Arts Toward the Year 2000 A.D.

Kendall N. Starkweather

Unpublished Doctoral Dissertation
University of Maryland
College Park, Maryland

Table 1
Statements Relating to the Nature of Programs in Industrial Arts

Item	TIME PERIODS 1975-1979	1980-1984	1985-1989	1990-1994	1995-2000
1. The name of industrial arts will be dropped in favor of some more relevant title for an era dominated by technology and social problems interface.	10	20	37.5	62.5	82.5

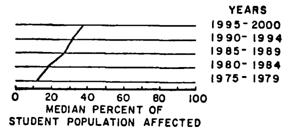


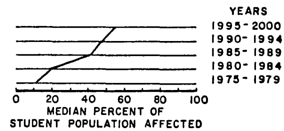
*The numbers in the columns after each statement represent the percentage of projected student population to be affected by that item during the indicated time period.

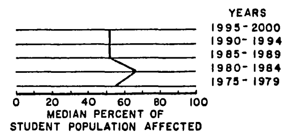
*This study initially had 113 items which were narrowed to 67 items for the third round of the delphi. The deletion of items accounts for some numbers not being represented in the tables.

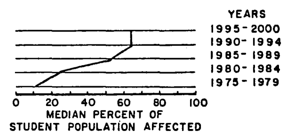
TIME PERIODS

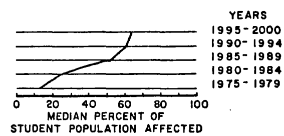
Item		1975-1979	1980-1984	1985-1989	1990-1994	1995-2000
7.	There will be many bright spots in industrial arts education appearing throughout the nation's schools in the form of curriculum emphases reflective of the times, e. g., programs on consumer education, education for discretionary time, and for cultural awareness.	10	17.5	27.5	30	35
8.	Programs in industrial arts at all levels will mirror the pluralism of society.	10	20	40	47.5	55
9.	Industrial arts will continue to have two central themes, occupational-vocational and general education.	55	65	50	50	50
15.	There will be a continuing trend for content to be organized around issues and problems associated with technology and society rather than jobs, skills, careers, and occupations.	10	25	50	62.5	62.5
16.	More emphasis will be placed on concepts and transfer of concepts and principles between pure science, science and technology as it applies to humanity and a more humane society.	12.5	25	50	60	62.5
19.	The group of industrial arts leaders, those who see it as the interpreter of technology for the American school, will seek stronger affiliation with the academics for acceptance and support of their position.	20	30	40	47.5	47.5
21.	The program will move in the direction of the application of technology in the solution of major problems facing mankind.	15	25	47.5	55	67.5
22.	The content of industrial arts will stress the impact of technology, both positive and negative, on the society.	15	25	40	62.5	77.5

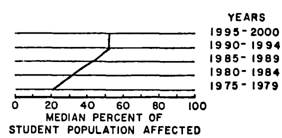


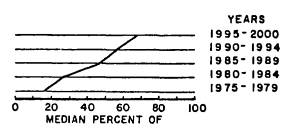


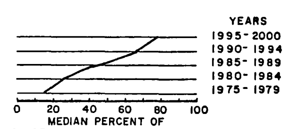






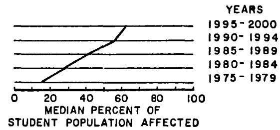




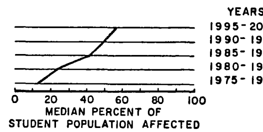


	TIME PERIODS				
Item	1975-1979	1980-1984	1985-1989	1990-1994	1995-2000

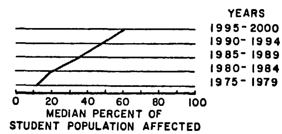
27. With a greater emphasis on man needing to learn to live in new relationships with other man, the program will include a stronger bent toward man's social-technological problems.
15 25 40 52.5 60



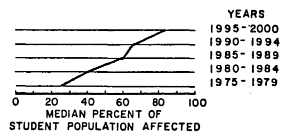
28. There will be a greater emphasis in industrial arts on technology and its impact on society to supplement the skill emphasis in traditional programs.
12.5 22.5 42.5 50 55



