DOCUMENT RESUME

ED 284 973 CE 047 946

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TITLE Quality Indicators for High-Technology Programs.
INSTITUTION Ohio State Univ., Columbus. National Center for Research in Vocational Education.
SPONS AGENCY Office of Vocational and Adult Education (ED), Washington, DC.
PUB DATE 87
GRANT G008620030
NOTE 87p.; Appendixes B and D contain small print.
PUB TYPE Reports - Research/Technical (143) -- Tests/Evaluation Instruments (160)

EDRS PRICE MF01/PC04 Plus Postage.
DESCRIPTORS Education Work Relationship; Guidelines; Program Administration; *Program Content; *Program Effectiveness; Program Evaluation; *Program Implementation; Relevance (Education); School Business Relationship; Standards; *Technological Advancement; Two Year Colleges

ABSTRACT

An investigation of quality indicators in high-technology programs in two-year postsecondary institutions explored three questions: the nature of high technology and its implications for educational practice; the essential components and features of a quality program; and the level of implementation of quality characteristics in exemplary programs. Conducted through surveys of over 140 educators and high technology industry representatives, the study resulted in identifying 46 practices that were judged as indicators of a quality program. A review of program practices reflected a high level of consistency between the perceived importance of these indicators and the extent of their implementation. Across 84 high-technology programs in 13 different technology areas in 25 different states, the following were judged as essential or very important elements: (1) technologically up-to-date faculty, equipment, and curriculum; (2) program content and practices relevant to work needs; (3) close attention to the needs of students; and (4) close cooperation between an educational institution and the related business/industry. (A profile of successful high-technology programs is offered in the report.) As a result of the project, a self-assessment process and supportive materials were developed and made available to the high-technology educational community. In addition to the study instruments, appendixes include a program listing, a table of indicator ratings by program area, and a program self-assessment form for participating faculty. (KC)

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QUALITY INDICATORS
FOR
HIGH-TECHNOLOGY PROGRAMS

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1987

FUNDING INFORMATION

Project Title:	National Center for Research in Vocational Education, Applied Research and Development
Grant Number:	GU08620030
Project Number:	051BH60001A
Act under Which Funds Administered:	Carl D. Perkins Vocational Education Act, P.L. 98-524, 1984
Source of Grant:	Office of Vocational and Adult Education U.S. Department of Education Washington, D.C. 20202
Acting Executive Director:	Chester K. Hansen
Disclaimer:	The publication was prepared pursuant to a grant with the Office of Vocational and Adult Education, U.S. Department of Education. Grantees undertaking such projects under government sponsorship are encouraged to express freely their judgment in professional and technical matters. Points of view or opinions do not, therefore, necessarily represent official U.S. Department of Education position or policy.
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FOREWORD

During the past 10 years, the term high technology has increasingly appeared in magazines and newspaper accounts of new waves of exotic technology that is changing the workplace. Since the end of the recession in the early 1980s, American industry has rushed to adopt new and sophisticated high-technology systems and processes in an all-out effort to resolve problems with product quality, rising labor costs, increased foreign competition, and sagging productivity.

Manufacturing industries have probably invested the most in time and money in their efforts to leapfrog into the high-tech age. In their hurried transition from old (sometimes antiquated) technology to the new, industries have created both surpluses and shortages of workers. Many blue-collar workers have been permanently displaced from semiskilled and unskilled jobs that no longer fit into a high-technology work world. At the same time, the demand has grown for highly trained technicians who can create, install, operate, program, and/or maintain the high-technology systems of today and tomorrow. Again, as they have in past years, the 2-year postsecondary institutions across the country have moved quickly to upgrade, expand, and create programs to train and retrain people to fill the technician jobs needed by industry. A number of schools reacted to the growing demand from a strong technological base of programs that have been in place since the early and mid-1960s. Some institutions have developed high-technology programs from the ground up with no previous technical program base from which to start. How are they doing? This is the question that is addressed by the project reported here.

This publication provides summary information regarding the basic components of high-technology programs that contribute directly to a high-quality program. The findings apply broadly to all types of high-technology programs in different fields. The outcomes of the project are the results of the combined survey responses of many technical educators and concerned business and industry representatives.

We would like first to express our appreciation to the members of the project advisory panel who provided valuable insights and recommendations to guide the project:

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Also we wish to thank the faculty in those colleges that serve as field test sites for early drafts of the assessment materials. The six institutions that cooperated were as follows:

College of Alamance
Alamance, North Carolina
M. Lewis McMillan, Jr., Chairman
Life Sciences Department

Fox Valley Technical Institute
Appleton, Wisconsin
Virgil Noordyk, Trade and Industry Coordinator
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Steve Faulkner, Dean of Engineering Technologies
Kemp Sigmon, Dean of Industrial Technologies

Triton Community College
River Grove, Illinois
Dallas Garrett, Dean
Business and Technology

In addition to these individuals and institutions, our appreciation is extended to the faculty members in the many colleges who participated in the survey of quality indicators. A full listing of the participating colleges and institutes is provided in appendix A. Our thanks are also extended to the many representatives of businesses and industries who took time to complete the survey questionnaires.

Our appreciation is extended to the external reviewers whose comments and suggestions were most helpful in finalizing this publication. Thanks go to Michael J. Dyrenfurth, Professor of Industrial Education, University of Missouri, Columbia, Missouri; and Paul McQuay, Dean of Applied Sciences; Delaware County Community College, Media, Pennsylvania. Thanks are also expressed to Novella Ross and Wayne Schroeder of the National Center Staff for their assistance. The National Center wishes to acknowledge the leadership provided to this effort by Robert E. Taylor, recently retired Executive Director. This project was carried out in the Special Programs Division under the direction of Harry Drier, Division Associate Director.

The project staff involved in this research project included William L. Ashley, Project Director, Ernest Fields, Research Specialist; and Graduate Research Associates, Judy Boylson, Larry Inks, and Patricia Medina. Secretarial and typing assistance was provided by Kathaleen Babbs and Abby Hurd. Beverly Haynes provided the word processing assistance. Editorial review was conducted by Judy Balogh.

Chester K. Hansen
Acting Executive Director
The National Center for Research
in Vocational Education

EXECUTIVE SUMMARY

This publication reports the outcomes of an investigation of quality indicators in high-technology programs in 2-year postsecondary institutions. The project addressed three basic questions. The first question probed the nature of high technology and its implications for educational practice. The second question inquired about the essential components and features that are reflective of a quality program, whereas the third question focused on the level of implementation and practice at which quality characteristics actually exist in exemplary programs.

The study did not seek to establish standards or national norms; to do so would have been a premature venture at the current stage of high-technology program development. Most programs are in a state of transition from older to newer technological content. Many programs are very new and still in initial development stages. Others represent one of only a few programs of their type in the country and are specifically designed and focused on technological applications unique to a corporation or region.

The study resulted in identifying and verifying 44 practices that were judged as indicators of a quality program. Eleven of the indicators were deemed to be "essential" to a quality program, especially in the development-start-up phase. An additional 24 indicators were rated as elements that are "very important" in enhancing and maintaining a program during its early growth years. Finally, eight other items were judged as "important" elements in the refinement and expansion of a high-quality program.

A review of program practices reflected a high-level of consistency between the perceived importance of the indicators and the extent of their implementation and practice. The factors that were in greatest practice by a majority of programs in the study sample were also among those of highest importance. Administrators and faculty in high-technology programs appear to be practicing what they deem to be important. What was perceived as important reflects many fundamental policies and practices that are important in many types of technical education. In summary, several key themes were reflected in the survey data collected from 74 educators and 68 employers. Across 84 high-technology programs in 13 different technology areas, the following were judged as essential or very important elements:

- Technologically up-to-date faculty, equipment, and curriculum.
- Program content and practices that are highly relevant to the business/industry work environment and organization demands.
- Close attention to the needs of students including educational and financial support and responsive curriculum.
- Underlying all of the above was the theme of close cooperation and mutual support between an educational institution and the related business/industry community.

In addition to the project survey activities, a self-assessment process and supportive materials were developed and are offered to the high-technology educational community. It is hoped that faculty and planners in high-technology programs will find the instruments and suggested procedures helpful in start-up planning and/or program improvement activities.

The following profile information is offered for those who are involved in high-technology programs or are interested in their general characteristics. The information applies to only those programs involved in the project but can, with caution, be considered as reflecting a typical program.

On the average, programs involved in the survey have 3.7 full-time and 4.6 part-time faculty teaching 108 students majoring in the program. The average lecture session has 22.5 students, whereas laboratory sessions average 15 students per session. Program facilities and 4 laboratories with a total of 6884 sq. ft. of usable floor space.

An average annual budget of $442,000 provides for faculty salaries (74 percent), laboratory teaching assistants (8 percent), equipment and supplies (12.3 percent), and program maintenance (5 percent). The average yearly cost per "Full-Time Equivalent" student enrolled is $2,307.

Advisory panels consisting of 10 members meet an average of 2.5 times a year, with more frequent informal and individual input to program faculty.

In summary, about half of the sample programs evolved out of older technology programs (engineering, electronics) started in the late 1960s and early 1970s, whereas the others (biotechnology, laser, computers) were developed as new programs during the last 6-8 years in response to emerging technologies. Changes, adaptability, and flexibility will increasingly characterize these successful programs.

INTRODUCTION

This publication was developed to provide administrators and faculty in 2-year postsecondary institutions with a self-review and assessment tool. The contents of the publication focus on the features, characteristics, and practices that were judged as important indicators of program quality.

The publication is divided into three chapters that address each of the following questions in turn. What is high technology and what are the related educational implications for program practices? What are the essential elements that contribute significantly to the educational quality of a high-technology program? At what level of practice and rate of implementation do the quality elements exist in programs?

A detailed and thoughtful discussion about high technology, reflecting the writings and thinking of scholars and scientists down through the ages, is presented in Chapter 1. It attempts to answer the first question.

Answers to the second and third questions addressed by the project represent the combined judgments of over 140 knowledgeable educators and high-technology industry representatives. Survey results are presented to illustrate the experiences and practices found in over 75 high-technology programs in 25 different states.

Finally, Chapter 3, presents a suggested approach and set of steps to guide administrators and faculty in conducting a self-review and assessment of their own program.

CHAPTER 1

A DISCUSSION OF HIGH TECHNOLOGY

High Technology: What Is It?

Although the term high technology has gained widespread usage in recent years, it remains an elusive concept. Few people who use it are able to render a precise definition (see Useem 1986, pp. 17-19). In most cases it is left undefined, assuming some common or general understanding. In other cases, the term is applied with trepidation to industries or processes that may or may not lie within its scope. Some see the application of the term to a very limited number of industries or processes with no widespread application or impact. Still others dismiss the term as only a "buzzword" with no implications for substantive differences in technological processes. If nothing else, the confusion argues the need for clarification.

Given that the term high and its alternative qualifiers--new, advanced, and emerging--that are increasingly applied to technology imply qualitative change, it might be fruitful to explore exactly what is changing and how. Drawing from the literature on change in different areas, one can begin to sharpen the concept of high technology and bring its implication into clearer focus by considering it within a much broader context of change. Transition along at least four dimensions is important--(1) conceptual, (2) instrumental, (3) environmental, and (4) structural--all of which are both producers and products of change. This introduction explores technological change within each of these four dimensions, suggests alternative terms which might be employed to refine the concept, and discusses the implications of changes on technical education in particular.

Dimensions of Technological Change

In the almost universally acknowledged transition from an industrial to a postindustrial era (for a dissenting opinion see Stearns 1984), the impact of technological change on our lives is dramatically apparent. Figure 1 delineates four dimensions of that transition--conceptual, technical, environmental, structural--to bring it into clearer focus.

The Conceptual Transition

The conceptual transition--a change in the way we view the world--is in large part a shift from mechanistic/reductionist to organic/expansionist doctrines. The two related doctrines, mechanism and reductionism, are rooted philosophically in the Renaissance and sparked the 18th Century Age of Enlightenment and the Industrial Revolution. Two of the most influential proponents of the concepts were French philosopher Rene Descartes and English physicist Sir Isaac Newton. Five of the key components of the doctrines as directly espoused or implied by Descartes are presented below.

