# Chapter 1

# Industrial and Technology Education Career Path Guide

The California culture is distinctly characterized as technological. Californians in the workforce and those preparing to enter or reenter the workforce must understand this technological culture if they are to function as responsible and productive citizens.

Educators, administrators, and business and industry partners are responding to the complexity of advancing technology and rapid technological changes by working together on Industrial and Technology Education (ITE) programs to prepare students for careers of their choice and for lifelong learning. Students are discovering that education in a single discipline and preparation of skills specific to a current job are no longer adequate for success in a technological culture. Students in industrial and technology education programs today are mastering curricula featuring basic scientific principles, mathematical concepts, and communication skills on which work and learning are based. Students who successfully complete an industrial and technology education program will adapt their understanding and skills as careers and technology change.

Because of the complexity of advancing technology and rapid technological changes, the ITE career path guide will serve as both the catalyst for and the basis of two essential activities: curriculum and student development. Each of these important functions is threaded throughout the career path guide, which is organized under the major categories of curricular paths, powerful teaching and learning, program and student assessments, and design and implementation of quality programs.

This guide provides a holistic description of the industrial and technology education career path continuum—a kindergarten-to-workforce continuum of well-planned experiences. These experiences prepare students for successful transition to the workforce; participation in the home, community, and workplace; and the pursuit of lifelong learning. Industrial and technology education programs produce individuals with a personal insight into and understanding of the technological culture in which they live, learn, and work.

Industrial and technology education programs in California center on students:

- **Students understanding systems and processes**

  Students become familiar with historical, current, and potential developments in industry and technology. They study the effects of such developments on the environment, consumers, and society and learn that the changing technologies of the future may require career changes.

- **Students building a flexible blueprint of career path options**

  Students participate in activities and develop a knowledge base that helps them make sound career choices. They learn to gather, analyze, and organize information to form options that help them in their selection of a program major and career path. (See Figure 1.1 for examples of career path options that are open to industrial and technology education students.)

- **Students engaging as active participants in the learning process**

  Students prepare to advance within their chosen field and change careers as required by the changing technologies of the future. Students acquire the knowledge, attitudes, and skills they need to be successful as they progress toward their career goals.

- **Students learning in a process-based curriculum**

  Students learn to apply technology, consistent with industry standards, in the organization of personnel, equipment, systems, strategies, and processes. The technical content in this concept-driven curriculum is derived from and linked to performance standards. Performance standards describe what the student should understand and be able to do in the future.

- **Students building leadership skills**

  Students develop leadership skills through participation in ITE course work, formal student organizations, and other school and community activities. Their personal and interpersonal skills are refined as they develop their leadership potential. They manage time and balance priorities as well as demonstrate a capacity for increased learning.

- **Students developing cooperative working relationships**

  Students learn to work cooperatively, share responsibilities, and assume leadership roles while working as a part of a team. They develop cooperative working relationships across gender and cultural groups. Through the use of communication, thinking, and problem-solving skills, students learn to resolve personal and group issues responsibly in a dynamic decision-making setting.

- **Students applying skills across subject-matter boundaries**

  Students participate in an interdisciplinary model that integrates themes and concepts across disciplines. Students engage in activities involving complex concepts and learn to apply skills across disciplinary boundaries. This collaboration helps students develop vocational, social, emotional, and academic alliances with other students and adults.

- **Students learning to communicate effectively**

  Students learn to use written and oral language effectively, solve problems, and present oral and written reports. An integrated linkage of technical and academic skills prepares high school students for enrollment in advanced academic, vocational, and technical courses at all educational levels.

- **Students receiving personalized service**

  All students, including language-minority students and those at risk of failure, engage in the learning process through a variety of strategies that provide each student with a personalized learning experience. The concept of integration and support encompasses the belief that all students can learn and that a student body has diverse needs for support.

- **Students achieving certification**

  Students participate in a student certification assessment system based on (1) authentic assessment strategies emphasizing student performance and application of knowledge; and (2) content, career-performance, and curriculum standards in an integrated format.

- **Students building graduation portfolios**

  Students, reflecting what they have learned and can do in their career paths, present themselves in the best possible position for entry into the workforce or for further education.

# Industrial and Technology Careers for the Future

Among the many factors challenging ITE are the trends that will reshape the workplace. Experts on transformation prod others to embark on rethinking, reinventing, reengineering, and restructuring institutionalized programs. Industrial and technology education programs provide an excellent school-to-work transition for students.

Industrial and technology education students will make the transition from school to a wide variety of established and emerging occupations serving the people of California. The future growth projected in California construction, transportation, communication, utilities, and manufacturing industries is expected to generate a substantial number of new jobs. Future employment in the service sector, including all repair services, will experience strong absolute and relative growth.

## Smaller Industries

Most U.S. companies will become smaller, employing fewer people. Many of the industrial giants, long the pillars of the U.S. economy, will downsize their operations. Taking the place of the hierarchical infrastructure will be not just one type of organization but a variety of organizations. The tasks that Americans do on the job will change too, and a new definition of work will be sought.

## New Technical Worker

Technicians, from computer repairpersons to biotechnologists, will replace manufacturing operatives. The computational infrastructure (in essence, computers) will progressively take over more of the work that can be routinized, such as guiding machines that make things and transmitting information within the organization or across its boundaries. The vertical division of labor will be replaced by a horizontal division. The new technical worker will end up working in so-called network organizations that are modular units downsized to core competencies and that send out for everything else.

The character of what workers need to know has changed also. A worker with a high school education but without some focused technical experience will become inadequate for the relatively high-paying positions that the service sector has been creating. Crucial higher-level skills will be required for work in computerized factories with digitally controlled machines. The workplace will be more decentralized, giving workers more autonomy and responsibility in the hope of enlisting their pride, judgment, and creativity in getting the job done.

## Work Redefined

Work itself will be redefined: constant learning; more higher-order thinking; fewer designated work hours; and a true understanding that production consists of furnishing services, even within what traditionally has been thought of as manufacturing. Opportunities will abound, too, in services that cannot be subsumed by the computational infrastructure because they require a human touch. Skilled decision makers will be literate, innovative, and capable of critical thinking. Work will become intervention—humans intervening in processes set in motion by others but maintained by new tools.