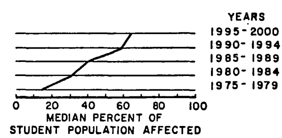
29. There will be a movement to place a greater emphasis on the study of industry and technology from the focal points of their contributions to society other than employment, profits and gross national product.
10 20 37.5 45 60



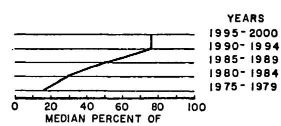
30. The study of industry, free enterprise, and how it is organized to provide our goods and services will be included along with the modifications of materials through manipulative experiences.
25 40 60 62.5 80



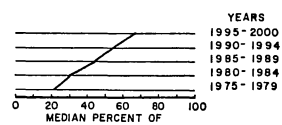
31. Course content will have an emphasis on environmental considerations, safety, pollution, effective utilization of resources, etc.
15 30 40 60 62.5



33. Product disposal and salvage will become more important as a factor of the total process of system and ecological influences in industrial arts.
15 30 50 77.5 77.5



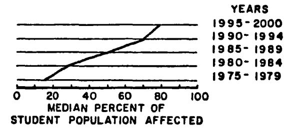
34. The inclusion of graduate level technical courses for graduate credit will become increasingly acceptable within the profession.
20 30 42.5 52.5 65



Item	TIME PERIODS 1975-1979	1980-1984	1985-1989	1990-1994	1995-2000

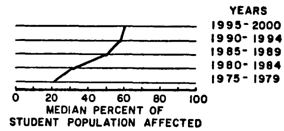
36. The "post-industrial" development of the United States will influence industrial arts content toward emphasis on technical knowledge, research methodology, sophisticated data retrieval and process monitoring, design of new processes and technological change.

36	15	27.5	50	72.5	77.5



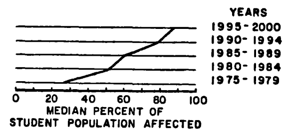
37. The subject matter focus will shift from the work of selected skilled tradesmen to industrial technology.

37	20	30	50	55	60



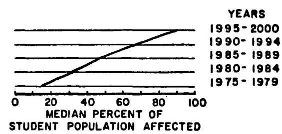
41. Traditional industrial arts activities such as wood, metal, etc. will be grouped into broader areas of study (e. g. – materials and processes, communications, etc.).

41	25	50	60	75	85



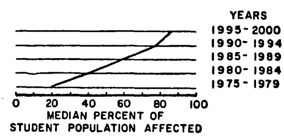
42. New areas of industrial studies will emerge and materials will become important aspects of our content.

42	15	30	45	65	85



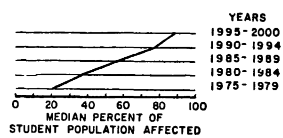
43. Conservation of our resources, energy and materials will become important aspects of our content.

43	20	40	60	77.5	85



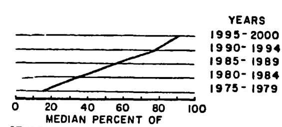
44. Recycling of materials and new materials and resources will be considered by our classes.

44	20	35	55	77.5	87.5



46. New programs of industrial arts will become more interdisciplinary and systems oriented.

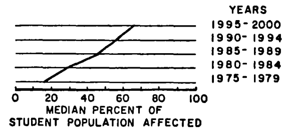
46	15	32.5	55	77.5	90



	TIME PERIODS				
Item	1975-1979	1980-1984	1985-1989	1990-1994	1995-2000

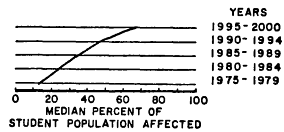
47. Broadly based curriculums will have overlappings in every subject area in the whole school. Industrial arts will overlap and tie in with language, social studies, politics, etc.

15 27.5 45 55 65



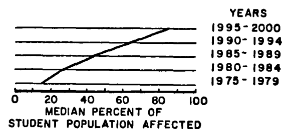
48. The program will involve a strong interaction with the world outside of the formal school not only as a resource but as a setting in which substantial parts of the program will be conducted.

15 22.5 32.5 45 67.5



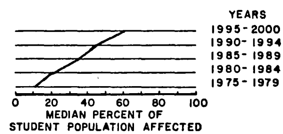
50. All forms of teaching (e. g., travel, work experience) will be used in teacher education programs.