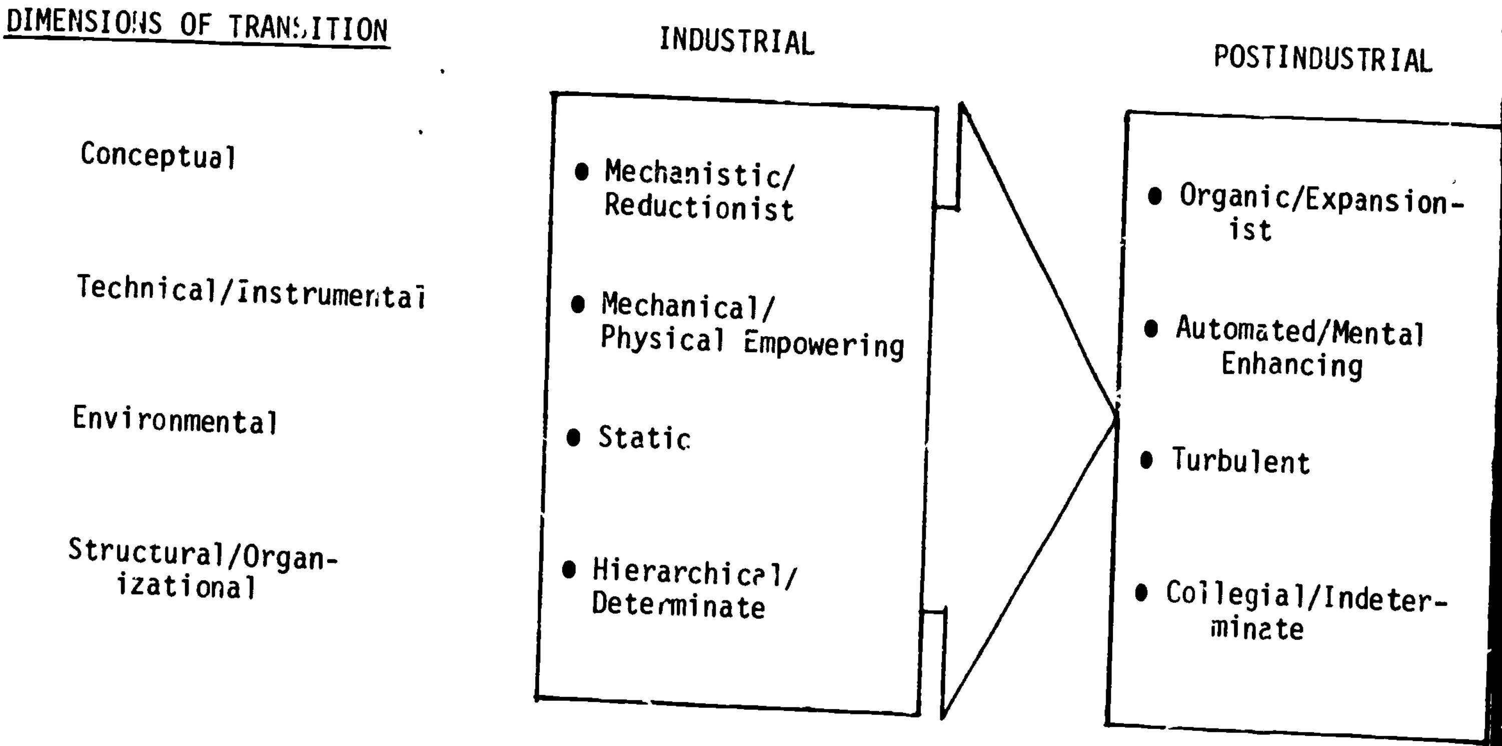

Figure 1. Dimensions of technological transition

First, all of nature was divided into two parts: (1) matter--the external or physical world that provided our only direct experiences, hence, our only source of true knowledge, and (2) the mind--the thinking substance that was controlled by God and belonged to the spiritual realm. Second, plants and animals, like all other matter, were comprised of tiny particles operating under laws of motion and were therefore essentially machines. "Thus did Descartes regard animals a piece of clockwork, and Robert Boyle (a philosopher and physicist of the same era) the human body as a 'matchless engine'" (Baumer 1961, p. 255). Third, any object or event could be understood by reducing it to its ultimate parts and studying the parts--the principle of reductionism. Fourth, everything that occurred in the world--the effects--was completely determined by something that preceeded it--the cause. Anything that could not be disassembled for study could be explained by its cause-effect relationships.

Newton's publication of Principia Mathematica in 1687 added mathematical laws to the mechanistic concepts that could be used to calculate the movement of objects under the influence of gravitational pull. The laws established a nonmysterious relationship between the forces that govern falling objects on earth and the forces which govern the operation of the solar system. His findings helped to solidify the conceptualization of a clocklike universe set on a mechanically predetermined course (Schroeer 1972). Mechanistic reductionist doctrines left an indelible impression on Western thinking. As a natural extension of reductionism, analysis--the process of breaking material to be understood into its lowest constituent parts to derive an understanding of the whole--became the pervasive mode of inquiry. The world was regarded as deterministic, and systems in which events occurred were conceptually "closed" to outside or environmental influences. Scientific research was separated into ever finer specializations with little communication between them. Because the physical world was considered the ultimate reality, physics was regarded as the premier subject for study, and the proper source from which other scientific (including social scientific) concepts were derived (Ackoff and Emery 1972, p. 3). Physics postulated the atom as the ultimate indivisible particle of matter, chemistry reduced matter to elementary substances, biology reduced life to the cell, psychoanalysis reduced personality to the id, ego, and superego (Ackoff 1974, p.9)

In illustrating the practical influences of mechanism and reductionism, Fritzoff Capra (1982) points out that in medicine, for example, the body is regarded essentially as a machine analyzed in terms of its parts. Disease is viewed as a malfunction of biological mechanisms studied from the perspective of cellular and molecular biology. Doctors, specialized in different parts, intervene either physically or chemically to correct the malfunctioning of specific mechanisms. The orientation, notes Capra, inhibits consideration of the interdependency of other tissues, organs, or psychological or social aspects.

Organic or systems concepts, which were under development around the turn of the century, began gathering momentum in the 1940s. A selfconsciousness of their distinct utility in explaining living and social phenomena and of their expansionist quality sparked the postindustrial revolution. Expansionist doctrine never considers objects or events as discrete parts, but rather as parts of larger wholes. It does not counter, but complements reductionism and analysis. Three interrelated lines of development important to the conceptual transition are identified below.

First, features unique to living systems, which distinguish them from nonliving systems, were being discovered from about the turn of the century. Self-regulating or homeostatic processes in living organisms were being identified whereby information on variation from some norm is fed back into the system to restore its internal equilibrium. Living systems are therefore purposeful rather than externally controlled (Dechert 1971, p. 72). Drawing on other developments in biological sciences, Ludwig von Bertalanffy (1950) delineated three tiers of functional interdependence in living systems--between (1) internal parts, (2) internal parts and the whole organism, and (3) the organism and its environment--that provide a more appropriate conceptualization of life and social phenomena than does the machine. The system as a whole can do more--that is, greater than--the sum of its parts; and it is open not closed to its environment.

Second, in the 1940s, it was noted that attention in philosophy over the previous two decades had shifted attention from elementary particles and their properties to symbols--essentially nonphysical elements--that produce a response to something other than themselves. In a series of conceptual expansions, as opposed to reductions, attention shifted from symbols to language, language to communication that formed the communication sciences (Ackoff 1979, p. 12).

Third, the Cartesian/Newtonian concept of a universe comprised of discrete particles that form fundamental building blocks was destroyed by electromagnetic experiments and Einstein's theory of relativity. The developments showed that subatomic particles have mass in the form of energy, but no material substance. The universe can thus more appropriately be considered a complex web of relationships than a machine. "Energy patterns form stable atomic and molecular structures that build up matter and give it a macroscopic solid apperance" (Capra 1982, p.22).

The Technical Transition

The technical transition--a change in the design and application of tools and techniques--is both the product and producer of change in the other three dimensions. Two features of the technical transition are (1) a shift from mechanical to automated tools and (2) a shift in application from increasing physical power to enhancing problem-solving and decision-making capability.

Prior to the industrial revolution, the craft worker served as the source of both direct energy and control of his machine (Dechert 1971, p. 78). In the transformation to industrialization, complex tasks were scientifically analyzed and reduced to simple, elementary operations. Where possible, human tasks were replaced by machine. Steam replaced muscle as a constant source of power to overcome the problem of human fatigue; wheel transmission provided a regular, repetitive operation (Herbst 1974, p. 14).

A continuing goal in machine development has been to increase flexibility by removing mechanical constraints. Hirschhorn (1984, 19-24) cites three mechanical developments in that direction. (1) The development of portable electric motors freed machine parts from being connected to the same primary power source, thus allowing them to move at different speeds. (2) The invention of the slide rest, a tool for automatically feeding a cutting tool to a metal piece to be shaped, freed the hands of the operator, as a means of feeding the operation. (3) A cam is "a specially and often irregularly shaped" replaceable machine component with an attached follower that is in turn equipped with a cutting tool. As the cam turns, its shape or some transformation thereof is imparted to the tool. The invention of the cam improved machine flexibility because it could produce a wide variety of shapes "without stripping down and rebuilding the machine (for each) new design" (p. 22).

As tools were freed from reliance on human energy in the industrial age, they were freed from direct human control in the postindustrial age. Three lines of development form the basis for tool automation in the postindustrial era. First, predating recognition in the 1940s of the philosophical preoccupation with symbols and communication was a series of communications-related inventions (Ackoff 1974, p. 17). The mechanization of symbol transmission was enabled by the invention of the telegraph in the early 19th century, the telephone, the wireless in 1895, and the radio and television in the 20th century. Another series of devices was developed that could observe and record properties of objects and events--for example, the thermometer, odometer, speedometer, and voltmeter were invented; and electronics was applied to mechanized observation through sonar and radar developed in England in 1937.

Second, the principles of autonomic or self-regulating processes in human neurophysiological systems were seized upon for their application to tool design. Norbert Wiener (1961) perceived the importance of communication control in self-regulatory systems and founded cybernetics--the science of control through communication. By the early 1940s an interdisciplinary approach to the development of servomechanisms--self-regulating machines that could be used for military purpose--was underway.

The self-correcting concept is based on a cyclic feedback loop or process built into the system. In the process, a sensing device perceives the system's variation from a predetermined goal and transmits the information to a selector or decision-making element. The selector compares the information with the objective or goal and transmits the information to an effector that adjusts the system to its goal. In a closed loop, the search is within the system; in an open loop, part of the search is carried on outside the system's environment. Flexibility derives from the fact that there is no predetermined sequence of actions as in mechanical systems, rather the system responds flexibly to changing environmental conditions to achieve its goal.

Following from cybernetics was the development of digital computerization. Computerization permits automatic execution of long and detailed logical manipulation of data otherwise beyond human capability. It also allows a rationality and precision in decision making unattainable before their invention.

The Environmental Transition

The environmental transition is a change in social, economic, political and interorganizational conditions in which an organization must operate. The shift has been from relatively static to turbulent environmental conditions.

In the mechanized world of the industrial era, the United States had achieved technological and industrial superiority dating from the last quarter of the 19th century. It had abundant physical and capital resources that provided a confident self-sufficiency. For the first three-quarters of the 20th century, it was faced with little competition. Although the United States pioneered in technological innovations, once industrial dominance was firmly established after the turn of the century, industrial adoption of technological changes was relatively slow.

Robert Reich (1983) notes that as late as the early 1960s, only 8 percent of U.S. economic goods were subject to foreign competition. With domination of domestic markets, similarity in production processes allowed capital and labor to be shifted easily from declining to growing industries. Consumer's choices were largely limited to domestic products.

In the post-World War II years, the reindustrializing countries in Northern Europe and Japan became prime beneficiaries of postindustrial technical innovations. By the mid-1970s, in a more competitive economic environment, the pace of change and the rate of technical adoption was increasingly externally set--to a great extent by Japan. By 1982, about 70 percent of U.S. goods were open to foreign competition (Reich 1983). In 1984, foreign producers made one of every four cars, one of every eight personal computers, two of every three pairs of shoes, and nearly every videocassette player.

The special brand of environmental unpredictability and uncertainty increasingly characteristic of the postindustrial era has been labeled "turbulent" by Emery and Trist (1965). Four features of turbulent environments are (1) factors are sufficiently interdependent so that a series of changes can be set off by the actions of a single event, (2) the changes take on a self-perpetuating life of their own, (3) the direction or duration of changes defy prediction, and (4) they are beyond the capacity of any single organization or small group of organizations to control. Turbulent conditions are caused by strategic moves of large organizations to operate unencumbered by other forces and the accelerating pace of organizational and technical developments to meet competitive challenges.

Structural Transition

The structural transition--a change in organization design to meet environmental conditions--shows a movement from a hierarchical/closed model to collegial/open systems.

During the industrial era, whether the focus was upon manufacturing (Taylor 1967), service units of organizations (Gulick and Urwick 1937), or government (Weber 1947), a common set of organizational principles based on mechanistic concepts applied. The model was concerned with achieving maximum efficiency through highly standardized, optimally functioning organization. Uncertainty was reduced, and a determinate operation achieved by conceptually closing the organization to outside influences--an easy process in the highly insulated, slowly changing environment of the era. The organization was always subordinated to a "master plan" flowing in pyramid form from a single head of the organization to successively larger layers of subordinates with decreasing skill levels. In manufacturing organizations, the work was particularly fractionated. "The semi-skilled worker performed rote tasks; the skilled worker varying tasks within a fixed framework" (Hirshhorn 1985).

Organic principles, first applied to automated tool design, become appropriate for organizations that must function in the turbulent environmental conditions of the postindustrial age. Adaptable organizations are essentially open systems--that is, they detect changes in the environment and feed the information back to allow the system to adjust to ambient conditions. In the new organizational design, information flow becomes highly valued. As a consequence, hierarchies are eroded. Firms no longer have the luxury of allowing communication to pass through several layers of organization and get distorted or lost on the way (Herbst 1974).

Adjustment to novel situations requires organizational learning. Constantly forming and reforming networks, based on neural networks that can create new paths for novel responses in human systems, replace hierarchical structures. Interdisciplinary knowledge, a holistic understanding of the organization and one's relationship to it, and an ability to interchange functions replace narrow specializations.

Tightening the Definition of High Technology

The previous section identified four interdependent dimensions influencing a general transition from mechanistic to organic systems. The question remains, however, as to the essential features of high technology, and high-technology occupations, industries, and programs.

To begin the clarification, technology will be defined as the development or utilization of tools to extend human capability beyond its natural limits (adopted from Faddis, Ashley and Abram 1982, p. 21). Drawing from the discussion in the previous section it was shown that the conceptual basis underlying machine (or tool) development and human organization underwent a transition from the industrial to the postindustrial era.