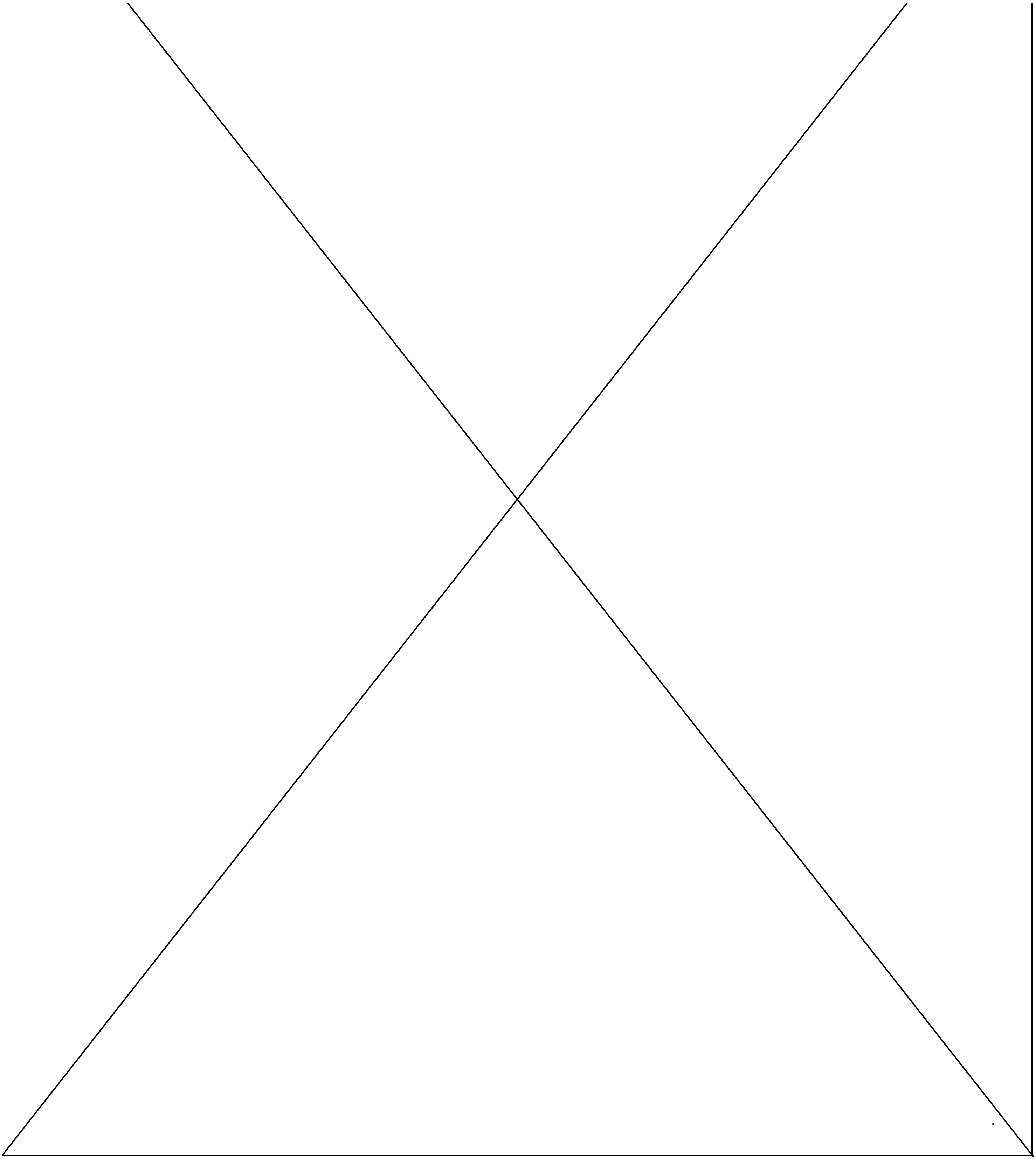

**Fig. 1.1. Examples of Entry-, Technical-, and Professional-Level Careers in ITE**

Industrial and technology education students completing entry, technical, and professional program career paths are prepared to make a lifelong career contribution in California. Their understanding of basic scientific principles, mathematical concepts, and communication skills, coupled with their broad-based technical knowledge and skills, will provide them with a transferable and renewable preparation for the workforce and enable them to be positive, productive contributors in the workplace.

# Industrial and Technology Education Curricular Paths

Industrial and technology education in California is a kindergarten-through-university continuum of well-planned, coordinated, articulated, integrated, and sequential activity-based programs (see Figure 1.2). It is concerned with the processes, materials, and systems of technology and their development, use, and importance. It is concerned with industry—its organization, processes, resources, systems, and products. It is concerned with the socioeconomic and environmental influences of industry and technology. Industrial and technology education programs help all students to understand their technological culture, enabling them to make rational decisions about their lives and provide a positive contribution in the increasingly technological workplace.

## Awareness of Industrial and Technology Education

Programs in industrial and technology education for children in the elementary school are designed to enhance and reinforce the educational goals of the whole elementary school curriculum. Students in the elementary school are at the ideal level to begin developing an understanding of the technological world. Activities in Technology Education for Children are integrated into the whole elementary school curriculum. These experiences orient students in technology, develop their psychomotor skills, and refine their attitudes about the influence of technology on society.

Programs in Technology Education for Children provide students with experiences which:

- Introduce them to tools, materials, processes, and systems of industry and technology.
- Integrate and reinforce skills across disciplines.
- Improve children's psychomotor skills.
- Promote cognitive synthesis.
- Develop an understanding of influence of technology on society.

## Exploration of Industrial and Technology Education

Exploring Technology Education programs are broad-based, modularized curricula offering middle school students integrated, active, and cognition-based activities.

The student of Exploring Technology Education becomes familiar with historical, contemporary, and potential developments in industry and technology and with the potential effects of such

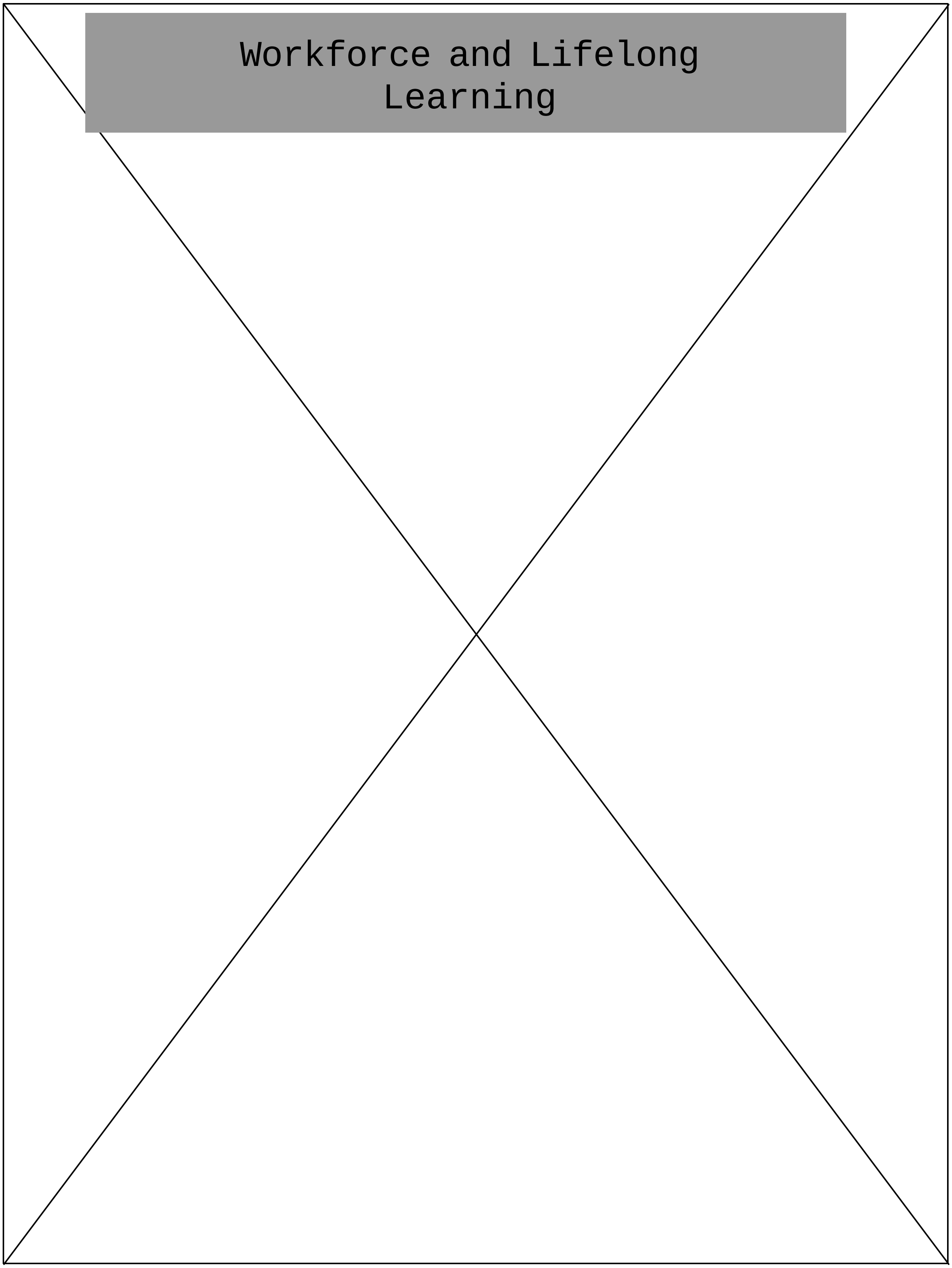


**Fig. 1.2. Industrial and Technology Education Continuum**

developments on consumers and society in general. As a result of participation in these explorations, the student entering high school from an Exploring Technology Education program will be able to:

- Make informed career, educational, and occupational decisions based on knowledge and skills acquired and according to personal interests and aptitudes.
- Apply creative skills and critical thinking skills to problem solving.
- Apply and integrate knowledge and skills across disciplines.
- Develop creative abilities and build self-esteem.
- Use the resources of technology safely and efficiently.
- Demonstrate an understanding of technological processes and systems.
- Develop social skills while working with others in small-group and large-group situations.

## Introduction to Industrial and Technology Education

Students move from Exploring Technology Education experiences to two unique opportunities: Technology Core and Introduction to Career Path Clusters.