15 22.5 42.5 62.5 82.5



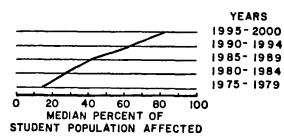
51. Students will study technology from an international base as the multinational corporations take over 85% of the world's manufacturing assets.

10 20 35 45 60



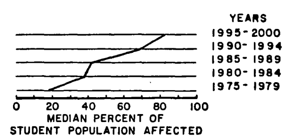
52. Societal and educational institutions will be forced toward better interfacing relationships as work progresses toward knowledge.

12.5 25 40 65 82.5



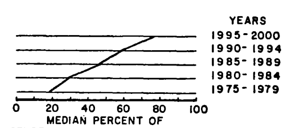
55. There will be a significantly increasing acceptance of research and development as both substance and means for all levels of industrial arts education.

17.5 32.5 40 67.5 82.5



56. Systems concepts will become accepted methodology; systems analysis will be used for content identification; systems modeling will contribute to individualized learning materials; work systems research will influence work-learning environment design.

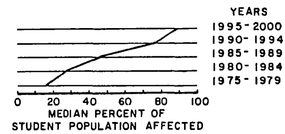
17.5 27.5 45 55 75



	TIME PERIODS				
Item	1975-1979	1980-1984	1985-1989	1990-1994	1995-2000

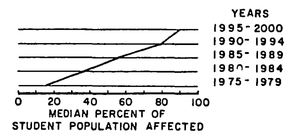
60. There will be a more flexible program and administrative schedule for education in general, year-round schools, modular schedules, home study centers linked to computers at school, (computer assisted instruction).

15 27.5 45 72.5 87.5



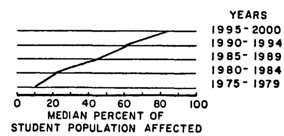
61. Industrial arts courses will be offered for varying lengths of time rather than the traditional 180 days, 1 period per day.

10 20 40 60 80



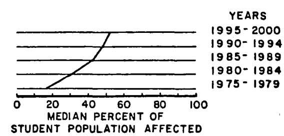
62. Industrial studies will more noticeably become a K-adult concern, in fact rather than only in theory.

10 20 40 60 80



63. The new form of "industrial arts" will have a great deal more application in the pre- and post-secondary years, i. e., elementary school and community college as well as four-year college.

17.5 27.5 40 45 50



65. There will be an even broader range of experiences that will substitute for organized school classes, credits and experiences.

15 25 40 60 80

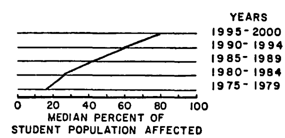
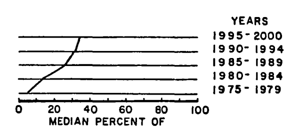


Table 2
Statements Relating to the Teacher of Industrial Arts

	TIME PERIODS				
Item	1975-1979	1980-1984	1985-1989	1990-1994	1995-2000

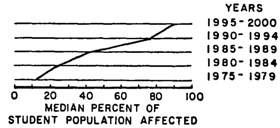
69. There will be an increase in the ratio of women teachers teaching industrial arts in the public schools.

5 12.5 25 30 32.5

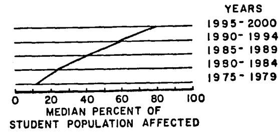


TIME PERIODS

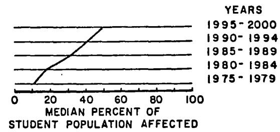
Item	1975-1979	1980-1984	1985-1989	1990-1994	1995-2000
70. The teacher will be more of a learning coordinator and guide rather than a lecturer.	10	25	40	75	90



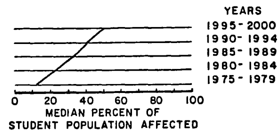
Item	1975-1979	1980-1984	1985-1989	1990-1994	1995-2000
71. Lectures will be television- and computer-based leaving time for the teacher to assist the student.	10	22.5	37.5	55	72.5



Item	1975-1979	1980-1984	1985-1989	1990-1994	1995-2000
72. The future industrial arts teachers will be supported with para-professionals.	10	17.5	30	40	50