Figure 2 suggests that the level of technology may be measured along two dimensions: (1) the level of machine (or tool) intelligence employed, from low to high, and (2) the level of human intelligence employed in the operation, from low to high. Intelligence in both instances is used to connote the self-regulating concepts applied to machine and organization development in the postindustrial era. It is important to clarify further that human intelligence does not refer to innate ability, rather it refers to the interdisciplinary and organizational attributes required at the technical core or productive level in flexible organizational structures. The four technology types are described below.

LEVEL OF MACHINE INTELLIGENCE	LEVEL OF HUMAN INTELLIGENCE: LHI	HHI
LMI	LMI/LHI TYPE I	LMI/HHI TYPE II
HMI	TYPE III HMI/LHI	TYPE IV HMI/HHI

Figure 2. Classification of technology types.

In Type I technologies, both low machine and low human intelligence are employed in the productive process. Type I productive processes include most large manufacturing organizations characteristic after the industrial revolution. They are suited for producing large volumes of highly standardized products. However, they are incapable of responding to sudden environmental changes that call for flexibility in product designs or other sudden responses to rapidly changing conditions facing the organization.

In Type II technologies, a low level of machine intelligence but a high level of human intelligence are utilized. Type II technologies include manufacturing or craft operations prior to the industrial revolution when the craftworker exercised complete control over the productive process and was required to have a holistic perspective of this operation. It is still typical of many small shops today. The type also includes traditional professional firms in the service sector such as those in law or medicine. In both cases, competition is forcing the adoption and integration of greater machine intelligence.

In Type III technologies, productive processes utilize a high level of machine intelligence and low human intelligence. The category encompasses some manufacturing firms in a transitional stage where workers still perform rote functions, but where automation is being introduced. Service organizations in this category include those where personnel who perform limited functions, such as routine clerical processing, are vulnerable to substitution by automatic teller machines and programmable cash registers. Here the tool may have high flexibility but is employed in combination with a worker with limited skill training thus rendering the organization inflexible.

In Type IV operations, both machine intelligence and worker intelligence are high. Although high machine intelligence is employed, it does not substitute for but simply expands the workers' problem-solving, decision, or creative capacity. The tasks still left for the worker include those of machine programming, high-level monitoring operations required to control the productive processes, and trouble shooting to maintain and repair the machinery. Worker, machine, and organization are all highly flexible and adaptable to changing conditions--that is, capable of learning. As competition increases, Type IV operations are becoming increasingly required in both the goods and service producing sectors of the economy.

Employing the typology outlined as a tool, we can further clarify definitions. First the typologies may be used to determine man-machine relationships and thereby to classify single occupations. Thus Type IV occupations would be classified as high or advanced technology occupations.

Likewise an organization characterized by Type IV man-machine relationships would be classified a high- or advanced-technology organization. With respect to organizations, it is important to point out (1) that different departments of an organization might be characterized by different types--for example, type IV manufacturing operations with Type III office functions--and (2) that an organization might not be representative of other organizations in its industry.

It also follows that industries in which the typical organization falls into a given category--for example, a requirement for survival in the industry is that the organization be Type IV--may be classified as a high-technology industry.

There is still a question remaining over the use of terms. Given that the horizons of development in tools, processes, and organizations are constantly receding, how enduring is the application "high technology"? (See Useem 1986, p. 19). A suggestion for dealing with this problem is to make two distinct terms: (1) For those technological developments that are at the cutting edge in their field and fulfill type IV requirements, the term <u>emergent</u> should be reserved. (2) Since <u>high</u> and <u>advanced</u> are relative terms--that is they must stand in relationship to something--they should simply be understood to refer to technologies with type IV or postindustrial, self-regulatory characteristics thus eliminating the buzzword quality.

Postindustrial Implications for Program Design

The two preceding sections delineated four mutually reinforcing dimensions of technological transition from the industrial to the postindustrial era and developed a typology of functional relationships between tool and organization design to clarify concepts of high technology. This section uses those previous sections as a basis for pointing to broad areas that should be given attention in the design of advanced technology programs.

The interdependence between industrial and educational organizations suggests that they will be affected by similar environmental forces bringing about a similarity in structural features. Herbst (1974), for example, makes the point that the model used for structuring the educational task will determine the characteristics of the educational organization. He points out that organizations in highly industrialized nations, therefore, have largely acquired the organizational characteristics for operating in the slow-changing environment of the traditional factory. With the rapid changes in specific fields of knowledge on the one hand, and rapid changes in industry and society on the other, there is a need to build a capacity for rapid adaptability into educational organizations in general. The need is particularly pronounced for technical education programs concerned with advanced and emerging technologies.

Adaptable programs are themselves learning systems--that is, they have the capacity to sense environmental changes and the internal flexibility to make rapid adjustments to novel environmental conditions. Moreover, program adaptability is required to transfer the capacity for continued adaptability to students.

The capacity to monitor environmental changes implies that the program is either directly linked to, or is otherwise in a position to sense forces and trends from, external sources that have a capacity to affect its operation. Following is a sample of suggested program features for increased environmental monitoring targeted by sector:

- Business/industry--faculty membership in local business organizations, provision for contract services by program or faculty to business/industry, maintenance of active advisory committees, faculty research in technological processes, joint or cooperative research efforts; program surveys of private industry.
- Government--participation on local/state economic development committees; service on commissions, task forces, committees; technical assistance to legislative bodies.
- Education--maintenance and service in professional organizations; vertical/horizontal cooperative relationships with other educational institutions, horizontal/vertical articulation agreements with 2-year and 4-year programs.

Under increasingly turbulent environmental conditions, the ability to adjust to novel conditions is dependent upon a rich network for communicating ideas (Nadler and Robinson 1983) combining knowledge and interchanging functions. In an educational setting, it also requires some sense among faculty members of the interdependence of their subjects. Equally important is the opportunity for faculty members at all levels to participate in defining the direction and working through the process of organizational change (Herbst 1974). A list of features that contribute to structural flexibility in technical programs include the following:

- Cross-training of faculty in various subject areas
- Flexible work schedules for faculty
- Team teaching for faculty in complimentary subject areas
- Faculty participation in program decisions--freedom to explore, implement, and test organizational alternatives

The ultimate test of an advanced technology program's relevance is the curriculum instructional design. The design will be a close reflection of the program's ability to monitor the environment and adapt to rapidly changing environmental conditions. It will also become a factor in the student's placement and his or her continued adaptability in the world of work. The curriculum and instructional format may be divided into three areas for consideration: (1) content, (2) delivery system, and (3) evaluation (Groff 1983). The division is employed to suggest program features that further contribute to program adaptability:

- Content--strong emphasis on basic skills, broad interdisciplinary core requirements, strong computer content to extend problem [illegible] capacity, emphasis on problem solving, emphasis on interpersonal skills.
- Delivery system--closely simulates workplace environment, integrates work and learning opportunities through industry training arrangements, teachers act as resource persons to aid students in reaching solutions rather than as authorities, students encouraged to work in teams rather than competitively, program is vertically and horizontally articulated to accommodate maximum flexibility for students; students advised on important features in assessing job opportunities, students are custom placed into jobs
- Evaluation--competency-based, multiple rather than single ways of arriving at solutions to problems

For a great number of people, the term high- or advanced technology conveys little substantive meaning. On closer examination, however, the technological transition can be viewed in the context of a set of highly interdependent changes which are cutting across the conceptual, instrumental, environmental, and structural dimensions of society. The transitional forces of the postindustrial age are at least as profound, if not more so, as those that ushered in the industrial era.

It is clear that the degree of utilization of high machine intelligence is increasing rapidly and at this stage of the transition, the logic of human replacement characteristic of the industrial age still prevails in many productive processes. The long-term trend, however, is toward greater human involvment with more discretionary power aided by machine intelligence (Nadler and Robinson 1983). Education, in general is calling for sweeping reforms to equip people to function with current and emerging technologies. In the transition, requirements for technicians in particular are undergoing change from narrow specialization in a technical field to the acquisition of increasingly broad interdisciplinary skills encompassing both technical/scientifc subjects and interpersonal skills. To survive, technical programs will have to understand and reflect the new logic.

CHAPTER 2

A SURVEY OF HIGH-TECHNOLOGY PROGRAMS

Introduction

This section presents the rationale, procedures, and results of a survey of exemplary high-technology education programs in 2-year postsecondary colleges. The purpose of the survey was to identify and validate a set of quality indicators that relfect important practices and policies among high-technology programs. A second objective was to assess the level of practice. The survey resulted in a profile of the characteristics and features that are considered by educators and industry representatives to be highly related to program quality. The indicators were incorporated into a self-assessment form and process that is presented in Chapter 3 of this publication. The following discussion explains the general approach and procedures followed in conducting the survey. Several tables present the overall results of the survey, and an interpretation of the findings is offered.

Survey Approach and Methods

The approach taken in designing and conducting the survey of high-technology program quality indicators was based on several assumptions. First, it was assumed that the state-level leadership for postsecondary community and technical colleges in each state would be a reliable source to identify leading high-technology programs. Therefore, the appropriate board or department in the sample of states was contacted to nominate programs to be surveyed.

A second assumption was that the leading programs have adopted various practices that contribute to successful program operation and outcomes. It was reasoned that a survey of leading programs would reveal the experiences and judgements of faculty with respect to the factors they had found over time to impact significantly on program quality. Acting upon the given assumptions and reasoning the following activitites were conducted.

Nomination of Quality Indicators

The names of deans, chairpersons, and lead faculty members from 25 institutions with previously recognized exemplary high-technology programs were selected from publications and reports. The individuals were sent an open-ended survey form that requested that they nominate the most important indicators of quality in their respective programs. Responses were provided in the respondents' own words along with explanations and descriptive material about the program. The nomination survey activity produced 55 statements or descriptors of practices and policies. The statements were identified in six categories as follows:

o Faculty and staff

- Facilities and equipment
- Curriculum and instruction
- Business and industry cooperation
- Budget, resources, and support
- Student recruitment, selection, and support

The initial list of nominated indicators were reviewed, combined, and reworded into a consistent style and format.

Verification of Quality Indicators

The next major activity was directed toward verification of the initial set of indicators. The approach was to resubmit the list to a large group of educators and industry personnel for their review and rating. Letters were sent to 30 randomly selected state departments/boards of 2-year postsecondary colleges and technical institutes, asking each to nominate their four to six leading high-technology programs. A total of 25 states returned the nomination forms for a total of 84 candidate programs in 13 different technological areas. A lead faculty member or administrator in each program was contacted and asked to participate in the survey. In addition, each educator was asked to name one or two business/industry representatives who were employers of their program graduates. A total of 76 employer names were provided. The final sample for the verification survey included 84 educators and 76 employer representatives.

Survey packets were prepared and mailed to each person in the sample. A period of 3 weeks was allowed for returns after which nonrespondents were called and encouraged to return the survey form. Final responses were received for a total of 74 educators and 68 business/industry representatives.

The survey questionnaire consisted of the nominated indicators arranged so each one could be rated on a 1-7 scale in terms of its importance to program quality (see appendix B). Tabulation of the survey data resulted in an average importance rating for each indicator. Importance ratings across programs are presented in appendix C. Space was provided for comments and its nomination of additional indicators. No new indicators were generated although some comments were offered from respondents. Data were summarized and the overall rank order of the indicators was determined as was their order within each category. Differences in importance rating across the program areas was also calculated and are reported in the following section.

The second phase of the survey was designed to measure the relative level of practice or implementation of each indicator among the programs included in the first survey. A modified form of the verification survey was prepared and mailed to the educators in the sample (see appendix D. A total of 44 usable returns were received. The lower number of usable surveys was due in part to the type of data requested, changes in several faculty personnel, and the fact that faculty in very new programs could not answer many of the questions. The results of the second survey are reported and discussed as a representation or "snapshot" of a small sample of programs. It was not intended to reflect national or regional trends and should not be viewed as doing so. Information abaout the programs was collected from the respondents and is reported in appendix E.

Survey Results

A total of 46 indicators was rated by educators and employers as important to high-technology program quality. Based on the overall rank and importance ratings, the indicators were divided into four groups labeled as essential, very important, important, and not important. Ratings for the indicators are reported in Table 1.

Essential Indicators

The first group of indicators, numbers, 1-11, were rated as essential to a quality program. These indicators, rated 6.0 or above on the 7.0 point scale, are descriptive of practices that occur during the development phase of a program. That is, project staff viewed the first 11 indicators as essential to the successful establishment of a sound program. In addition, the underlying themes of currency and relevance are suggested by the 11 indicators; currency means that high-technology programs must be on the forefront of technological developments. Programs should incorporate current practices, and also, should prepare students for changes and developments that will occur in the future.

Relevance means the program should, in terms of content, skills, equipment, and practice, reflect the realities of the work scene the technician will enter. Frequent and systematic input from business/industry contributes to efforts to keep programs relevant.

Each of the 44 programs surveyed were requested to complete a program description. Along with statistical information such as the number of faculty, students enrolled, floor space, and so forth. Also respondents were asked for a description of the program's design and operation, key or unique features, and the current status of the program's content and operation. These descriptions yielded a number of common practices that are related to program quality.

The development of current and relevant programs were specifically described as having well-equipped, up-to-date laboratories to which all students had full access.

The most common feature across 44 programs that was essential in developing a high degree of relevance was the guidance of an advisory committee. An active committee ensures that the program is in touch with the current status and future needs of high technology industries. The committee also ensures that equipment and facilities are similar or the same as those being used in industry.