### *Technology Core*

The Technology Core is designed to ensure that high school students have a broad knowledge base in the application of technological concepts and the flexibility needed to function efficiently in a technological society. The Technology Core curriculum activities are designed to help all students:

- Develop problem-solving skills.
- Think independently.
- Develop career awareness and career paths.
- Develop positive attitudes.
- Function in an ever-changing society.
- Set high career goals.
- Have safe and efficient work habits.
- Work collaboratively in teams.
- Become responsible for their own learning.
- Become leaders in technological processes and the application of those processes.

The Technology Core enables all high school students to learn about the technology that affects their present and future lives. Hands-on activities provide the experiences necessary to make wise career choices and develop career paths. These activities are integrated with and reinforce content across academic disciplines.

### *Introduction to Career Path Clusters*

Students in Introduction to Career Path Clusters enter from the broad-based Technology Core high school experience into one or more of the courses in Introduction to Career Path Clusters as part of a natural decision-making process. These courses are designed specifically to take the high school student completing a Technology Core course through a cluster focus—providing the student with the perfect opportunity to realize the full range of career opportunities within that particular career path cluster.

Students who successfully complete one or more courses in the Introduction to Career Path Clusters will have a knowledge base that helps them to make sound career choices. They will be able to identify the knowledge, skill, training, and education requirements typically associated with careers at the three points of entry into the workforce:

1. Entry-level skilled jobs
2. Technician/supervisor
3. Professional/management

Introduction to Drafting Technology, for example, would provide students with the opportunity to evaluate their workforce entry potential in (1) entry-level positions in drafting, including those of junior drafter and drafter-illustrator; (2) technical-level or supervisory-level positions in drafting, including those of mechanical drafter and structural drafter; and (3) professional-level and management-level positions in drafting, including those of architect and civil engineer.

## Career Path Clusters in Industrial and Technology Education

To pursue a career path cluster interest from choices made in Technology Core courses and courses in Introduction to Career Path Clusters, high school students enter occupational-specific courses within the following career path clusters:

- Construction Technology
- Drafting Technology
- Electronic Technology
- Engineering Technology
- Graphic Communications Technology
- Manufacturing Technology
- Transportation and Energy Technology

### *Career Path Cluster: Construction Technology*

Construction Technology programs prepare individuals for employment or advanced training in a variety of construction-related industries. These programs prepare individuals to enter the workforce as skilled workers, technicians, supervisors, and managers.

### *Career Path Cluster: Drafting Technology*

Drafting Technology programs prepare individuals for employment or advanced training in a variety of industries. These programs prepare individuals to plan, prepare, and interpret mechanical, architectural, structural, marine, piping, electrical, electronic, topographical, and other drawings.

### *Career Path Cluster: Electronic Technology*

Electronic Technology programs prepare individuals for employment or advanced training in a variety of electronic industries. These programs prepare individuals to work as technicians, engineers, and professionals who perform research and design, manufacturing, maintenance, and service functions.

### Career Path Cluster: Engineering Technology

Engineering Technology programs prepare individuals for employment or advanced training in a variety of industries that require the application of scientific and engineering knowledge and methods combined with technical skills.

### *Career Path Cluster: Graphic Communications Technology*

Graphic Communications Technology programs prepare individuals for employment or advanced training in a variety of electronic, photographic, and printed communications media. These programs prepare individuals to enter the workforce as technicians, supervisors, and engineers.

### *Career Path Cluster: Manufacturing Technology*

Manufacturing Technology programs prepare individuals for employment or advanced training in systems approaches to primary and secondary material processing. These programs prepare individuals to work as technicians, engineers, and professionals performing research and design, manufacturing, maintenance, and service functions.

### *Career Path Cluster: Transportation and Energy Technology*

Transportation and Energy Technology programs prepare individuals for employment or advanced training in a variety of related industries. These programs prepare individuals to work as technicians, managers, engineers, teachers, and professionals performing research and design, manufacturing, maintenance, and service functions.

## Career Specializations in Industrial and Technology Education

Although secondary curricula prepare students for intelligent career planning, students naturally graduate to specializations within a specific career path cluster for employment and advanced education in that area (see Figure 1.3). Secondary, postsecondary, and combinations of secondary and postsecondary career specializations for students in industrial and technology education include such program options as two-plus-two, two-plus-two-plus-two, academy, magnet, tech-prep, apprenticeship, and college/university programs. These options help students feel connected to the school, offer a personalized approach to learning, and support students and teachers working together.

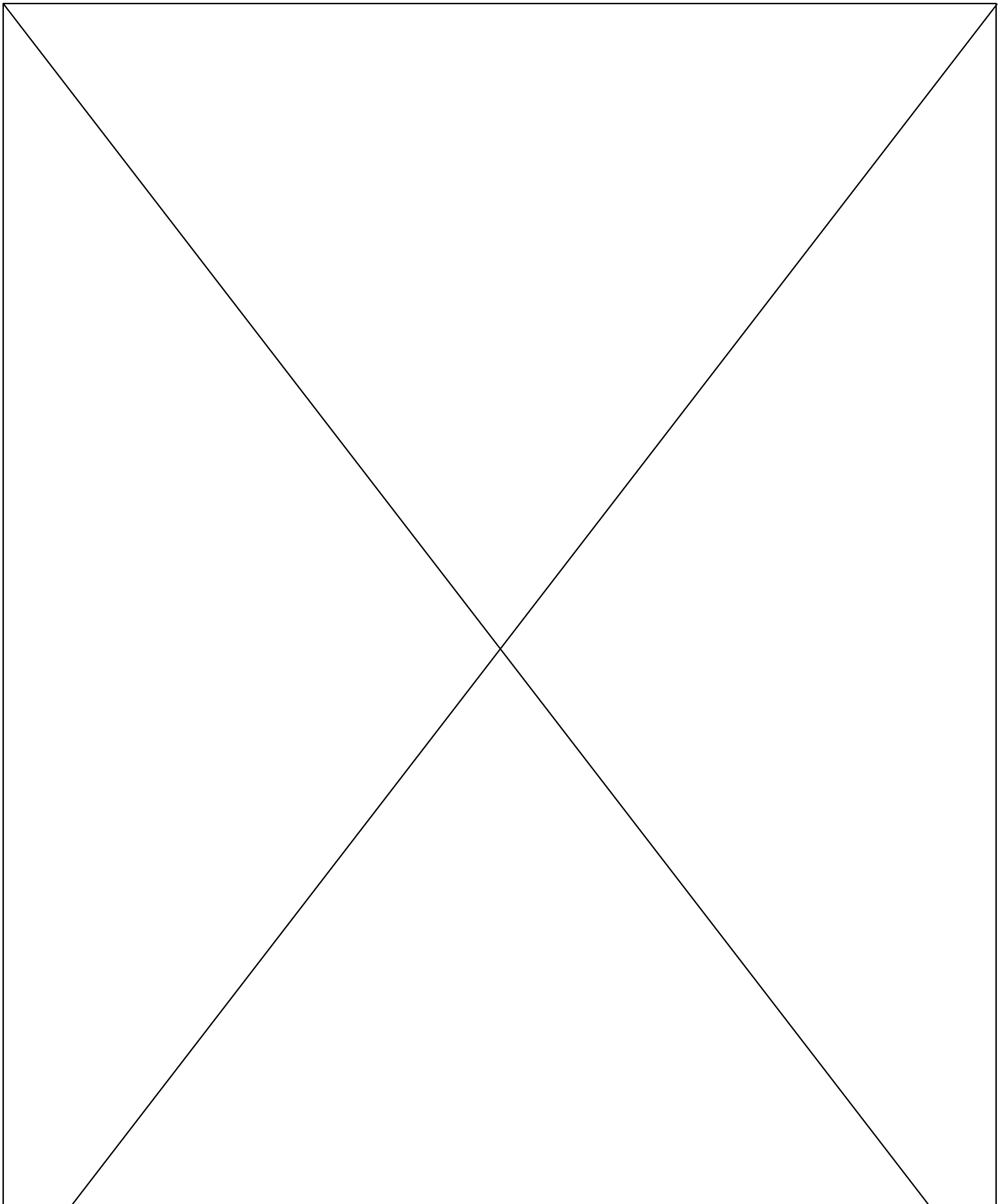

**Fig. 1.3. Examples of ITE Career Path Specializations**

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## Links with Workplace Learning

Proposals for restructuring C–VE programs reflect the influence of popular concepts, such as linking classroom with workplace learning to increase the relevancy for students. Four C–VE delivery systems offer high potential for promoting this linkage and relevancy: magnet school, academy, technical preparation (tech prep), and apprenticeship programs.