Item	1975-1979	1980-1984	1985-1989	1990-1994	1995-2000
73. A new type of educator will emerge in the form of an entrepreneur or a teacher-scholar with the capability of understanding the technological society and its effect on people.	10	20	30	37.5	50



Item	1975-1979	1980-1984	1985-1989	1990-1994	1995-2000
74. The number of women as teachers of industrial arts education at all of its levels will increase substantially.	10	15	22.5	30	35

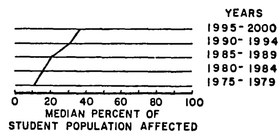
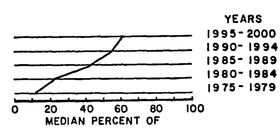


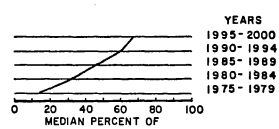
Table 3
Statements Relating to Industrial Arts Student Activities

TIME PERIODS

Item	1975-1979	1980-1984	1985-1989	1990-1994	1995-2000
76. The student body will shift from practically all male to a more representative cross section of the total student population.	10	22.5	40	55	60



Item	1975-1979	1980-1984	1985-1989	1990-1994	1995-2000
77. Increased numbers of female students will be enrolled in all classes at all levels.	12.5	30	45	60	65

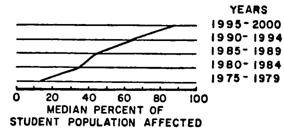


TIME PERIODS

Item	1975-1979	1980-1984	1985-1989	1990-1994	1995-2000

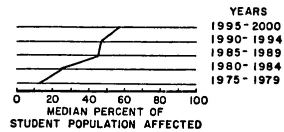
78. There will be greater use of independent or individualized instruction.

12.5 32.5 42.5 65 85



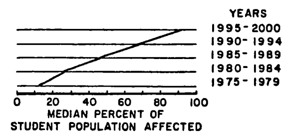
79. The content material employed by the industrial arts profession for television, computers, and other automated teaching devices will be organized for individualized instruction.

12.5 25 42.5 45 55



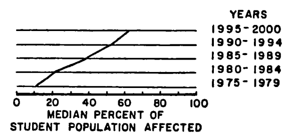
80. Industrial arts learning environments will be designed to accommodate a wide spectrum of individual talents and interests through utilization of functional enterprise operation and improved individualized learning materials.

12.5 27.5 45 65 90



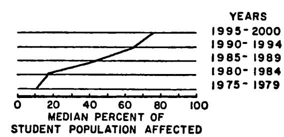
81. Individualized, computerized lessons will be available through the public libraries.

10 20 35 50 60



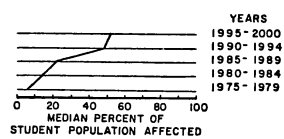
83. Individualized, computerized lessons will be available through the public libraries on a state-wide basis in some states.

10 17.5 40 65 75



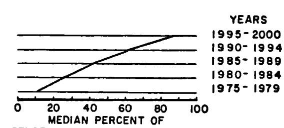
84. Individualized, computerized lessons will be available through two way television on a state-wide basis in some states.

5 12.5 20 47.5 50



85. Students will be using individualized computers and calculators in the better school districts.

10 25 40 60 85



86. Individualized computers will allow students to advance much more rapidly in the understanding of concepts.

10 20 32.5 52.5 70

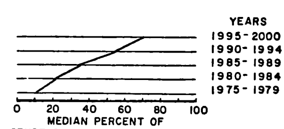
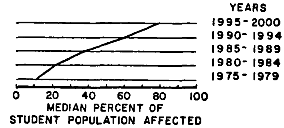
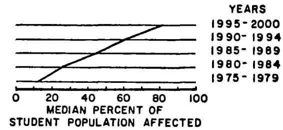
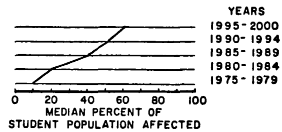
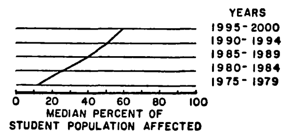
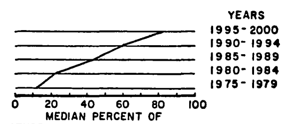
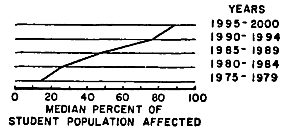
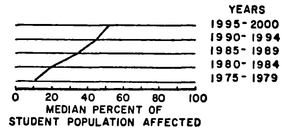