TABLE 1

PROGRAM QUALITY INDICATORS

Indicators (Rank Order)	Importance Rating
1. Faculty attend conferences, workshops, or seminars to keep up to date in their technical field.	6.6
2. Programs provide fully equipped lab and work stations for students.	6.5
3. Cooperation includes frequent input from advisory committees of business/industry personnel.	6.4
4. The curriculum reflects the newest technological developments and applications.	6.3
5. Budgets include funding to upgrade and update equipment as programs mature.	6.3
6. Program facilities and equipment are the same as or very similar to the type found in business or industry.	6.2
7. Curriculum and instruction stresses the development of problem-solving abilities.	6.1
8. Programs recruit and enroll superior high school students (GPA of B or above).	6.0
9. Cooperation includes the development of customized training programs for business/industry personnel.	6.0
10. Programs promote the success of graduates as a recruitment aid.	6.0
11. Curriculum and instruction are formulated on and incorporate performance-based objectives and evaluations.	6.0
12. Programs test and place students in basic skills improvement courses if needed.	5.9
13. Programs test and place students in basic skills improvement courses if needed.	5.9
14. Programs receive vendor technical assistance in implementing hardware and software systems and applications.	5.9

Table 1--Continued

Indicators (Rank Order)	Importance Rating
15. Cooperation involves faculty in business/industry work experiences or projects to help maintain their occupational expertise.	5.8
16. Cooperation includes private sector support through donations of equipment and/or funds.	5.8
17. Curriculum includes special courses to strengthen math and communication skills.	5.8
18. Program facilities and equipment allow maximum integration and replication of workplace settings.	5.8
19. Programs recognize students' dedication and motivation in addition to intelligence.	5.8
20. Budgets include grants to purchase special equipment.	5.7
21. Budgets include funding for new faculty positions.	5.7
22. Faculty have at least 3 years of recent work experience related to their teaching area.	5.6
23. Programs collaborate with high schools to better prepare students for postsecondary education.	5.6
24. Curriculum content first develops core technical skills and then develops specialized skills.	5.6
25. Budgets include funding to hire laboratory assistants to maintain facilities and equipment.	5.6
26. Faculty hold professional degrees in the technical field in which they teach.	5.3
27. Cooperation includes student participation in work experiences at local business/industry sites.	5.3
28. Curriculum content stresses the development of interpersonal skills.	5.3
29. Programs have lab assistants to set up, service, and maintain equipment.	5.3
30. Budgets provide for faculty salaries that are competitive with private sector salaries.	5.3

Table 1--Continued

Indicators (Rank Order)	Importance Rating
31. Program equipment is available to business/industry personnel for instruction and demonstration.	5.2
32. Faculty stay informed about comparable technical programs in other institutions.	5.2
33. Faculty are active members in a professional or technical education association.	5.2
34. Programs have flexible facilities that can accommodate periodic equipment and curriculum changes.	5.1
35. Curriculum is articulated with related curricula in 4-year institution programs.	5.0
36. Faculty have previous teaching experience in industry, education, or the military.	5.0
37. Cooperation includes the loan of business/industry personnel to serve as adjunct faculty.	4.9
38. Budgets are separate from other technical program budgets.	4.8
39. Cooperation involves joint industry faculty participation at conferences, trade associations meetings, and presentations to other groups.	4.7
40. Faculty serve as consultants to business or industry.	4.7
41. Curriculum is articulated with secondary pretechnical or vocational courses.	4.6
42. Faculty participate in programs to enhance their teaching skills.	4.3
43. Curriculum and instruction use computer-assisted instructional systems.	4.2
44. Curriculum and instruction incorporate self-paced individualized learning materials.	4.0
45. Faculty publish articles or books on topics in their technical field.	2.7
46. Faculty conduct funded research activities in their technical field.	2.5

Very Important Indicator

The second division of the 46 indicators are numbers 12-36 and were rated from 5.0 to 5.9 on the importance scale. If it is agreed that 1-11 are essential to the development of a quality program, then the second set is very important to the operation and maintenance of a program. Specifically, three underlying themes are apparent: cooperation with business and industry, attending to students' needs, and enhancing and enriching the curriculum so that it remains adaptable to change and educationally challenging.

Looking beyond the advisory committee, representatives from business and industry can help maintain a cooperation by aiding in the design of programs and selection of equipment. Training is thus directed at both educational and industrial needs.

Students' needs are also considered when representatives, offering their knowledge of industry, help students direct their training toward a specific goal and even aid in their placement. The close cooperation allows industries, with direct affiliations to a program, to recruit top students from the program to begin work upon graduation.

The curriculum offered by the high-technology programs tends to be more generic in nature. The broad range of courses offer the students full exposure to several content areas, and thus allows them to either:

- o diversify and broaden their interests,
- o design a specific curriculum sequence in order to specialize in a 2-year program, or
- o transfer to a 4-year program. The ability to make adjustments in the curriculum is very important.

Important Indicators

The third division of indicators are these that are important to program quality. These indicators, numbers 37-44, were rated between 4.0 and 4.9 on the importance scale. A review of the indicators suggests a focus on refining the activities of the entire program. Although not essential, these features can make the program more attractive. Several programs reported that they separated their laboratory and classroom instructors. By offering both classroom instructors and laboratory instructors, each can concentrate on specific materials and give students more tutoring aid. An instructor is thus available at all times.

Self-paced individualized learning materials and computer-assisted instruction help meet alternative student learning-styles. However, the rapid pace of curriculum changes required to stay up to date often are far ahead of the development of good individualized and computer-phased instructional materials.

Levels of Practice

A secoı round survey was conducted among the educators in the sample. The questionnaire was designed to obtain measures that would reflect the relative level or extent of practice for each of the quality indicators. Answers to the survey questions were given as percentage measures. For example, question 1 asked for the percentage of program faculty that attend a conference/workshop/seminar annually to keep up to date in their field. Responses could range from 0 percent to 100 percent. The procedure followed in tabluating the data consisted of grouping responses into four percentage ranges as follows:

- 1 to 25%--low level
- 26 to 50%--moderate level
- 51 to 75%--high level
- 76 to 100%--very high level

The results are .eported according to the number of programs that responded in each of the four ranges. Usable responses were received from 44 program faculty in 9 technological groups as follows:

- Laser, 3
- Robotics, 4
- CAD/CAM, 6
- Microelectronics, 6
- Health/Biotechnology, 5
- Computer, 3
- Engineering, 9
- Communication, 2
- Others*

*Programs included in the Others category included W.. .cing Consultancy Project, Science Laboratory Technology, Microcomputer (certificate program) Applications, Office Information Technology, Quality Assurance Technology, Avionics Technology

Survey Results

The results of the second survey provide an initial look at the levels of practice for each of the indicators and features of a quality program. The results reflect the degree of consistancy between the perceived importance of various practices and the extent to which they have been implemented across a small sample of high-technology programs. Recognizing that many high-technology programs are and will continue to be in a state of transition and change, the reader is cautioned not to place undue emphasis on the data reported here. At this point in time, it is impractical to draw hard conclusions about the ideal level of practice for the various indicators. Other programs, because of their content, curriculum focus, organizational structure, student body, funding, or any one of a number of other functions, may have higher or lower levels of practices on some variables. In fact, the range of variation among the programs in this study was great. Also it is important to keep in mind that programs with small numbers (1-4) of faculty reported percentages that have quite different meanings from programs with larger numbers of faculty. For example, if 3 of 4 faculty members attend a conference, the percentage reported was 75 percent. When compared to a faculty group with 5 of 10 members attending a conference, a 50 percent rate, the real difference is not apparent. The possibility of such differences between a readers program and data presented here should be considered in making comparisons and drawing inferences. However, the results presented in table 2 is not without validity and usefulness. At least one of three observations can be made with respect to the pattern of program responses. The possible observations include

- o the majority of response cluster at the upper level of practice,
- o the majority of responses cluster at this lower level of practice,
- o the responses are spread across the levels of practice.

In addition, attention should be given to the degree of consistency between the ranked position of an indicator and it's relative level of practice. Consider indicator 1 for example. The program responses clustered at the upper level of practice (30 programs at the "very high" level). This result would seem to be consistant with the logical premise that what is considered to be most important should be practiced to the greatest extent possible. In comparison, however, consider the respones to indicator 5.

Budgets include funding to upgrade and update equipment. Here, a different interpretation is reflected by the cluster of programs at the lower level. Recall that the "low" category translates into a 1-25 percent response, which means that 34 programs have from 1-25 percent of their budgets allocated to equipment replacement and update. It would appear as if the level of funding is relatively consistent across the sample. The question of the adequacy of the level of funding is not answered by the data that was collected.

TABLE 2

IMPLEMENTATION OF QUALITY INDICATORS

Indicators (Rank Order)	Level of Practice: Low	Moderate	High	Very High
1. Faculty attend conferences, workshops, or seminars to keep up to date in their technical field.	4	4	6	30
2. Programs provide fully equipped lab and work stations for students.	1	0	1	41
3. Cooperation includes frequent input from advisory committees of business/industry personnel.	20	6	3	12
4. The curriculum reflects the newest technological developments and applications.	15	6	12	11
5. Budgets include funding to upgrade and update equipment as programs mature.	34	5	0	1
6. Program facilities and equipment are the same as or very similar to the type found in business or industry.	2	5	6	31
7. Curriculum and instruction stresses the development of problem-solving abilities.	5	6	2	7
8. Programs recruit and enroll superior high school students (GPA of B or above).	18	15	3	0
9. Cooperation includes the development of customized training programs for business/industry personnel.	24	15	4	1
10. Programs promote the success of graduates as a recruitment aid.	0	5	4	33
11. Curriculum and instruction are formulated on and incorporate performance-based objectives and evaluations.	6	5	4	27
12. Programs test and place students in basic skills improvement courses if needed.	3	14	14	13
13. Programs test and place students in basic skills improvement courses if needed.	20	17	2	0

Table 2--Continued

Indicators (Rank Order)	Level of Practice: Low	Moderate	High	Very High
14. Programs receive vendor technical assistance in implementing hardware and software systems and applications.	15	10	1	7
15. Cooperation involves faculty in business/industry work experiences or projects to help maintain their occupational expertise.	15	15	3	4
16. Cooperation includes private sector support through donations of equipment and/or funds.	24	6	1	0
17. Curriculum includes special courses to strengthen math and communication skills.	24	6	1	0
18. Program facilities and equipment allow maximum integration and replication of workplace settings.	4	13	7	15
19. Programs recognize students' dedication and motivation in addition to intelligence.	12	12	9	4
20. Budgets include grants to purchase special equipment.	22	4	0	1
21. Budgets include funding for new faculty positions.	0	1	16	22
22. Faculty have at least 3 years of recent work experience related to their teaching area.	8	9	5	14
23. Programs collaborate with high schools to better prepare students for post-secondary education.	6	20	11	4
24. Curriculum content first develops core technical skills and then develops specialized skills.	4	10	8	21
25. Budgets include funding to hire laboratory assistants to maintain facilities and equipment.	30	0	0	0

Table 2--Continued

Indicators (Rank Order)	Level of Practice			
	Low	Moderate	High	Very High
26. Faculty hold professional degrees in the technical field in which they teach.	5	12	3	10
27. Cooperation includes student participation in work experiences at local business/industry sites.	18	5	2	5
28. Curriculum content stresses the development of interpersonal skills.	27	7	2	3
29. Programs have lab assistants to set up, service, and maintain equipment.	30	0	0	0
30. Budgets provide for faculty salaries that are competitive with private sector salaries.	0	1	16	22
31. Program equipment is available to business/industry personnel for instruction and demonstration.	14	2	0	3
32. Faculty stay informed about comparable technical programs in other institutions.	8	11	6	16
33. Faculty are active members in a professional or technical education association.	1	18	7	22
34. Programs have flexible facilities that can accommodate periodic equipment and curriculum changes.	2	2	6	31
35. Curriculum is articulated with related curricula in 4-year institution programs.	8	7	4	11
36. Faculty have previous teaching experience in industry, education, or the military.	8	7	3	3
37. Cooperation includes the loan of business/industry personnel to serve as adjunct faculty.	5	2	0	1
38. Budgets are separate from other technical program budgets.	22	4	0	1

Table 2--Continued

	Level of Practice			
Indicators (Rank Order)	Low	Moderate	High	Very High
39. Cooperation involves joint industry faculty participation at conferences, trade associations meetings, and presentations to other groups.	12	12	4	10
40. Faculty serve as consultants to business or industry.	7	14	8	10
41. Curriculum is articulated with secondary pretechnical or vocational courses.	12	7	3	3
42. Faculty participate in programs to enhance their teaching skills.	8	18	2	11
43. Curriculum and instruction use computer-assisted instructional systems.	16	6	0	3
44. Curriculum and instruction incorporate self-paced individualized learning materials.	19	3	2	1
45. Faculty publish articles or books on topics in their technical field.	12	12	1	2
46. Faculty conduct funded research activities in their technical field.	6	4	0	0

The following statements summarize broad levels of practice for each group of indicators.