### *Magnet*

Magnet schools or career magnet schools provide students with a college preparation curriculum as well as a workforce preparation curriculum, enabling them to enter immediately into a well-paying career. By grouping students interested in broad occupational themes, magnet school programs focus on a career path cluster and link it closely with related business and industry. A magnet program career path cluster might be communications technology, computer science, child and human services, health careers, agricultural science, or business technology.

### *Academy*

The academy program design is typically organized similarly to that of magnet programs; however, an academy is structured as a school-within-a-school. A common academy structure involves a collaborative team of mathematics, science, English, and career-vocational education instructors. The C–VE discipline serves as the core of the academy and as the basis for a business and industry linkage that includes mentoring and workplace learning experiences. Academies can focus on a variety of career paths, such as graphic arts technology, hospitality, marketing, or environmental agriculture.

### *Apprenticeship*

Apprenticeship training programs are registered with the Department of Labor or the California apprenticeship agency in accordance with the National Apprenticeship Act. These programs are conducted or sponsored by an employer, a group of employers, or a joint apprenticeship committee representing both employers and a union and contain all the terms and conditions for the qualification, recruitment, selection, employment, and training of apprentices. Typically classified as a workplace learning program, apprenticeship training programs are often coordinated with secondary and postsecondary education and combine supervised, structured, on-the-job training with related technical instruction.

### *Youth Apprenticeship*

Youth apprenticeship programs involve a variety of models, but all programs involve structured or organized learning on the job and coordinated classroom training. Thus youth apprenticeship lies between the extremes of limiting all work to a classroom setting and limiting student learning to workplace experiences. In California youth apprenticeship a growing emphasis is on C–VE programs that promote a recognized certification; participate in statewide curriculum restructuring initiatives; support secondary, postsecondary, business, and industry collaboration; employ mentoring strategies; and develop students' lifelong learning skills, including opportunities for formal education beyond the completion of an apprenticeship program.

## Two-plus-Two

The two-plus-two program option is an established articulation process that is finding renewed interest in an era of curriculum integration and program restructuring. Linking two or more educational systems, agreements are generally designed to permit students to move from one course or program to a subsequent course or program between participating educational institutions—typically, from high school to community college. A fundamental articulation principle is that no student should be required to repeat the same course content for which credit has already been earned.

## Two-plus-Two-plus-Two

Two-plus-two-plus-two program options carry the two-plus-two articulation concept one educational institution further, into the four-year college or university. The guiding principle of nonduplicative learning remains the basic organizational tenet. Whereas two-plus-two options are largely designed to enable students to enter technical fields, two-plus-two-plus-two articulation agreements are designed to promote student achievement and success in professional career opportunities.

Early two-plus-two and two-plus-two-plus-two articulation programs often focused on the nonduplicative linkage of industrial and technology education curriculum content. Contemporary articulation agreements are quickly moving toward a broad-based linkage involving cooperative decision making between educators in industrial and technology education and those in academic programs across articulation levels. Teams of industrial and technology, mathematics, science, and communication program leaders from high schools are developing articulation agreements with teams of similar representatives from community colleges and four-year colleges and universities. Such agreements have resulted in the streamlining of curriculum by the elimination of unnecessary redundancy and duplication.

## Tech Prep

A major high school or community college option for students pursuing a career path cluster is tech prep. Tech prep in California is a sequence of study beginning in high school and continuing through at least two years of postsecondary occupational education. Engineering Technology Tech Prep and Industrial Technology Tech Prep represent courses of study in this state that integrate college preparatory course work with rigorous technical education concentrations.

Engineering Technology Tech Prep is a unique program that prepares students who are system oriented and interdisciplinary in their technical preparation. Industrial Technology Tech Prep is a unique program designed to prepare students for new and multisystem approaches to swiftly changing technical content. Both programs are designed to meet the changing needs of the workplace.

Tech prep prepares students for high-skill technical occupations and allows for either direct entry into the workplace after high school graduation or continuation of study leading to a certificate or associate degree in a two-year college. The tech-prep program integrates academic and occupational subjects, placing heavy emphasis on articulation from secondary to postsecondary education. Articulation between high schools and two-year colleges embodies a competency-based, technical curriculum, designed jointly by business/labor and secondary/postsecondary schools, which teaches essential competencies without duplication or repetition.

### College/University

Students electing to pursue their industrial and technology education career path clusters through the university level may do so directly from high school through a tech-prep program or through a combination of secondary and postsecondary opportunities combined with workplace experiences.

Students who complete a university-level certificate or diploma program may pursue midmanagement, environmental engineering, teaching, construction management, research and design, and many other professional-level and managerial-level careers. All students, regardless of their initial level of entry into the workforce, may choose to upgrade or retrain (or both) at an appropriate career path educational opportunity.

## Powerful Teaching and Learning in Industrial and Technology Education

Industrial and technology education teachers provide powerful, high-quality educational programs that prepare students for employment and citizenship and that promote students' intellectual, ethical, emotional, and physical growth. Emerging programs designed to address this provision focus on systems and strategies that offer students the opportunity to learn in context while solving realistic problems and improve the match between the requirements of work, citizenship, and learning and the subject matter that students are taught.

Broad strategies for powerful teaching and learning in industrial and technology education programs include but are not necessarily limited to the teacher's role, the use of instructional materials, cooperative learning, integration of disciplines and interdisciplinary collaboration, and involvement in the Vocational Industrial Clubs of America. These industrial and technology education strategies rely to a large extent on the quality of teacher education; the upgrading of systems, instructional technology, equipment, facilities, and student support systems; and the emerging professional roles of participants in the educational and business and industry communities in the ITE kindergarten-to-workforce delivery system.

### Students as Active Learners

The challenge for teachers is to help students learn to think, solve problems, and communicate and to encourage their involvement in their own learning. It is not enough for students merely to complete academic assignments and achieve good grades. They need to formulate and solve problems; criticize their own work; work in teams; communicate about what they are doing; and achieve mastery of a topic, skill, or craft. The authentic and activity-based industrial and technology education learning process draws students in, captures their interest, and engages them in their own development.

#### *Cognition-Based Education*

Given that learning and teaching involve multifaceted human beings in complex interactions, educators have no choice but to acknowledge and comprehend that complexity and recognize the need for the implementation of teaching and learning strategies ranging from behaviorism to brain-based learning. The enterprise of learning and instruction occurs in classrooms that reflect diversity and a broad range of student aptitudes. These simultaneous interactions between students, teachers, and technological concepts contribute to the complexities of the industrial and technology education classroom and its wide range of laboratory environments.

Student cognitive processes, which mediate between content instruction and skill development and the knowledge of the learner, assist in the intellectual development of the student. In this cognitive domain skill acquisition and intellectual growth are fostered. Teachers must engineer the learning environment and content structure of classrooms to combine realistic learning experiences and activities that promote synthesized cognitive actions on the part of the learner. In an industrial and technology education program, all levels of the cognitive domain are evident throughout the curriculum. Through the simple knowledge of recall of facts, the comprehension activities of translating meanings into other applicable forms, and the application of this newly acquired knowledge, industrial and technology education students analyze, synthesize, and evaluate their learned experiences and those of their peers.

### *Collaborative Learning*

Industrial and technology education programs rely on an understanding of how students learn. The programs call for collaborative teaching and learning strategies that break down classroom walls to extend related learning opportunities throughout the school, across disciplines, and into the community. Emerging strategies include cross-disciplinary efforts, academy and magnet programs, and authentic assessments.

The key to collaborative learning is the student's ability to be an active learner, with teachers serving in a facilitating role. Students often collaborate in teams of two on modularized activities and in larger groups with a thematic focus. Collaborating students are encouraged to seek information from others, ask for feedback for peers, and work together. The same interactional skills learned in school-site collaborative activities are those that will be used in the workplace.

### *Learning to Learn*

As the workplace and required worker skills change fundamentally, industrial and technology education seeks to accommodate that change by contributing to students' professional development and promoting lifelong learning. Employers in the high-performance, high-involvement workplace require a workforce of individuals committed to change. Workers must be able to assimilate new information, adapt to new technologies, and be occupationally mobile. Experts agree that as competition forces American industry into new patterns, workers will be required to shift from one job role to another and accept changing responsibilities. Members of the workforce will be requested to absorb, process, and apply new information quickly and effectively.