Table 4
Statements Relating to the Industrial Arts Teaching Facilities

TIME PERIODS

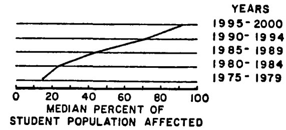
Item	Statement	1975-1979	1980-1984	1985-1989	1990-1994	1995-2000	
87.	New programs will require facilities which provide a wide range of capabilities in a variety of technical areas.	10	20	37.5	60	80	
88.	There will be a general tendency to develop facilities for the study of technological systems in areas such as production, communications, and transportation.	12.5	25	42.5	60	82.5	
89.	Industrial arts laboratories will be open for general community use after school hours.	10	20	40	52.5	60	
90.	There will be a development of a general industries laboratory away from unit or specific labs (to achieve an integrated program).	12.5	25	40	52.5	60	
91.	The physical plant will become more open and flexible with little or no fixed, large equipment.	12.5	22.5	45	60	80	
92.	The facilities will change to include items associated with testing, analysis, and simulation, still maintaining items of a constructional nature to support these new emphases.	15	25	47.5	77.5	87.5	
93.	The facilities will more nearly approach laboratory settings in contrast to the present construction environment.	10	20	35	45	52.5	

TIME PERIODS

Item	1975-1979	1980-1984	1985-1989	1990-1994	1995-2000

94. Equipment in the laboratories will change because of the changing technology.

15	22.5	45	72.5	90



95. Equipment in the laboratories will change as a result of a more conscious effort to make a safe work place, the impact of OSHA.

15	22.5	30	40	50

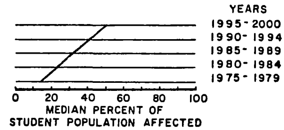


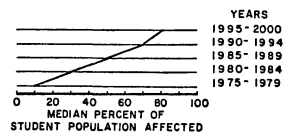
Table 5
Statements Relating to the Evaluation of Industrial Arts Programs

TIME PERIODS

Item	1975-1979	1980-1984	1985-1989	1990-1994	1995-2000

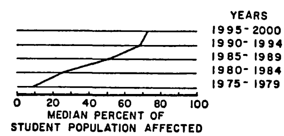
101. Teachers will be accountable and measured by their product-student outcomes.

10	30	50	70	80



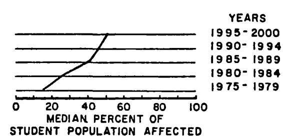
104. Evaluation models will be based upon a more analytical individualized behavioral change construct with emphasis on personal goal attainment.

10	25	50	67.5	72.5



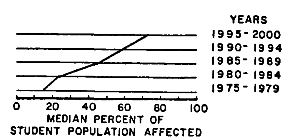
108. Accountability, competency- or performance-based instruction with behavioral objectives will continue to have an impact.

15	25	40	45	50



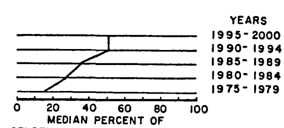
109. The affective domain and values and value systems will become more important.

15	22.5	45	60	72.5



110. There will be a continuing development of industrial arts programs based on competencies.

15	27.5	35	50	50

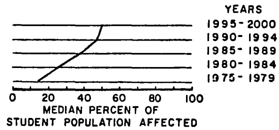


Item	1975-1979	1980-1984	1985-1989	1990-1994	1995-2000

TIME PERIODS

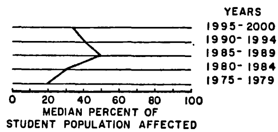
111. The continuing development of industrial arts programs based on competencies will be based on skills which are knowledge based.

15	25	37.5	47.5	50



112. Competency- and behavioral-based systems of instruction will peak and decline from the impact of rapidly changing technology and the resultant emphasis upon individual fulfillment, creativity, and change.

20	30	50	40	32.5



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