Across the first 11 "essential indicators" program practices were distributed according to the following:

- Majority of programs with practice levels above 51 percent
  - --faculty attend conferences/workshops/seminars
  - --provide fully equipped labs and work stations
  - --curriculum reflects the newest developments
  - --facilities and equipment same as type in industry
  - --promote success of grads as recruitment aid
  - --curriculum incorporates performance-based approach
- Majority of programs with practice levels below 51 percent
  - --frequent input from advisory committees
  - --budget includes funding for equipment update
  - --curriculum stresses problem-solving abilities
  - --recruit and enroll superior students
  - --customized training for business and industry

Across the "very important" indicators, numbers 12 through 36, programs were sorted according to the following:

- Majority of programs with practice levels above 51 percent
  - --establish limits on class size
  - --facilities/equipment allow integration replication of workplace
  - --budgets include funding for new faculty
  - --faculty have 3 or more years work experience
  - --curriculum develops core skills then specialized skills
  - --faculty salaries are competitive with private sector salaries
  - --faculty stay informed about comparable programs

--faculty are members in professional/technical education association

--facilities accommodate periodic equipment and curriculum changes

- Majority of programs with practice levels below 51 percent

--place students in basic skills classes

--receive vendor assistance in implementing systems

--faculty involved in industry work or projects

--private sector support for equipment

--special courses to strengthen math and communications skills

--recognize student dedication and motivation

--include grants to purchase equipment

--collaborate with high schools

--funding to hire laboratory aids

--faculty hold professional degree

--student work experience at local business

--curriculum stresses interpersonal skills

--lab assistants set up and maintain equipment

--equipment available to business/industry

--articulation with 4-year programs

--faculty have previous teaching experience

Across the 8 "important" indicator, number 37-44, programs were sorted according to the following:

- Majority of programs with practice levels above 51 percent

NONE

o Majority of programs with practice levels below 51 percent

--industry personnel loaned to faculty

--budgets separate from other technical programs

--industry/faculty cooperation at meeting/conferences

--faculty consult with business/industry

--curriculum articulated with secondary programs

--faculty participate in programs to enhance teaching skills

--use computer assisted instruction

--instruction incorporates self-paced learning materials

Findings and Conclusions

Programs reported having practice levels above 51 percent, on a minority of the indicators, (15 of 44). The first 10 of the 15 indicators were in the upper half of the ranking (number 1-22). The remaining 5 indicators were in the upper half of the lower 22 indicators on the list.

The 15 indicators represented 5 of the 6 categories of indicators according to the following distribution.

- o Faculty, 5
- o Facilities/equipment, 4
- o Curriculum/instruction, 3
- o Students 2
- o Budget, 1

The indicators with a majority of programs above the 51 percent level parallel the relative importance levels assigned to the indicator, that is, more important indicators were being implemented at high levels of practice.

Allowing for the practical reality that a lower level of practice is quite appropriate or even desired for some indicators, programs practices seem to be in general accord with the levels of importance assigned to the indicators by faculty. In a time of scarce educational resources, increasing demands on faculty, and rapid technological changes, the programs included in this study are focusing their efforts on faculty, equipment, and curriculum. These three areas represent the backbone of a solid program. With six majority level indicators from the first 11 "essential" indicators, the focus is clearly on a strong developmental basis for a high-technology program. The second set of majority level indicators reflect key operational and program enhancement features. Again, the focus seems to be on emphasizing those characteristics and practices that produce and sustain a fundamentally sound educational program.

Indicators that were less then the 51 percent practice level reflect features that are important and contribute to the quality of a program but take longer to achieve or can be implemented at lower levels in the beginning of program development.

Recommendations

From the preceding analysis of the survey results, and with consideration given to the many written comments from high technology program faculty, the following recommendations are offered:

- The development of a high-technology program is a long-term and expensive educational endeavor. Success of a program depends on thorough and systematic planning with substantial commitments from the educational institution and the private sector companies that will hire the graduates of the program. Without a high level of confidence that all of the essential indicators can be acquired and implemented, consideration should be given to deferring the start-up of a new high-technology program.

- Once a decision has been made to start a new high-technology program, full leadership attention should be directed at the key factors related to program quality. First, the very best faculty members that can be obtained should be located and hired. Adequate funding to keep the faculty at the institution and up to date in their field should be ear-marked in the budget.

  Second, the latest state-of-the-art facilities and equipment should be reviewed and sources of funding sought to acquire that which is most essential to the educational needs of the program. Much equipment can be acquired as donations. Although some categories of equipment might not be state-of-the-art, they will serve very well in an educational situation. For example, equipment designed to store, clean, maintain, preserve, or prepare materials, samples, specimens, and other such things may be donated for models. But if they work well or can be repaired, will serve the program and conserve funds for the purchase of essential new equipment. In any case, the equipment start-up costs of a high-technology program can during the first 12-24 months reach or exceed one-half to three-quarters of a million dollars, ($500,000 to $750,000); substantially higher costs will be involved if facilities construction or modifications are involved in the project. In the early phases of a program student enrollments will likely be lower and per-student cost will be very high. Careful attention should be given to the potential impact on existing program budgets, before the expenditure of such a large amount of money is undertaken. Acquisition of new equipment for some types of programs may not be exceedingly expensive because existing program facilities, equipment, and materials may form the base or core of the new program. In addition, equipment may be acquired in phases to match the first wave of students going through the program. Highly specialized equipment that will be needed only for upper-level courses can be purchased or perhaps leased during the second year of the program thus spreading costs over several budget years. Regardless of the costs and purchase arrangements, facilities and equipment were ranked as essential components of a high-technology program and must be available to students in adequate numbers and for adequate periods of time to assure student competency.

Third, faculty and equipment do not alone ensure a sound program. A technically up-to-date, well-planned program of study including a curriculum based on an analysis and documentation of the knowledge, skills, and abilities required of graduate technicians is needed to complete the basic program. Sources of information and resources from which to build a quality curriculum include other similar technology programs at 2-year or 4-year colleges, business or industry training programs, military programs for nonclassified skill areas, and materials prepared through federal or state funded projects. Each of these sources should be researched to locate the best available materials to support the educational process. In addition, vendors and manufacturers usually can and do provide basic training and operations manuals that can be adapted.

- Following the start-up of a new high-technology program, frequent attention must be given to the enhancement and maintenance of the program. Activities should be pursued that encourage (1) close cooperation with business and industry, (2) articulation with secondary and higher education programs, and (3) the development of financial and supportive educational services for students. Renewal and technological update of faculty should be encouraged and supported through cooperative ventures with universities, research centers, industry training institute, and travel to other exemplary programs. Improvements in curriculm structure and instructional practices should be systematically accomplished through a critical review and self-evaluation process that includes faculty, student, and employer input. Both the content and delivery of the instructional process should be reviewed to identify effective technique trouble spots that can be improved. These activities are essential to the quality of the program as it matures and grows.

In summary, sound educational practices, implemented through careful planning, with the full support of the institutional leadership and business/industry community are fundamentally essential components of a quality program. If any one of the essential elements is missing the program and its long-term success is in jeopardy of failing.

CHAPTER 3

A PROGRAM ASSESSMENT PROCESS

Purpose of Assessment

High-technology programs in postsecondary institutional settings are subject to forces from several groups of internal and external variables. The groups of variables that impact on programs include the following:

- Institutional mission and capacities
- Technological practices and trends in industry
- Student abilities and needs
- Employer demands and needs

Within each group there are specific variables that influence the character and quality of an educational program. A basic tension exists between the groups of variables as they act as competing forces on a program. For example, as technology changes, a need to respond is exerted on the educational program. A response might include updating the curriculum, acquiring additional equipment, and/or providing inservice training for faculty. Limited resources may prevent programs from implementing all of the appropriate responses, thus impacting on program capacity and quality.

From another dimension, labor market changes, can increase or decrease the number of students enrolling in various technology programs. The end effect of such enrollment shifts can be too many or too few classes and instructors, which in turn forces program realignment, reductions, and/or expansions. Any appropriate response has a cost.

Another case might also exist when the basic skills competency levels of students decline and institutions find it necessary to offer remedial courses. There is a corresponding cost to the institution as well as to the students. Employers may also find it necessary to increase in-house training in response to a decline in literacy levels. Demands for local college remedial education services may increase or decrease accordingly. As resource allocation decisions are made regarding high-technology program responses to these various types of changes, other programs may have to postpone a needed revision or improvement. (In a time of declining or limited resources, hard trade-off must be made.)

Over time, the various competing pressures from external and internal variables have a tendency to drive programs toward a central mode of operation and practice. Periodic program review can aid in realignments and adjustments.

A program review process should provide comparative measures from other successful programs. The results of a program self-assessment process should provide answers to planning and revision questions and should provide information useful in weighing alternatives and options. It is intended that the process suggested here accomplishes these goals.

Assessment Approaches

The suggested approaches to conducting a self-assessment of a high-technology program are based on the following criteria:

- o Be easy and simple to conduct
- o Be conducive to faculty acceptance and use
- o Be applicable to different technology programs and institutional settings

Three general approaches are suggested in order to accommodate different sized faculty groups and institutional arrangements and schedules.

The "large-group" approach is intended for settings in which (1) relatively large numbers of faculty (seven or more) are teaching in the same high technology program, (2) faculty are located at remote sites, or (3) part-time faculty are away from campus most of the time.

The "small-group" approach is intended to accommodate settings in which (1) the high-technology program faculty number less than seven individuals, (2) they are on the same campus most days of the week, and (3) they have daily opportunities to meet in informal sessions to discuss assessment activities.

The "individual" approach is suggested for use in settings where (1) the faculty number from one to three members in the same high-technology program, (2) they teach together, and (3) they spend considerable time together discussing program plans and activities.

Large Group Approach

The large-group approach will best fit the needs and schedules of faculty groups that find it difficult to frequently spend large amounts of time (several hours) together. Large faculty groups usually consist of two or three person teams who teach similar or related courses and can meet frequently to discuss their instructional responsibilities. The large-group approach is intended to capitalize on the frequency and closeness of the team relationships within the large faculty groups.

A facilitator/coordinator will be needed to expedite several functions and tasks and to provide special assistance to off-campus and part-time faculty. Also the facilitator will be responsible for ensuring cooperation and involvement of all concerned faculty. A general set of steps and tasks that should be carried out is presented in table 3 with approximate times suggested.

TABLE 3

LARGE-GROUP SELF-REVIEW PROCEDURES AND TASKS

Step	Task	Time in Days
1	Prepare and distribute a memo suggesting and explaining the benefits and purpose of a program review. Faculty/administration may vote on a motion to conduct a review. Agreement should be obtained from a large majority.	14 to 21
2	Appoint/select a coordinator and provide him or her with this publication to review.	10
3	Duplicate a sufficient number of assessment materials to supply all faculty members and advisory panel members as appropriate. Prepare instructions for completing and returning the materials.	2
4	Schedule an orientation meeting. Hold the meeting and explain the assessment process and schedule of events. Emphasize the fact that the process is a self-review for program improvement and future planning and is not intended to identify a poor program. Distribute assessment materials and explain procedures.	1 to 5
5	Designate a location where the assessment forms are to be returned. Collect all forms and tabulate the responses. After results are tabulated, the forms are to be returned to faculty for their use.	10
6.	Tabulate and analyze faculty responses and prepare handout materials indicating the appropriate program data from the tables in this publication.	7
7	Distribute to all concerned faculty and advisory personnel copies of the assessment results and comparison data from the tables. Allow 5 days for faculty to review results; encourage the development of questions for discussion.	10
8	Schedule and convene a general review meeting including the program advisory committee members to discuss results and possible interpretation and actions at the meeting, develop an agenda of issues to be reviewed/studied, and form faculty teams or committees to develop recommendations.	1

Table 3--Continued

Step	Task	Time in Days
9	Distribute team/committee recommendations to all faculty for their review and consideration.	10
10	Schedule a final meeting to solicit acceptance of recommendations and schedule development and/or revision actions. Assign or request volunteers to carry out actions according to normal procedures and policies.	1

An estimated time span of 66-78 days would be required to execute a program review procedure, according to the steps presented above. The steps are general suggestions that may, in many settings, be completed sooner than estimated. A large faculty (15-25 members) might well require more time for distribution and collection of materials. The amount of advance notice required to schedule a meeting will also vary according to institutional schedules and practices.

Regardless of the minimum time required, it is strongly recommended that the process be conducted in an efficient manner, but it should not become a burden to faculty with a full schedule. Program renewal and improvement is an ongoing process and the assessment procedure should flow into the normal schedule and pace of events involving faculty.

Small Group Approach

Faculty groups of seven or less who are located on the same campus may find the less-formal, small-group approach appropriate to their needs and style of working together. The tasks are based on the assumption that smaller groups can find time to meet frequently (twice a week) for discussion and planning sessions of 1-2 hours. The tasks in table 4 are suggested as a general set of activities for a small-group approach.

TABLE 4

SMALL-GROUP SELF-REVIEW PROCEDURES AND TASKS

Step	Task	Time in Days
1	The appropriate administrator(s) should be informed as necessary. A lead member of the faculty group should review this publication and initiate a discussion of the self-assessment procedure and its benefits.	5

Table 4--Continued

Step	Task	Time in Days
2	The faculty group should agree to conduct the self-assessment and each person should read this publication.	
3	The group should meet and set up a schedule to complete the assessment procedure. Materials should be duplicated and distributed to faculty and advisory committee members. Questions regarding the assessment instrument and response procedures should be resolved. One person should be designated as facilitator to collect and compile results.	1
4	Each faculty and committee member should complete the assessment form and return it to the facilitator.	5
5	The facilitator should compile-summarize the results and distribute copies of the totals to other faculty and advisory committee members.	5
6	After each member has reviewed the results, the group should meet again to discuss the implications and related issues. Plans for revisions, or further information-gathering activities, should be developed.	10
7	The faculty members should summarize their deliberations and proposed improvement actions. A letter detailing their plans should be sent to the appropriate administrator for review and approval as needed.	10
8	After approvals are received faculty should implement improvement actions and continue to meet to review their results.	10 to 90

The suggested small-group approach to program assessment is intended to capitalize on the close working relationship that exists between small groups of faculty teaching in the same program. Excessive formality is usually not needed when small groups can regularly meet to share concerns and make plans. The faculty should discuss each indicator, their responses to the assessment form, and other program data and arrive at a consensus regarding future program directions in light of their particular setting.