The new technical worker must be skilled at thinking integratively, at employing different sets of skills and concepts interactively, and in adjusting to changing conditions. The ability to learn and apply new skills becomes more and more important as American workers meet the challenge of a competitive global economy. Learning to learn adds transition skills that provide workers with the ability to move easily within the high-involvement workplace. An organization ideally structured, equipped, and managed is unproductive without a brain. The brain is a well-educated workforce. Future workers need to consider education as a continuous process throughout a working lifetime. Learning to learn seems to be the most basic of all skills. It enhances the application of other basic and higher-order skills, providing the key to future success. In industrial and technology education, learning to learn is a top priority.

## Skills USA–VICA—An Integral Part of the Industrial and Technology Education Curriculum

Students develop leadership skills through student organizations and other school and community activities sponsored by industrial and technology education. Students involved in Skills USA–VICA refine their personal and interpersonal skills as they develop their leadership potential. Skills USA–VICA students manage time and balance priorities as well as demonstrate a capacity for increased learning.

Skills USA–VICA students share responsibilities and assume leadership roles while working as a part of a team. That helps them to develop cooperative working relationships across gender and cultural groups. Through the use of communication, thinking, and problem-solving skills, they learn to resolve personal and group issues in a dynamic setting. As an integral part of the industrial and technology education curriculum, involvement in Skills USA–VICA appears to promote the concepts of curriculum integration and articulation and provides some quality of experience that promotes active participation in the workforce.

## Integrated Curriculum and Interdisciplinary Collaboration

Throughout the industrial and technology education continuum, communication skills, mathematical concepts, and scientific principles are learned through an activity-oriented approach. Communication skills are taught in a setting that models the challenges and responsibilities of the workplace. Mathematical skills are developed and refined in solving problems related to the world of work. Critical concepts from the sciences of biology and chemistry are provided through a curriculum relevant to the workplace of today and the future.

Understanding the complexities of the field of economics is facilitated through an activity-oriented curriculum. A course in applied physics enables students to understand physical principles and their application to current and novel tasks in the workplace. Students learn to communicate effectively, solve problems, and present oral and written reports. This integrated linkage of technical and academic skills prepares high school students for enrollment in advanced academic, vocational, and technical courses at all educational levels.

Through an interdisciplinary model, exemplified by collaborative performance activities, industrial and technology education programs form a positive bond between the technical core and the academic core. These programs integrate themes and concepts both within and across disciplines. Learning activities include complex concepts that require students to perform across subject-matter boundaries, reflecting the practical contexts in which the concepts apply. This collaboration helps students to develop vocational, academic, social, and emotional alliances with other students and adults.

### *Transferable Skills*

Students experience interdisciplinary teaching and learning strategies, exemplified by collaborative performance activities, that help them to understand connections between otherwise isolated disciplines. Themes and concepts are integrated within and across disciplines.

Industrial and technology education blends and interrelates various disciplines into an integrated and comprehensive education program that emphasizes higher-order thinking and problem-solving skills. By using a variety of approaches, such as applied learning and experimentation, the system encourages students to learn how to learn.

The industrial and technology education laboratory, along with the nature of activities associated with it, is the most appropriate setting in the school for the integrating function to take place. It is a setting in which the disciplines, such as mathematics, science, communication, history–social science, environmental studies, visual arts, philosophy, and geography, can find relevance and meaning in a context that brings the world of work into the school and takes the school out into the world of work.

### *Workforce Competencies*

Few educators are more aware of the importance of teaching workplace know-how than those in industrial and technology education. Industrial and technology education classes can become high-performance centers for training by incorporating foundation skills into the curriculum. Reading, writing, mathematics, and science are currently being woven into industrial and technology education studies to enable students to achieve workplace competencies.

Because of the need to teach foundation skills, critical thinking, and interpersonal skills, industrial and technology education is progressively becoming a team-teaching effort. Teachers from other disciplines work side by side to reinforce the relevance of academics by demonstrating how they apply to the high-performance workplace. When a student understands the job that needs to be done in allocating resources of time, money, materials, personnel, and information, that student is learning in the context of application. Industrial and technology education demonstrates how the productive use of resources, interpersonal skills, information systems, and technology is necessary to achieve excellence in business and industry. The link between school and work becomes clear to everyone involved.

Work Experience Education (WEE) programs in California schools link the school curriculum with the world of work. WEE has gained recognition as a vital component of modern education in the rapidly changing, complex, and technological society of today. With unskilled jobs disappearing and old skills becoming obsolete, new and transferable skills are increasingly in demand. California WEE represents a part of the total educational process that helps young people choose a career wisely, prepare for full-time employment suited to their abilities and interests, and learn to work with others in successful and rewarding ways. Although these objectives are shared with other educational programs, WEE extends the learning experiences of students into the community.

As an integral part of the high school experience, WEE provides a connection between classroom learning and the community. The success of the program requires a cooperative effort among students, parents, the community, and schools. The community furnishes a training laboratory in which students can polish their skills and assess their capabilities while working in an adult environment. Students may also evaluate occupations, identify career goals, and develop plans to achieve those goals.

Developing a culture that fosters responsible work attitudes requires teamwork and leadership skills. Those skills are essential elements in the industrial and technology education curriculum. Student and community organizations working cooperatively provide cocurricular activities that promote the development of leadership skills. In telling students about work, industry should be a full and equal partner with the schools.

### *Business and Industry Partnerships*

Industrial and technology education instructional programs are evaluated on the basis of the students' success in meeting program objectives, which are based on business and industry performance standards, including career-performance standards. The programs reflect state and national standards from industry and are reviewed by a wide spectrum of business, industry, and educational professionals.

Standards of excellence are possible only through a cooperative partnership between industrial and technology education and business and industry. Business and industry professionals validate program standards, and provide curriculum suggestions, market data, and contextual and career opportunities for students.

### *Technological Literacy*

Technological literacy is a concept used to describe the extent to which an individual understands and is capable of using technology. Characteristic of technological literacy is the means humans use to control, adapt to, or modify their environment to satisfy personal and societal needs and wants.

In planning for and delivering technological literacy, industrial and technology education personnel recognize that technological development is bringing about a dynamic social reconfiguration. Technology is seldom the only cause of change. Various technologies are often seen as components, within a gigantic structure, that reshape the roles, relationships, and institutions that comprise people's ways of living together. Substantial technological innovations often change and influence the experiences of people in their work and communities. The technologies that reshape the workplace are giving data processors vast new power and responsibility. A marriage of accelerating, inexpensive technologies in computers and communications will alter every enterprise.

The cutting edge of technology has been honed by such things as personal digital devices that may soon become fashion items, selected and worn like jewelry. Wearable computers are designed for use in places where desktop and laptop computers are inconvenient. Optoelectronic integrated circuits, using photonic and electronic technologies for computers, are capable of achieving performance greater than current personal computers and workstations. Holographic technology capable of capturing data within crystals will be the key to the future development of photonic computing and holographic memory devices, which will replace hard-disk drives in personal computers. Fuzzy logic and neural technology are incorporated into the creation of machines that will mimic the human brain. Fuzzy logic, employed in everything from cameras to industrial process control, may be combined with neural-network technology to create fuzzy-neural functions. Neural networks learn by themselves and acquire computing capabilities through learning. Chip sets, high-temperature superconductor products, and diamond-thin film will be integrated into almost all commercial and industrial applications.

Ills that plague the environment will be alleviated by sensing and mapping systems, microwave garbage disposals, and improved recycling programs. Genetically engineered fruits and vegetables will be arriving at the produce counter with a long shelf life as well as a resistance to bacteria. Agricultural biotechnology will create new companies and products.

A crew of computer chips may very well operate vehicles on land and sea, using the global positioning system that provides accurate positioning, tracking, mapping, and navigating information for a transportation infrastructure. From agricultural biotechnology to micromechanics, leading-edge technologies are destined to have an impact on industrial and technology education in California.

Literacy in the technological sense is manifested along a continuum ranging from nondiscernible to exceptionally proficient. As such, the competencies that are characteristic of literacy range from basic functional skills to critical thinking and include constructive work habits, use of generalized procedures for working with technology; the capability to manipulate, synthesize, and construct technological systems; interpersonal and team-building skills; and the ability to learn, conduct disciplined inquiry, and act independently.

### *Professional Development and Renewal*

New and emerging issues and imperatives are quickly redefining the industrial and technology educator's role. The once-defined role of the classroom teacher is undergoing an operational change proportional to a program's redefinition or restructuring process. Today, the teacher's role is commonly described as that of a facilitator of learning.