Individual Approach

Individuals teaching in a program area with one or two fellow faculty can carry out an assessment on either an individual or team approach. The major advantage of the approach is that it takes full advantage of the close relationship among two or three faculty members in the same program. The focus of this approach is to involve faculty in an item-by-item discussion of the indicators, related program data, and their own program practices. The steps/tasks in table 5 are suggested.

TABLE 5

INDIVIDUAL SELF-REVIEW PROCEDURES AND TASKS

Step	Task	Time in Days
1	Each faculty member should review this publication and make a personal copy of the assessment materials for future reference during discussion sessions. Administrative approval should be obtained if needed or desired.	5
2	Faculty should meet to discuss their general concerns, objectives and preferences regarding the assessment process. The group should arrive at a consensus regarding their approach and time lines. Advisory committee members should be involved in the review process.	1-2
3	Faculty and committee members should meet again, according to their own schedule, and begin substantive discussions of the indicators in each category. Discussions can be limited to one category at a time. The data on the overall importance rankings and program specific ranking should be reviewed and compared to the local program practices currently being followed. Differences and similarities should be noted and recorded for each category of indicators as they are discussed. A consensus rating should be recorded on the assessment form to indicate faculty opinion.	1
5	Faculty and advisory panel members should meet to discuss the list of similarities and differences and consider alternative courses of action for each. (This activity may be done at several different meetings to avoid overly long sessions).	3-5
6	Based on the preceding discussions, a tentative list of high priority actions and revisions should be prepared and reviewed. The list will represent a program improvement action agenda for a specified period of time (quarter, semester, year).	3-5

Table 5--Continued

Step	Task	Time in Days
7	The list of actions should be presented to the appropriate administrative officer for review, approval, and support as dictated by policy.	10
8	Upon approval, faculty should proceed to implement actions according to plans and schedules.	10

The key feature of the individual approach is that a single assessment form is completed. Each indicator is discussed by the faculty members and a consensus rating is recorded. Differences and similarities are discussed one at a time, and important points are noted as the list of actions is developed. Because only one, two, or three faculty members are involved, the formality of filling out individual rating forms and tabulating the results is avoided.

The forms that have been developed for use in the self-review process are presented in appendix F.

APPENDIX A

PROGRAM LISTING

Nominated Techhology Programs

Laser

Camden County College
P.O. Box 200
Blackwood, NY 08012

North Central Techincal Institute
1000 Campus Drive
Wausau, WI 54401

Pikes Peak Community College
5675 South Academy Boulevard
Colorado Springs, CO 80906

Triton College
2000 5th Avenue
River Grove, IL 60171

University of New Mexico-Los Alamos
4000 University Drive
Los Alamos, NM 87544

Microelectronics/Electronics

Columbia Basin College
2600 North 20th Avenue
Pasco, WA 99301

Daytona Beach Community College
P.O. Box 111
Daytona Beach, FL 32015

Durham Technical College
1637 Lawson Street
Durham, NC

Durham Technical Institute
Analog Devices
Greensboro, NC

Gulf Coast Community College
5230 W. Highway 98
Panama City, FL 32401

Hagerstown Junior College
Hagerstown, MD 21740

Hillsborough Community College
Pavilion Building, Room 1042
3405 W. Buffalo Avenue
Tampa, FL 33622

Honlulu Community
874 Dillingham Boulevard
Honolulu, Hawaii 96817

Kansas City Kansas Community College
7250 State Avenue
Kansas City, KS 66112

Mesa Community College
1833 West Southern Drive
Mesa, AZ 85202

Nashville State Technical Institute
120 White Bridge Road
Nashville, TN 37209

Parkland College
2400 West Bradley
Champaign, IL 61821

Pima Community College
P.O. Box 3010
Tucson, AZ 85705-3010

Spartansburg Technical College
Box 4386
Spartansburg, NC 29305

University of Akron
Division of Engineering & Science
Technology
Akron, OH 44325

Robotics

Illinois Central College
East Peoria, IL 44325

Illinois Valley Community College
Rural Route #1
Oglesby, IL 61348

Jefferson College
Box 1000
Hillsboro, MO 63050-1000

Niagara County Settlement Road
3111 Saunders Settlement Road
Sanborn, NY 14132

Wake Technical College
9101 Fayetteville Road
Raleigh, NC 27603

Electromechanical Engineering

Cincinnati Technical College
3520 Central Parkway
Cincinnati, OH 45223

Fox Valley Technical Institute
1825 Bluemount Drive
P.O. Box 2277
Appleton, WI 54913

Montgomery College
Germantown Campus
20200 Observation Drive
Germantown, MD 20874

North Shore Community College
3 Essex Street
Beveraly, MA 01915

Thomas Nelson Community College
Hampton, VA 23670

Engineering Manufacturing

Butler County Community College
901 South Haverhill Road
El Dorado, KS 67042

Delaware Technical and Community College
Newark, DE 19702

CAD/CAM

Anne Arundel Community College
101 College Parkway
Arnold, MD 21012

Bellevue Community College
P.O. Box 92700, Room A 202
Bellevue, WA 98009

Brookdale Community College
Drafting Design Department
765 Newman-Springs
Lincroft, NJ 07738

Chattanooga State Technical and Community College
4501 Amicola Highway
Chattanooga, TN 37406

College of Lake County
19351 West Washington Street
Grayslake, IL 60030

Moraine Park Technical Institute
235 North National Avenue
Fond du Lac, WI 54935

New Mexico Junior College
5317 Livington Highway
Hobbs, MN 88240

New River Community College
P.O. Drawer 1127
Dublin, VA 24084

Niagara County Community College
3111 Saunders Settlement Road
Sanborn, NY 14132

Engineering Technology

Hocking Technical College
Ceramic Technical Department
Nelsonville, OH 45764

Honolulu Community College
874 Dillingham Boulevard
Honolulu, HI 96817

University of Cincinnati
College of Applied Science
ML 103
Cincinnati, OH 45210

York Technical College
Highway 21 Bypass
Rock Hill, SC 29730

Computer

Genessee Community College
1 College Road
Batavia, NY 14020

Glendale Community College
6000 West Olive Drive
Glendale, AZ 85302

Greenville Technical Community College
P.O. Box 5616
Greenville, SC 29606

Kapiolani Community College
Honolulu, HI 96814-2859

Milwaukee Area Technical College
Technical Division
1015 North 6th Street
Milwaukee, WI 53203

Springfield Community College
1 Armory Square
Springfield, MA 14020

State Techical Institute at Memphis
5983 Macon Cove
Memphis, TN 14020

Manufacturing

Greenville Technical College
P.O. Box 5615, Station B
Greenville. SC 29606

Johnson County Community College
12345 College at Quivira
Overland Park, KS 66210

Moraine Valley Community College
Palos Hills, IL 60465

Northern Virginia Community College
Annandal Campus
8333 Little River Turnpike
Annandale, VA 22003

Rock Valley College
2812 19th Avenue
Rockford, IL 61108

Weber State College
Ogden, UT 84408

Services

Catonsville Community College
800 South Rolling Road
Catonsville, MD 21228

Delaware Technical and Community College
P.O. Box 897
Dover, DE 19903

Glendale Community College
6000 West Olive
Glendale, AZ 85302

Honolulu Community College
874 Dillingham Boulevard
Honolulu, HI 96817

New Mexico State University
Box 3DA
Las Cruces, NM 88003

North Central Technical College
P.O. Box 698
Mansfield, OH 44901

Spokane Community College
N. 1810 Green Street
Skpokane, WA 99207

Other

Clayton Junior College
P.O. Box 285
Morrow, GA 30260

Cuyahoga Community College
700 Carnegie Avenue
Cleveland, OH 44115

Delaware Technical and Community College
P.O. Box 897
Dover, DE 19903

Lorain County Community College
1005 North Abbe Road
Elyria, OH 44035

Orange County Community College
115 South Street
Middletown, NY 10940

Piedmont Technical College
Drawer 1467, Emerald Road
Greenwood, SC 29648

Piedmont Virginia Community College
Route 6, Box 1A
Charlottesville, VA 22901

Pikes Peak Community College
5675 S. Academy Boulevard
Colorado Springs, CO 80906

Health/Biological Science

County College of Morris
Route 10 and Centergrove Road
Randolph, NH 07869

Delaware Technical and Community College
P.O. Box 897
Dover, DE 19903

Johnson County Community College
12345 College Boulevard
Overland Park, KS 66210

Owens Technical College
Caller Number 10000 Oregon Road
Toledo, OH 43699

Schoolcraft College
18600 Haggerty Road
Libonia, MI 48151

Technical College of Alamance
P.O. Box 623
Haw River, NC 27258

Maricopa Technical Community College
108 North 40th Street
Phoenix, AZ 85034

Phoenix College
1 Madrid Plaza
Mesa, AZ 85201

Stanly Technical College
Route 4, Box 55
Albemarie, NC 28001

Wilbur Wright College
3400 North Austin
Chicago, IL 60634

Communications

Jefferson College
P.O. Box 1000
Hillsboro. MO 63050-1000

West Virginia Institute of Technology
Community and Technical College
Montgomery, WV 25136

Mercer County Community College
P.O. Box B
Trenton, NJ 08690

APPENDIX B

QUALITY INDICATOR
VERIFICATION QUESTIONNAIRE

A NATIONAL SURVEY OF HIGH TECHNOLOGY PROGRAM CHARACTERISTICS

This survey has been designed to investigate how important certain characteristics are to the success of a high-technology program. Please read the list of program characteristics in each section and rate the importance of each on the 7-point scale by drawing a circle around the appropriate number. Even though many items may be somewhat interrelated, please avoid having all of your ratings similar (e.g., all around "4"). We realize that all of these items are of at least slight importance. However, we are trying to determine the relative importance of each item in comparison to the others in the same section.

7 = Extremely Important
4 = Moderately Important
1 = Slightly Important

SECTION ONE: FACULTY

A faculty member in a high-technology program should--

1. be an active member of a professional or technical education association — 1 2 3 4 5 6 7
2. have previous teaching experience in industry, education, or the military — 1 2 3 4 5 6 7
3. have a professional degree in a technical field related to the teaching area — 1 2 3 4 5 6 7
4. take courses in education to enhance teaching skills or to develop new ones — 1 2 3 4 5 6 7
5. keep up to date with the technical field by attending conferences, workshops, or seminars — 1 2 3 4 5 6 7
6. stay informed about similar technical education programs in other institutions — 1 2 3 4 5 6 7
7. serve as a technical consultant to business and industry — 1 2 3 4 5 6 7
8. have at least 3 years of recent work experience in a job related to the teaching area — 1 2 3 4 5 6 7
9. conduct public or privately funded research in the technical field — 1 2 3 4 5 6 7
10. publish articles or books on topics in the technical field — 1 2 3 4 5 6 7

(write in) ______________________ 1 2 3 4 5 6 7

______________________ 1 2 3 4 5 6 7

SECTION TWO: BUDGET, RESOURCES, AND SUPPORT

The budget, resources, and support for a high-technology program should--

1. include grants to purchase special equipment — 1 2 3 4 5 6 7
2. include follow-up funding to upgrade equipment as the program matures — 1 2 3 4 5 6 7
3. provide funding for new faculty positions — 1 2 3 4 5 6 7
4. be separate from other technical program budgets — 1 2 3 4 5 6 7
5. be determined by faculty negotiating directly with top-level administration — 1 2 3 4 5 6 7
6. provide funds for laboratory technicians to maintain facilities and equipment — 1 2 3 4 5 6 7
7. include provisions for supplementing faculty salaries to keep them competitive with private sector compensation — 1 2 3 4 5 6 7

(write in) ______________________ 1 2 3 4 5 6 7

______________________ 1 2 3 4 5 6 7

SECTION THREE: BUSINESS/INDUSTRY COOPERATION

Cooperation between a high-technology program and business/industry should include--

1. frequent input from an advisory committee of business/industry people — 1 2 3 4 5 6 7
2. student participation in planned work experiences at local business/industry sites — 1 2 3 4 5 6 7
3. loan of business/industry personnel to serve as adjunct faculty — 1 2 3 4 5 6 7
4. joint participation or presentations at business and industry conferences or trade association meetings — 1 2 3 4 5 6 7
5. close involvement of regular faculty in business/industry work experiences and projects to maintain their occupational expertise — 1 2 3 4 5 6 7
6. development of customized training programs for upgrading industry personnel in a new technology — 1 2 3 4 5 6 7
7. private sector support through donations of equipment and/or funds — 1 2 3 4 5 6 7
8. discounts on equipment and merchandise from vendors — 1 2 3 4 5 6 7
9. equipment loans, gifts, and grants — 1 2 3 4 5 6 7

(write in) ______________________ 1 2 3 4 5 6 7

______________________ 1 2 3 4 5 6 7

7 = Extremely Important
4 = Moderately Important
1 = Slightly Important

SECTION FOUR: FACILITIES AND EQUIPMENT

Facilities and equipment in a high-technology program should--

1. provide fully equipped study and work stations for students 1 2 3 4 5 6 7
2. be the same as or very similar to the equipment used in business or industry 1 2 3 4 5 6 7
3. receive technical support from vendors to implement systems, hardware, software, and/or applications 1 2 3 4 5 6 7
4. be set up, operated, and maintained by technical support staff employed by the college 1 2 3 4 5 6 7
5. be designed to provide maximum integration of equipment and technical systems 1 2 3 4 5 6 7
6. provide space for optimum hands-on learning activities for students 1 2 3 4 5 6 7
7. feature flexible buildings to accommodate periodic changes in equipment and curriculum 1 2 3 4 5 6 7
8. be available to business/industry personnel for instruction and demonstration purposes on a scheduled basis 1 2 3 4 5 6 7