The teacher as coach is central to the idea of powerful teaching. Coaching builds on students' strengths while addressing their weaknesses. Having a coach a means that every student learns in an active, participatory context, rather than a passive one; every student contributes, is encouraged to succeed, and can excel if expectations are kept high. A teacher as coach conceptualizes the job as that of making certain that all students learn, instead of thinking of the job as one of presenting the materials and leaving the students to learn the lesson successfully on their own. The basis of coaching is that the student and teacher are involved in an interactive relationship to teach and learn together.

Local, state, and national imperatives that are changing the role of and challenging the classroom teacher in a variety of ways include the following:

- The instructional emphasis is on what the student understands and is able to demonstrate. As both the planner and mediator of learning, the teacher must determine the strategies students need to learn and how to help them use those strategies.
- Powerful learning is linked to performance standards. Students know in advance the standards and related competencies they must demonstrate.
- Recent developments in instructional or educational technology have major implications for instructional delivery systems.
- Advances in technology, and the rapidity of those developments, within and across career-vocational program areas are changing the nature and substance of student understanding and performance in selected career areas.
- State and national imperatives for school restructuring, program articulation, and curriculum integration require cooperative, cross-disciplinary, cross-institutional, and cross-business/industry efforts.

In light of such imperatives, the industrial and technology educator's changing role has expanded to include program restructuring; collaborative program and community resource articulation; and the curricular integration of mathematical concepts, scientific principles, communication skills, transferable career skills, and specific career skills.

As industrial and technology educators assume their changing professional roles, colleagues across program areas accept complementary and cooperative professional roles. They recognize the reinvention of career pathways for students, abandoning the outdated notion that the college or university pathway is the sole definition of excellence. Teachers also pursue the development of contextual learning opportunities for students, work together to provide programs of excellence for all students, and prepare students to pursue lifelong career and learning opportunities. These new roles are essential to quality industrial and technology education programs and will prove to be mutually beneficial to professionals and students.

Professional development opportunities for both preservice and in-service teachers are critical to the growth and development of industrial and technology education programs in California.

### *Preparation of Industrial and Technology Educators*

The industrial and technology education community in California must work with California colleges and universities to meet the obligations for teacher preparation that must be accomplished if the profession is to remain a vital and leading force. This retooling process must facilitate new and emerging concepts and strategies. For example, a cadre of teachers must be taught skills in curriculum integration—integrating academic and vocational knowledge, attitudes, and skills—to provide a bridge between school and the workforce.

California needs effective industrial and technology education teachers who are masters of their subjects; are able to clarify and distinguish relationships; and are talented in organization and cross-curriculum coordination. They are also individuals who can motivate students, demonstrate reason, are concerned about the abilities and progress of students, work effectively with special-population students, and have imagination regarding student and curriculum potential.

California colleges and universities play an important role in industrial and technology education as an integral component of career pathways to professional opportunities, represented in a broad range of teacher education and industrial and technology education program offerings. The emergence of such programs as “tech prep,” combining two years of high school and two years of community college work, accents the need to offer graduates the opportunity to study at a four-year institution.

### *Need for Industrial and Technology Educator In-service Programs*

Industrial and technology education teachers provide high-quality, efficient educational programs that prepare students for employment and citizenship and that promote students’ intellectual, ethical, emotional, and physical growth.

Critical to the fulfillment of this mission is the development and emergence of new programs across California’s career-vocational education community. Emerging programs are designed to:

- Offer students the opportunity to learn in context while solving realistic problems.
- Improve the match between the requirements of work and what students are taught.
- Involve the entire community in the process.

These new programs rely on an understanding of the way in which students learn. They call for cooperative teaching strategies which break down classroom walls to extend related learning opportunities throughout the school, across disciplines, and into the community. Emerging strategies include cross-disciplinary efforts, partnership academy and magnet programs, and authentic assessments. The new programs will require a new system of school administration and assessment.

A few programs are in place and serve as models for this curriculum reinvention process. Many other programs are at a conceptual stage. The multitude of program configurations across the diversity of California's multicultural population presents more questions than examples or answers at a critical time in California's industrial and technology education history. The need has never been greater for teacher in-service opportunities.

# Program and Student Assessment

Industrial and technology education teachers and administrators may measure the degree to which their programs support measurable student outcomes through participation in the Career–Vocational Education Program Improvement and Certification System. Student achievement of industrial and technology education career path cluster objectives may be assessed through the Career–Technical Assessment Program (C–TAP).

## Pursuing Excellence in Industrial and Technology Education

Industrial and technology education programs that promote student achievement share nine "quality criteria" with all C–VE program areas. The quality criteria are curriculum and instruction; leadership and citizenship development; practical application of occupational skills; qualified and competent personnel; facilities, equipment, and materials; community, business, and industry involvement; career guidance; program promotion; and program accountability and planning. Both Pursuing Excellence, the Western Association of Schools and Colleges/California Department of Education (WASC/CDE) accreditation process, and the statewide Career–Vocational Education Program Improvement and Certification System apply these standards to conduct a self-study and develop an action/program improvement plan.

The Career–Vocational Education Program Improvement and Certification System focuses on the improvement of individual C–VE programs in high schools, ROC/Ps, and adult schools. It incorporates a three-phase strategy: (1) self-assessment and planning for improvement; (2) program improvement plan implementation; and (3) on-site validation and certification as a "Program of Excellence," with appropriate recognition. The system may be used on-site as a stand-alone program improvement process or may be incorporated into the WASC/CDE accreditation process.

Programs involved in the three-phase strategy will receive technical assistance from an industrial and technology education consultant. Once the program improvement plan has been achieved, the consultant will conduct an on-site review to determine the fulfillment of the quality criteria. Programs that satisfy all quality criteria receive formal recognition as a Program of Excellence. Recertification may occur after three years, in a minireview, and after six years with an external review team visitation.

## Validating Achievement Through Assessment and Student Certification

Industrial and technology education secondary students will graduate with an individual record of accomplishment. This record of accomplishment may be presented to a postsecondary institution as well as to a prospective employer. An important feature of the individual record of accomplishment will be documentation of the student's achievement of industrial and technology education career path cluster objectives, assessed through the C–TAP system.

C–TAP is a student certification system, incorporating authentic assessment tasks, for C–VE programs offered in California high schools, adult education programs, and ROC/Ps. Certification is intended to indicate that students possess the knowledge and skills to be successful beyond high school—whether they continue their education, immediately enter the workforce, or choose a combination of continued education and workforce entry.

All components of the C–TAP system assess industrial and technology education curriculum, career-performance standards, and academic standards in an integrated format. Because content standards must be appropriate for a performance-based certification system, industrial and technology education model curriculum standards have been revised to contain cognitive and behavioral component. Along with these revised curriculum standards, career performance standards were developed to represent workplace readiness skills that cut across all career paths. Finally, academic standards were incorporated to represent skills needed to perform a specific task or function.

The C–TAP system incorporates two categories of assessment tasks: cumulative and administered. Cumulative tasks ensure that students develop the ability to plan, implement, and evaluate a project over time. Administered tasks ensure that students can perform a particular task on demand. The cumulative tasks include a supervised practical experience, an assessment project, and a structured portfolio. Administered assessments include an oral presentation of the assessment project, a written scenario, and a written test of the career performance standards.

Industrial and technology education students, teachers, and administrators have a long tradition of incorporation of authentic assessment tasks and certification. An important element in this tradition is the use of industry-supported and validated student certification and licensure protocols. One certification process, for example, incorporates the nationally recognized standards established by the National Automotive Technicians Education Foundation (NATEF). Established and emerging certification and licensure protocols will continue to be a fundamental element of industrial and technology education programs. Industry-validated student certification and licensure programs will highlight individual records of accomplishment.

## Developing and Implementing a Strong Industrial and Technology Education Program

Industrial and technology students entering the workforce of the future must be prepared to compete successfully in the increasingly technological job market, participate in a democratic society, maintain strong moral and ethical values, and reach the highest level of their individual potential. The complexity of advancing technology and the rapidity of technological change call for industrial and technology education leaders to develop and implement strong programs based on well-planned teaching and learning strategies, and comprehensive program support. Curricular paths, based on elements of the kindergarten-through-university continuum discussed earlier, need to be carefully designed. Powerful teaching and learning strategies, incorporating those broad career path elements noted before, must be used to develop quality curriculum. Comprehensive program support includes facilities, equipment, materials, instructional resources, and information resources appropriate to the curriculum standards.

## Designing Curricular Paths

Industrial and technology curricular paths combine industrial, technological, academic, and elective content to form a well-planned, articulated, and sequential activity-based program leading to the attainment of an educational goal, a career goal, or a combination of the two.

The industrial and technology education continuum promotes awareness programs in kindergarten through the fifth or sixth grade that are designed to enhance and reinforce the educational goals of the total elementary school curriculum. Technology Education for Children activities orient students to technology, develop psychomotor skills, and refine attitudes about the influence of technology on society.

Middle school students participate in Exploring Technology Education programs, which are broad-based, modularized curricula offering students integrated, lively, and cognition-based activities. One critical outcome of these programs, with implications for subsequent academic success, is the opportunity for students to make informed career, educational, and occupational decisions based on knowledge and skills acquired as well as personal interests and aptitudes.

Ninth-grade middle school students and high school students should enter into an industrial and technology education curricular path sequence that includes (1) the Technology Core; (2) an Introduction to Career Path Cluster experience in at least one of the seven possible career path clusters—chosen by the student as a result of experiences in Exploring Technology Education and Technology Core; followed by (3) advanced or occupational-specific instruction in a career path cluster, which may involve a delivery system or combination of delivery systems, such as the ROC/P, academy, tech prep, college or university, or other system described earlier.

Two sample industrial and technology curricular paths are provided on the accompanying pages. Figure 1.4 illustrates a curricular path composite from kindergarten through a four-year-college or university. Figure 1.5 builds on the first figure, providing an example of only one of a wide range of possible curricular paths—in this case, drafting technology, which is one of the seven industrial and technology career path clusters. The reader must understand that these examples represent composites or generic paths only. The existence statewide of more than 30 different middle school program configurations alone, without considering the differences in high school program patterns, graduation requirements, rural compared with urban considerations, time schedules, school calendars and the like, obligates all curricular path designers to (1) conceptualize a generic curricular path scope and sequence; and (2) work to achieve the best possible design for their students.

The curricular path samples illustrated in Figures 1.4 and 1.5 provide good examples of the ways in which a student may progress along the ITE continuum. The example is organized by traditional school grade levels and class titles. Other examples could be organized to reflect restructured schools without grade levels and course sequences. A curricular path of that type might be organized around performance standards rather than by course sequences and titles.

Whichever way a curricular path is organized, the curricular path should be of sufficient scope and sequence to ensure that students may successfully complete a program and be prepared to move on to achieve an educational goal, a career goal, or a combination of the two. A four-year program that prepares high school students for entry-level jobs would include a one-year Technology Core course, a one-year Introduction to Career Path Cluster course, and two years of ROC/P courses. There are only a small number of these entry-level jobs available, and workforce entry at this level is not recommended for many career path choices.

| [redacted] | [redacted] | | | TECH-PREP | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | HIGH SCHOOL | | | | POSTSECONDARY | | | |
| K-6 | 7 | 8 | **Subject** | 9 | 10 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| I&TE for Children | Exploring Technology Education | Exploring Technology Education | Industrial and Technology Education | Technology Core | Introduction to Career Path Cluster | Career Path Cluster | Career Path Cluster | Technical Career Path Cluster | Technical Career Path Cluster | Professional Career Path Cluster | Professional Career Path Cluster |
| | | | Other | X | X | X | Career Path Cluster | Technical Career Path Cluster | Technical Career Path Cluster | Professional Career Path Cluster | Professional Career Path Cluster |
| X | X | X | Math | X | X | X | X | | | | |
| X | X | X | Science | X | X | X | X | | | | |
| X | X | X | English | X | X | X | X | | | | |
| X | X | X | History/ Social Science | X | X | X | X | | | | |

Technology/ Academic Core Competency Assessment

I&TE Major Competency Assessment

Associate Degree/ Certificate

Baccalaureate Degree/ Certificate

[redacted]

High School Diploma

Apprenticeship

This material represents a composite and is provided as an example. Course titles, requirements, sequences, and year to be completed may vary from school to school.

**Fig. 1.4. Sample Industrial Technology Curricular Path**

| [redacted] | [redacted] | | | TECH-PREP | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | HIGH SCHOOL | | | | POSTSECONDARY | | | |
| K-6 | 7 | 8 | **Subject** | 9 | 10 | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| I&TE for Children | Exploring Technology Education | Exploring Technology Education | Industrial and Technology Education | Technology Core | Introduction to Drafting | Drafting Occupation Specific | Drafting Occupation Specific | Technical Drafting/ Engineering | Technical Drafting/ Engineering | Engineering/ Architect | Engineering/ Architect |
| | | | Other | PE | PE | Visual & Performing Arts or Foreign Language | Drafting Occupation Specific | Technical Drafting/ Engineering | Technical Drafting/ Engineering | Engineering/ Architect | Engineering/ Architect |
| X | X | X | Math | Math A or Algebra 1 or Int. Math | Albegra 1 or Geometry or Int. Math | Geometry/ Trigono-metry or Int. Math | Trigono-metry or Int. Math | | | | |
| X | X | X | Science | | Life Science or Principles of Technology | Physical Science or Principles of Technology | Principles of Technology | | | | |
| X | X | X | English | [redacted] | [redacted] | [redacted] Comm. | [redacted] Comm. | | | | |
| X | X | X | History/ Social Science | | World History | US History | Government/ Economics | | | | |

Technology/ Academic Core Competency Assessment

I&TE Major Competency Assessment

Associate Degree/ Certificate

Baccalaureate Degree/ Certificate

[redacted]

High School Diploma

Apprenticeship

This material represents a composite and is provided as an example. Course titles, requirements, sequences, and year to be completed may vary from school to school.

**Fig. 1.5. Sample Curricular Path in Drafting Technology**

For example, the field of Electronic Technology offers little high school entry-level employment beyond minimum wage. Students with career paths in Electronic Technology will most likely follow a plan through a two-year degree or certificate program. Many of these students will participate in an electronics tech-prep program. In another example, students pursuing a career path in the automotive field under the Transportation and Energy cluster will likewise follow a plan through a two-year degree or certificate program. Students entering this career field must be able to read manuals written at approximately the fourteenth grade level. Industry-supported certification, such as the NATEF certification discussed earlier, is a prerequisite to most jobs in this field. Students may be able to graduate from high school with one or even two of the approximately 20 available NATEF certificates, but their career plans will include continued study in ROC/P, adult education, or community college programs to earn all certificates and eventually become a master mechanic.

A school site that has limited ITE programs should offer the Technology Core, Introduction to Career Path Cluster, and Career Path Specialization sequence in as many of the seven career path clusters as possible. Schools participating in magnet, academy, ROC/P, tech-prep, and similar articulation agreements should provide students with curricular paths in as many of the seven career path clusters as possible. ITE personnel are encouraged to collaborate with each other and with personnel in other disciplines within, between, and across institutions.

## Developing Quality Curricula

Quality ITE curricula are designed to provide students with the skills, knowledge, and attitudes necessary to help them gain employment in the career of their choice, gain entry into postsecondary institutions, and acquire the ability to work with changing technologies of the future. ITE interdisciplinary approaches provide students with strong foundation skills and advanced-level skills in the career field of their choice.

The ITE model curriculum standards should guide curriculum development in defining program performance standards and outcomes for all levels of the ITE continuum and career path clusters.

## Supporting Quality Programs

Strong industrial and technology education programs require performance-standard facilities, equipment, materials, instructional resources, and information resources appropriate for integrated performance activities.

### *Facilities*

Traditional and extended classroom environments, up-to-date equipment, the flexibility to respond to advancing technological changes, safety considerations, and the inclusion of community resources are important elements of a successful industrial and technology education program. Appropriate program facilities provided by education and business or industry partners must be of sufficient quality to enable students to acquire vocational knowledge and skills that meet or exceed industrial and technology education performance standards and allow for integrated performance activities.

The physical resources of the entire school and community learning environment must be considered in planning industrial and technology education programs. Optimal facilities promote individual, small-group, and large-group instruction and learning, including modular and thematic modalities.

Safety considerations are paramount in industrial and technology education programs. Facility design is a crucial element in providing a safe learning environment. Many program facilities will modify or completely change their traditional floor plans in keeping with emerging teaching and learning strategies.