(write in) ________________________________ 1 2 3 4 5 6 7

________________________________ 1 2 3 4 5 6 7

SECTION FIVE: CURRICULUM AND INSTRUCTION

The curriculum in a high-technology program should--

1. incorporate performance-based training objectives 1 2 3 4 5 6 7
2. represent the newest technological developments and applications 1 2 3 4 5 6 7
3. be articulated with secondary school pretechnical cour s 1 2 3 4 5 6 7
4. be articulated with related curricula in 4-year institutions 1 2 3 4 5 6 7
5. be designed in concert with local industry leaders 1 2 3 4 5 6 7
6. stress the development of problem-solving abilities 1 2 3 4 5 6 7
7. include special courses to enhance math and communication skills 1 2 3 4 5 6 7
8. incorporate self-paced learning materials 1 2 3 4 5 6 7
9. be sequenced to develop core skills first, then specialized skills 1 2 3 4 5 6 7
10. use computer-assisted instructional systems for indivi ized learning 1 2 3 4 5 6 7
11. stress the development of interpersonal skills 1 2 3 4 5 6 7
12. include courses in the behavioral and management sciences 1 2 3 4 5 6 7

(write in) ________________________________ 1 2 3 4 5 6 7

________________________________ 1 2 3 4 5 6 7

SECTION SIX: STUDENTS

The recruitment, selection, and support of students in high-technology programs should--

1. follow normal policy regarding minimum admission requirements 1 2 3 4 5 6 7
2. establish controls on class sizes 1 2 3 4 5 6 7
3. provide for diagnostic testing and placement in developmental skill classes to assist students 1 2 3 4 5 6 7
4. include collaboration with high schools to prepare students more fully for post-secondary education 1 2 3 4 5 6 7
5. disseminate information and products to high schools to attract and motivate superior students 1 2 3 4 5 6 7
6. recognize students' dedication and drive as an importance factor in addition to intelligence 1 2 3 4 5 6 7
7. allow the department to control its own admission process 1 2 3 4 5 6 7
8. use the success of former students as a recruiting aid 1 2 3 4 5 6 7

(write in) ________________________________ 1 2 3 4 5 6 7

________________________________ 1 2 3 4 5 6 7

APPENDIX C

INDICATOR RATINGS
BY PROGRAM AREA

HIGH TECHNOLOGY QUALITY INDICATORS
IMPORTANCE RATING BY PROGRAM

Faculty	LASER	ROBOTICS
1. Faculty should attend conferences, workshops, or seminars to keep up to date in their technical field.	6.2	6.6
2. Faculty should have at least 3 years of recent work experience related to their teaching area.	5.5	5.2
3. Faculty should hold a professional degree in the technical field in which they teach.	5.1	5.2
4. Faculty should be active members in a professional or technical education association.	5.1	4.5
5. Faculty should stay informed about comparable technical programs in other institutions.	4.4	5.0
6. Faculty should have previous teaching experience in industry, education, or the military.	4.1	5.1
7. Faculty should serve as consultants to business or industry.	3.5	4.2
8. Faculty should participate in programs to enhance their teaching skills.	4.2	4.7
9. Faculty should publish articles or books on topics in their technical field.	2.2	2.2
10. Faculty should conduct funded research activities in their technical field.	1.7	2.6

CAD/CAM	MICROELECTRON.CS ELECTRONICS	HEALTH AND BIOLOGICAL SCIENCE	COMPUTER	ENGINEERING TECHNOLOGY	COMMUNICATION	OTHER
6.1	6.1	6.7	6.0	6.0	6.7	6.2
4.7	4.2	6.2	6.0	5.3	4.7	5.6
6.1	5.2	6.6	5.4	6.1	5.2	5.6
5.0	4.1	6.1	4.6	6.0	5.5	3.6
5.5	5.1	5.0	5.0	5.7	5.5	4.2
5.3	5.1	5.8	4.6	5.3	4.5	4.6
5.7	4.5	4.2	3.6	5.5	4.0	3.4
4.9	4.5	5.3	4.4	5.5	5.0	5.2
4.0	2.2	3.2	2.2	5.2	2.7	2.4
3.6	2.3	2.9	3.0	4.3	3.2	2.0

HIGH TECHNOLOGY QUALITY INDICATORS
IMPORTANCE RATING BY PROGRAM

	LASER	ROBOTICS
Student Recruitment, Selection, and Support		
1. Programs should recruit and enroll superior high school students (BPA of B or above).	5.1	6.5
2. Programs should promote the success of graduates as a recruitment aid.	6.4	6.2
3. Programs should establish limits on lecture and laboratory class size.	5.5	5.3
4. Programs should test and place students in basic skills improvement courses if needed.	5.5	5.7
5. Programs should recognize students' dedication and motivation in addition to intelligence.	6.4	6.3
6. Programs should collaborate with high schools to better prepare students for postsecondary education.	5.7	6.5
7. Programs should follow normal admission policies in accepting students.	4.5	4.5

CAD/CAM	MICROELECTRONICS ELECTRONICS	HEALTH AND BIOLOGICAL SCIENCE	COMPUTER	ENGINEERING TECHNOLOGY	COMMUNICATION	OTHER
6.0	5.5	6.2	5.0	6.2	6.2	5.6
5.3	6.5	5.6	4.8	5.8	6.0	6.2
5.1	5.9	6.0	6.2	4.0	5.7	5.4
6.2	5.5	6.3	3.6	5.5	5.2	5.8
5.0	6.0	5.9	5.8	6.5	6.5	4.8
6.2	5.5	6.2	4.2	6.1	5.5	5.0
4.5	4.7	5.3	3.4	3.2	5.5	5.0

HIGH TECHNOLOGY QUALITY INDICATORS
IMPORTANCE RATING BY PROGRAM

	LASER	ROBOTICS
Curriculum and Instruction		
1. The curriculum should reflect the newest technological developments and application.	5 8	6.2
2. Curriculum and instruction should be designed in concert with local business/industry personnel.	5.2	6.2
3 Curriculum and instruction should stress the development of problem-solving abilities.	6.2	6.2
4. Curriculum and instruction should be formulated on and incorporate performance-based objectives and evaluation.	5.7	5.8
5. Curriculum should include special courses to strengthen math and communication skills.	6.2	6.1
6. Curriculum content should first develop core technical skills.	5.5	5.5
7. Curriculum content should stress the development of interpersonal skills.	6.1	4.8
8. Curriculum should be articulated with related curricula in 4-year institution programs.	5.0	5.5
9. Curriculum should be articulated with secondary pretechnical or vocational courses.	5.5	5.5
10. Curriculum and instruction should use computer-assisted instructional systems.	5.0	3.6
11. Curriculum and instruction should incorporate self-paced individualized learning materials.	4.1	4.3

CAD/CAM	MICROELECTRONICS ELECTRONICS	HEALTH AND BIOLOGICAL SCIENCE	COMPUTER	ENGINEERING TECHNOLOGY	COMMUNICATION	OTHER
6.7	6.7	6.7	6.2	7.0	6.2	6.2
6.0	6.3	6.0	5.6	5.3	5.5	6.6
5.3	5.8	6.2	6.0	6.2	6.0	6.4
5.4	5.6	6.8	4.4	4.5	6.0	6.2
5.6	6.4	5.6	5.2	5.7	6.0	6.0
6.0	6.4	5.7	5.4	5.5	5.7	6.6
5.1	5.7	5.4	4.2	5.2	6.2	5.0
3.5	4.6	5.1	4.8	2.6	5.7	4.4
6.1	4.5	4.9	4.0	5.3	4.5	5.0
4.5	4.6	4.4	2.4	5.6	4.0	4.4
3.5	3.5	4.3	2.6	4.7	5.0	4.0

HIGH TECHNOLOGY QUALITY INDICATORS
IMPORTANCE RATING BY PROGRAM

	LASER	ROBOTICS
Business/Industry Cooperation		
1. Cooperation should include frequent input from advisory committee of business/industry personnel.	6.4	6.5
2. Cooperation should include the development of customized training programs for business/industry personnel.	5.8	5.6
3. Cooperation should involve faculty in business/industry work experiences or projects to help maintain their occupational expertise.	5.0	5.8
4. Cooperation should include private sector support through donations of equipment and/or funds.	5.8	5.6
5. Cooperation should include student participation in work experiences at local business/industry sites.	4.5	6.1
6. Cooperation should include the loan of business/industry personnel to serve as adjunct faculty.	4.7	5.7
7. Cooperation should involve joint industry-faculty participation at conferences, trade association meetings, and presentations to other groups.	4.0	5.2

CAD/CAM	MICROELECTRONICS ELECTRONICS	HEALTH AND BIOLOGICAL SCIENCE	COMPUTER	ENGINEERING TECHNOLOGY	COMMUNICATION	OTHER
5.8	6.5	6.6	5.0	5.5	6.7	7.0
6.3	5.5	5.2	5.8	6.0	5.5	5.2
5.6	6.0	5.4	6.6	6.2	6.0	4.8
5.0	5.5	5.8	4.6	4.7	7.0	5.4
5.7	5.5	6.1	4.6	5.6	5.0	5.8
5.6	4.5	5.4	4.4	5.1	5.0	4.4
5.1	4.5	4.8	3.2	5.5	6.0	3.6

HIGH TECHNOLOGY QUALITY INDICATORS
IMPORTANCE RATING BY PROGRAM

	LASER	ROBOTICS
Facilities and Equipment		
1. Programs should p ovide fully equipped lab and work stations for students.	6.0	6.2
2. Program facilities and equipment should be the same or very similar to the type found in business and industry.	5.0	6.1
3. Programs should receive vendor technical assistance in implementing hardware and software systems and applications.	5.8	5.5
4. Program facilities and equipment should allow maximum integration and replication of workplace settings.	5.4	5.7
5. Programs should have lab assistant to set up, service, and maintain equipment.	4.5	4.1
6. Program equipment should be available to business/industry personnel for instruction and demonstration.	4.2	5.1
7. Programs should have flexible facilities that can accommodate periodic equipmen and curriculum changes.	4.2	4.7

CAD/CAM	MICROELECTRONICS ELECTRONICS	HEALTH AND BIOLOGICAL SCIENCE	COMPUTER	ENGINEERING TECHNOLOGY	COMMUNICATION	OTHER
6.5	6.7	6.7	6.4	5.0	6.2	5.5
6.5	6 3	6.5	6.4	4.4	5.7	6.0
6.3	5.8	5.8	5.4	2.7	6.7	5.6
5.5	5.6	5.6	5.2	7.0	5.5	6.0
5.3	4.1	5.0	5.0	7.0	4.0	5.8
5.2	4.4	4.8	4.4	5.1	4.5	4.8
4.9	5.4	5.4	4.8	4.7	4.7	5.6

HIGH TECHNOLOGY QUALITY INDICATORS
IMPORTANCE RATING BY PROGRAM

	LASER	ROBOTICS
Budget, Resources, and Support		
1. Budget should include follow-up funding to upgrade or update equipment as the program matures.	6.4	6.5
2. Budgets should include grants to purchase special equipment.	6.4	5.7
3. Budgets should include funding for new faculty positions.	4.8	5.5
4. Budgets should include funding to hire laboratory assistants to maintain facilities and equipment.	4.8	5.2
5. Budgets should provide for faculty salaries that are competitive with private sector salaries.	5.4	6.3
6. High tech program budgets should be separate from other technical program budgets.	4.2	3.3

CAD/CAM	MICROELECTRONICS ELECTRONICS	HEALTH AND BIOLOGICAL SCIENCE	COMPUTER	ENGINEERING TECHNOLOGY	COMMUNICATION	OTHER
6.2	6.4	6.6	6.6	5.1	6.2	5.8
6.2	5.9	5.9	5.4	5.6	5.2	5.2
4.5	5.1	6.0	4.8	4.8	5.2	5.0
5.9	5.5	6.0	5.8	6.0	5.0	6.0
5.6	5.1	5.6	5.8	6.2	5.0	5.0
4.2	4.0	5.2	5.2	4.7	4.5	4.4

APPENDIX D

LEVEL OF PRACTICE
SURVEY QUESTIONNAIRE

SURVEY OF HIGH TECHNOLOGY PROGRAM CHARACTERISTICS
PART 2

Name of Program ______________________ Name of Respondent ______________________
Name of School ______________________ Position or Title ______________________

This is the second questionnaire in the two-part survey of high technology programs. This form is designed to determine the amount of each characteristic that exists in various program areas. The order of the items on this form reflects their importance based on the results of the first survey. Please respond to each item by indicating the appropriate percentage for your high tech program. You may need to make approximations for some of the items. In those cases please indicate upper and lower limits (i.e. 30% ± 5% or 30 -35%).