### *Equipment and Materials*

Appropriate equipment and material resources are extremely important in providing students with the knowledge and skills necessary for meaningful career planning and for postsecondary education and eventual employment. Equipment and materials used in both education and business/industry delivery systems for career path cluster and career path specialization programs must be of sufficient quality and quantity to enable students to gain vocational knowledge and skills that meet business and industry performance standards.

Decisions in the choice of industrial and technology education equipment and materials are founded on the concept that teaching and learning must be done in context. The time-proven concept of learning in order to do is no longer separate from learning in order to know. In particular, educators select equipment and materials that improve the match between what is required by business and industry and what students are taught and how they learn.

High-performance industrial and technology education programs require high-quality equipment and material inventories. The selection of equipment and materials appropriate for the workforce is an ongoing process involving both education and business/industry communities.

A related and significant challenge is helping students obtain not only the skills, understandings, and attitudes that will enable them to be successful in obtaining employment in the career of their choice but also the transition skills needed to enable them to work with the changing technologies of the future. Rapid and constant technological changes affect industrial and technology education programs and services almost daily. Processes, technologies, systems, information, and equipment change; and so must industrial and technology education if it is to remain viable and relevant.

Equipment and material inventories also address concerns about language proficiency, which might otherwise adversely affect learning, and a growing concern about differences in student learning styles. Finally, equipment and materials inventories facilitate instructional strategies, including those used in the introduction, reinforcement, and enhancement of concepts.

### *Instructional Resources*

Educational technology resources serve as powerful mechanisms for teaching and learning. Compact discs, video-based materials, computer-assisted or computer-aided manufacturing, technical writing systems, networking systems, and other educational technology resources provide a means for introducing, reinforcing, and enhancing concepts. Students build their understanding of and skills in educational technology in order to assume an active role in the learning environment as well as to prepare for their role in a high-performance workplace. As students master a multiplicity of information-accessing technologies, they become more proficient problem solvers.

Relevant instructional materials address multiple objectives simultaneously; provide for student experiences that provoke curiosity, fire the imagination, and deepen one’s understanding; and provide a powerful curriculum in every classroom.

### *Information Resources*

Textbooks can be important sources of information if they do not merely represent facts to be memorized. If powerful teaching and learning is to occur in industrial and technology education programs—if the curriculum is to be realistic and engage students—then teachers and students must go beyond the boundaries of textbooks. Teachers must model intellectual curiosity, motivating students to seek accurate and up-to-date information. Students, teachers, parents, and administrators must be moved to go beyond the boundaries of textbooks and classroom walls to seek out those valuable resources.

The acquisition of computer data, providing valuable information tied to a richer curriculum, is difficult for students without the use of educational technology. Powerful teaching and learning requires educational technology and industrial and technology education resources to be used in new ways. Educational technology resources, such as new computers, compact discs, electronic mail, on-line information networks, and video-based materials, offer the potential for students to inquire about important themes. One use of educational technology is to connect students with databases, information sources, and electronic bulletin boards within and outside the school site. Educational technology helps students move quickly to main themes and ideas. It also serves to enhance students' verbal and computational capabilities. Writing fluency improves with the use of word processing, and revisions outpace work that is merely recopied.

Another use of educational technology is to connect students to ITE processes and systems, such as computer-aided (or computer-assisted) drafting and design, computer-assisted manufacturing, two- and three-dimensional modeling processes, simulation strategies, testing and evaluation opportunities, technical writing and publishing, and related networking systems.

Educational technology in ITE programs historically connects students to rich, contextual teaching and learning experiences. Completely redefined programs are planned and are emerging throughout California's industrial and technology education community. These programs rely on an understanding of how students learn. They call for cooperative teaching strategies, incorporating tabletop modeling, simulations, and process and system strategies, which break down classroom walls to extend related learning opportunities throughout the school, across disciplines, and into the community.

## Industrial and Technology Education Program Funds

Ongoing funding of industrial and technology education programs is provided by school districts and Regional Occupational Centers/Programs (ROC/Ps) and through federal education dollars. District and school-site funds are generated mainly through the state's average daily attendance (ADA) reimbursement system. ROC/Ps generally operate on fiscal-year state allocations defined in annual funding legislation. At this printing funds through federal legislation are available under the Carl D. Perkins Vocational and Applied Technology Education Act of 1990, PL 101-392 (Perkins Act). Under certain conditions ITE programs may be eligible for Perkins Act allocations or grants, including but not necessarily limited to those under the following categories:

- Community-Based Organizations (grant)
- Sex Equity: Making Electives Count for Career Achievement (competitive project: Perkins Act and California State Plan 1991/1994)

- Vocational Education (grant and entitlement)
- Willa Brown Aviation Project (competitive project: Perkins Act and California State Plan 1991/1994)

Under certain conditions ITE programs may be eligible for state and federal funding, other than Perkins Act dollars, including but not necessarily limited to the following:

- Education Technology Local Assistance (matching grant: Article 13 of Chapter 5 of Part 24, *Education Code* Section 41920 and Article 15 of Chapter 5 of Part 28, *Education Code* sections 51870 and 51876–51880)
- Elementary and Secondary Education Act (ESEA), Chapter 1, Program Improvement (formula: PL 100-297)
- Environmental Education (competitive grant: *Education Code* Section 8700)
- Instructional Materials Management, Grades K–8
- Instructional Materials Management, Grades 9–12 (formula: *Education Code* Sections 60246 and 60247)
- Mentor Teacher Program (entitlement: *Education Code* Sections 44490–44497)
- Partnership Academies (grant: *Education Code* Section 54686.2)
- SB 1882 Staff Development Program (grant: *Education Code* Sections 44670.1–44680.8)
- SB 1882 Subject Matter Projects (grant: *Education Code* Sections 44670.1–44680.8)
- School Improvement Program (SIP) (entitlement and grant: *Education Code* Section 52000)

Fund-raising activities are established alternatives in many districts for the support of program improvement. Grants from business and industry sources, including civic groups, may provide additional support for local programs.

## Information for Program Reviews

Program reviews are a long-term, broad-based measure of a program's effectiveness. Reviews involve the analysis of student progress beyond the boundaries of the school or training site, and the results of the analysis are used to implement program improvement plans.

Program review data extend beyond information typically associated with measures of program accountability and planning criteria (Program Improvement and Certification). The data include information from instructors, administrators, students, other staff, and advisory committee members. Review data include but are not necessarily limited to the following:

- The number of students who complete an industrial and technology education program
- The number of students who earn certification
- Subsequent history of student employment and education (career path)
- Perceived, actual, and apparent achievement as a factor of program design

Industrial and technology education leaders should collect program review data on a scheduled basis for annual analysis. Program review data should affect program improvement plans and assist in setting program goals.

## Industrial and Technology Education in Summary

The California culture is distinctly characterized as technological. Californians in the workforce and those preparing to enter or reenter the workforce must understand this technological culture if they are to function as responsible and productive citizens. Industrial and technology education programs produce individuals with personal insight into and understanding of the technological culture in California, the Pacific Rim, and beyond.

Industrial and technology education programs are responding to the complexity of advancing technology and the rapidity of technological change; educators, administrators, and business and industry partners are working together to prepare students for careers of their choice and for lifelong learning. Students are discovering that education in a single discipline and preparation of skills specific to a current job are no longer adequate for success in a technological culture. Students in industrial and technology education programs today are mastering curricula featuring basic scientific principles, mathematical concepts, and communication skills on which work and learning are based. Students successfully completing an industrial and technology education program will adapt their understanding and skills as careers and technology change.

In response to the demands of advancing technology and technological changes, the *Industrial and Technology Education Career Path Guide and Model Curriculum Standards* establishes a foundation for programmatic change under the major categories of curricular paths, powerful teaching and learning, program and student assessments, and the design and implementation of quality programs. Industrial and technology educators are committed to program improvement and the growth of programs of excellence based on model curriculum standards.

These exciting and demanding industrial and technology education programs prepare students for the challenges of the changing workforce and technology through:

- Leading-edge delivery systems that address student needs
- A proactive career path guide that supports curriculum development to meet the challenge of today's technology and remains flexible to address the changes of the future
- A renewed dedication to quality
- Curriculum and instruction that emphasize relevant workplace and living skills

This career path guide provides a holistic description of the industrial and technology education career path continuum—a kindergarten-to-workforce curriculum of well-planned, articulated, integrated, and sequential experiences. These experiences prepare students for successful transition to and participation in the home, community, and workplace and the pursuit of lifelong learning. Industrial and technology education programs produce individuals with a personal insight into and understanding of the technological culture in which they live, learn, and work.