SECTION ONE: FACULTY

Please indicate the percentage of regular faculty in your high technology program, who:

1. have during the past year, attended a conference, workshop, or seminar to keep up-to-date with their technical field? ____ %
2. hold one of the following degrees in a technical field related to the subjects they teach?
   Bachelor degree ____% Masters degree ____% Ph.D. degree ____% other ____%
3. have three or more years work experience related to the courses they teach?
   1 to 3 years ____% 3 to 5 years ____% 5 to 7 years ____% 7 plus years ____%
4. have visited technical education programs in other schools in order to keep up-to-date with their field? ____ %
5. have had previous teaching experience in any of the following settings?
   Other colleges ____% Private Industry ____% Military ____% Other ____%
6. are active members in a professional or technical education association related to their teaching field? ____ %
7. have, during the past year, participated in a formal program to improve their teaching skills? ____ %
8. have, during the past year, served as a technical consultant to business or industry? ____ %
9. have, during the past year, conducted funded research in their technical field? ____ %
10. have ever published an article or book on topics in their technical field? ____ %

SECTION TWO: STUDENTS

For the students in your program please indicate the percentage of those who:

1. obtain a position in their technical field upon graduation? ____ %
2. require financial aid to attend school? ____ %
3. do not graduate due to
   academic difficulties ____% financial difficulties ____% employment ____% personal reasons ____%
4. are well prepared in their high schools for the academic work in a postsecondary program? ____ %
5. are placed in special classes to improve their basic skills? ____ %
6. were superior high school students (GPA of "B" or above)? ____ %
7. on the average, how much of course grades are based on each of the following:
   class participation ____% exam scores ____% lab participation ____% student project ____%
   term papers ____% student effort ____%

SECTION THREE: BUSINESS/INDUSTRY COOPERATION

Please indicate the relative amount of cooperation and sharing between your program and business and industry. What is the percentage of:

1. student enrollment that consists of industry personnel involved in upgrading or retraining in high technology? ____ %
2. regular faculty who participate annually in business industry work experiences or projects to maintain their technical knowledge? ____ %
3. annual program support provided by private sector donations of equipment or funds? ____ %
4. students completing the program who are placed with a local business/industry? ____ %
5. regular faculty who participate jointly with business/industry personnel at technical conferences and association activities? ____ %
6. teaching faculty that are employees on loan from local business or industry? ____ %
7. full-time faculty who annually teach special or customized training courses for industry personnel? ____ %
8. program content and practice that is revised annually because of advice from the business/industry advisory committee? ____ %

SECTION FOUR: FACILITIES AND EQUIPMENT

Please indicate the percentage of:

1. students in your program who have regular access to fully equipped study and laboratory stations? ____ %
2. students who use cooperative work experiences or internships to gain access to equipment and training ____ %
3. student learning time allocated to classroom ____ %; laboratory ____ %; off campus activities ____ %
4. program facilities and equipment that is the same as or comparable to the type currently used in business or industry ____ %
5. vendor service and support provided to implement new equipment and systems? ____ %
6. technical support needed to implement new equipment and systems that has been provided by vendors ____ %
7. program facilities and equipment designed to replicate workplace settings and operations ____
8. program facilities and equipment that are adequate to deliver an up-to-date education and training program ____ %
9. program equipment that is used jointly by business or industry personnel for their own instruction or demonstration purposes ____ %

SECTION FIVE: CURRICULUM AND INSTRUCTION

Please indicate for your program, the percentage of curricular content and instructional practice that:

1. focuses on the newest technological developments and applications? ____ %
2. has been designed and developed in concert with local industry personnel? ____ %
3. stress the development of problem-solving abilities ____

   communication skills ____ % mathematics skills ____ % interpersonal skills ____ %
4. is formulated on and incorporates performanced based objectives and evaluation? ____ %
5. is focused on fundamental technical concepts and principles? ____ %
6. is articulated with related four-year college programs? ____ %
7. is articulated with a secondary vocational or pretechnical program? ____ %
8. is delivered through the use of computer-assisted instructional systems? ____ %
9. incorporates self-paced individualized learning materials? ____ %

SECTION SIX: BUDGET AND RESOURCES

Please answer the following questions as indicated.

1. What is the average dollar value of your total program budget? $ ____
2. What percentage of the annual budget is allocated for

   faculty salaries ____ %; lab/teaching aides ____ %; equipment and supplies ____ %

   program maintenance ____ %
3. What percentage of the total departmental budget is allocated to this high tech program? ____ %
4. What percentage of annual program support comes from special grants or gifts? ____ %
5. What is the average annual cost per full-time-equivalent student in the program? $ ____

APPENDIX E

PROGRAM INFORMATION

TABLE 6

PROFILE OF PROGRAM SPECIFICATIONS

PROGRAM INFORMATION	LASER	ROBOTICS	CAD/CAM	MICROELECTRONICS ELECTRONICS	HEALTH AND BIOLOGICAL SCIENCE	COMPUTER	ENGINEERING TECHNOLOGY	COMMUNICATION	OTHER	COMPOSITE AVERAGE
Average Number of Faculty										
Full-Time	1.25	3.0	5.3	4.6	3.2	2.5	6.6	2	5.5	3.7
Part-Time	2.50	2.0	7.0	3.8	6	1	10.3	3	6.0	4.6
Average Number of Students	51	46	152	224	58	70.5	125	50	161	108.5
Average Class Size										
Lecture	22.5	24	24	33	2[illegible]	21	23.1	16.5	17.5	22.5
Laboratory	14	15	16	20	16	16	16.2	12.0	13.5	15.3
Average Number of Laboratories	5	3	7	2	3	2	3.9	7	3	4
Average Floor Space (Sq. Ft.)	3066	8500	12,666	3237.5	5250	6450	16.491	4146.6	2150	6884
Average Program Budget ($)	105,000	326,250	385,000	266,550	486,866.70	161,000	567,280	NA	681,000	442,000
Average Budget Allocations	%	%	%	%	%	%	%	%	%	%
Faculty Salaries	78	64	78	80	79	55	79	90	68	74
Lab/Teaching Assistants	9	30	3	11	2	2	5	0	8	7.8
Equipment/Supplies	16	28	15	8	8	5	13	5	13	12.3
Program Maintenance	6	5	5	5	4	5	3	5	11	4.8
Average Yearly Cost Per FTE ($)	1944	2356	2487.50	2288	3351	1350	2425	NA	2262	2307
Number of Advisory Committee Members	8	9.5	10	9.5	10	9	10	12	13	10
Number of Committee Meetings Per Year	2	3	2	3	4	2	2.1	2	2.5	2.5

APPENDIX F

SELF-ASSESSMENT FORM

HIGH TECHNOLOGY
PROGRAM QUALITY REVIEW

(A Self-Assessment Process)

Name ______________________________ Check One:

Faculty Rank ______________________________ Full-Time ___

Technical Speciality ______________________________ Part-Time ___

Purpose

This form has been designed to be used by individual faculty members in high-technology programs to conduct an assessment of program activities. All faculty members in the same program should each fill out a copy of the assessment f rm. Faculty responses should be tabulated, summarized, and used as a bases for planning or improving program practices. (The results of your own review can be compared with the data provided in the companion publication.)

Instructions

Read the instructions given on the following page and respond as directed. There are no "right" or "wrong" answers. All questions are to be answered by individual faculty members and advisory committee members. Responses should be based on individual experiences. Adequate time and thought should be given to each item. Don't rush. After all the individual ratings have been compiled and averaged, faculty should meet to discuss the results and their implications for the program.

RATING THE IMPORTANCE OF ACTIVITIES

This self-assessment form has been designed to rate the importance of various activities iin terms of their contribution to the quality of your program. Carefully read each characteristic in each section and rate its importance by drawing a circle around one of the numbers on the 7 point scale. Space is provided to add other indicators.

Essential
Very Important
Important
Not Important

SECTION ONE: FACULTY ACTIVITIES

As a faculty member in a high-technology program, how important is it that you--

1.	attend conferences, workshops, or seminars to keep up to date in your technical field.	1	2	3	4	5	6	7
2.	have recent work experience related to your teaching area.	1	2	3	4	5	6	7
3.	hold a professional degree in the technical field you teach.	1	2	3	4	5	6	7
4.	maintain an active membership in a professional or technical education association.	1	2	3	4	5	6	7
5.	stay informed about comparable technical programs in other institutions.	1	2	3	4	5	6	7
6.	have previous teaching experience in industry, education, or the military.	1	2	3	4	5	6	7
7.	serve as a consultant to business or industry.	1	2	3	4	5	6	7
8.	participate in programs to enhance your teaching skills.	1	2	3	4	5	6	7
9.	publish articles or books on topics in your technical field.	1	2	3	4	5	6	7
10.	conduct funded research activities in your technical field.	1	2	3	4	5	6	7

	Not Important		Important		Very Important		Essential

SECTION ONE (continued)

Others ______________________	1	2	3	4	5	6	7
______________________	1	2	3	4	5	6	7

SECTION TWO: STUDENT RECRUITMENT SELECTION AND SUPPORT

How important is it that your high-technology program--

1. recruit and enroll superior high school students (GPA of B or above).	1	2	3	4	5	6	7
2. promote the success of graduates as a recruitment aid.	1	2	3	4	5	6	7
3. establish limits on lecture and laboratory class size.	1	2	3	4	5	6	7
4. test and place students in basic skill improvement courses if needed.	1	2	3	4	5	6	7
5. recognize students' dedication and motivation in addition to academic achievement.	1	2	3	4	5	6	7
6. collaborate with high schools to better prepare students for postsecondary education.	1	2	3	4	5	6	7
7. follow normal admission policy in accepting students.	1	2	3	4	5	6	7
Others ______________________	1	2	3	4	5	6	7
______________________	1	2	3	4	5	6	7

SECTION THREE: CURRICULUM AND INSTRUCTION

How important is it that the curriculum and instruction in your high technology program--

1. reflect the newest technological developments and options.	1	2	3	4	5	6	7

Essential
Very Important
Important
Not Important

SECTION THREE (continued)

2.	be designed in concert with local business/ industry.	1 2 3 4 5 6 7
3.	stress the development of problem-solving skills.	1 2 3 4 5 6 7
4.	be formulated on and incorporate performance-based objectives and evaluation.	1 2 3 4 5 6 7
5.	include special courses to strengthen math and communication skills.	1 2 3 4 5 6 7
6.	first develop core technical skills and then develop specialized skills.	1 2 3 4 5 6 7
7.	stress the development of interpersonal skills.	1 2 3 4 5 6 7
8.	be articulated with related curricula in 4-year institution programs.	1 2 3 4 5 6 7
9.	be articulated with secondary pretechnical or vocational courses.	1 2 3 4 5 6 7
10.	use computer-assisted instructional systems.	1 2 3 4 5 6 7
11.	incorporate self-paced individualized learning materials.	1 2 3 4 5 6 7
Others	________________ ________________	1 2 3 4 5 6 7
	________________________________	1 2 3 4 5 6 7

SECTION FOUR: FACILITIES AND EQUIPMENT

How important is it that your high-technology program--

1	provide fully equipped lab and work stations for students.	1 2 3 4 5 6 7

Essential
Very Important
Important
Not Important

SECTION FOUR (continued)

2.	provide the same or very similar facilities and equipment as those found in business or industry.	1 2 3 4 5 6 7
3.	receive vendor technical assistance in implementing hardware and software systems and applications.	1 2 3 4 5 6 7
4.	allow maximum integration and replication of workplace facilities and equipment.	1 2 3 4 5 6 7
5.	provide lab assistants to set up, service, and maintain facilities and equipment.	1 2 3 4 5 6 7
6.	make the facilities and equipment available to business and industry personnel for instruction and demonstration.	1 2 3 4 5 6 7
7.	maintain flexible facilities that can accommodate periodic equipment and curriculum changes.	1 2 3 4 5 6 7
8.	allocate student learning time to each of the following settings:	
	o classroom,	1 2 3 4 5 6 7
	o laboratory,	1 2 3 4 5 6 7
	o off-campus sites.	1 2 3 4 5 6 7
9.	encourage students to participate in cooperative work experience or internship programs.	1 2 3 4 5 6 7
Others	______________________________	1 2 3 4 5 6 7
	______________________________	1 2 3 4 5 6 7

	Not Important		Important		Very Important		Essential

SECTION FIVE: BUSINESS/INDUSTRY COOPERATION

With respect to business/industry cooperation, how important is it that your high-technology program--

1. include frequent input from an advisory committee of business/industry personnel.	1	2	3	4	5	6	7
2. include the development of customized training programs for business/industry personnel.	1	2	3	4	5	6	7
3. involve faculty in business/industry work experiences or projects to help maintain their occupational expertise.	1	2	3	4	5	6	7
4. include private sector support through donations of equipment and/or funds.	1	2	3	4	5	6	7
5. include student participation in work experiences at local business/industry sites.	1	2	3	4	5	6	7
6. include the loan of business/industry personnel to serve as adjunct faculty.	1	2	3	4	5	6	7
7. be involved in joint industry-faculty participation at conferences, trade association meetings, and presentations to other groups.	1	2	3	4	5	6	7
Others ______________________ ____________________	1	2	3	4	5	6	7
______________________ ____________________	1	2	3	4	5	6	7

SECTION SIX: BUDGET, RESOURCES, AND SUPPORT

How important is it that the budget and resources of your high-technology program--

1. include follow-up funding to upgrade or update equipment as the program matures.	1	2	3	4	5	6	7
2. include grants to purchase special equipment.	1	2	3	4	5	6	7

SECTION SIX (continued)	Not Important		Important		Very Important		Essential
3. include funding for new faculty positions.	1	2	3	4	5	6	7
4. include funding to hire laboratory assistants to maintain facilities and equipment.	1	2	3	4	5	6	7
5. provide faculty salaries that are competitive with private sector salaries.	1	2	3	4	5	6	7
6. be separate from other technical program budgets.	1	2	3	4	5	6	7
Others ______________________	1	2	3	4	5	6	7
______________________	1	2	3	4	5	6	7

COMMENTS:

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