AN ABSTRACT OF THE THESIS OF

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Title: A SYSTEMS APPROACH TO ORGANIZATION, CONTROL, AND INSTRUCTION FOR INDUSTRIAL SAFETY EDUCATION

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The purpose of the study was to demonstrate the effectiveness of a safety systems approach, so designed, to reduce instructional needs by the application of research to the conceptualization and development of a computer-assisted safety management program.

Procedure

Two hundred accredited schools served as the respondent population for the study. A representative sampling from administrators in 50 percent of these schools served as the statistical base. A computer printout provided the data base tabulations for determination of appropriate product development.

A comprehensive questionnaire was utilized to identify Industrial Education Safety needs. The questionnaire was designed to facilitate computer tabulations of statistical data relating to school size, staff size, number of course offerings, policy development, program development, program standardization, safety media needs, safety

equipment needs, organizational, housekeeping and in-service needs.

A Likert-type scale was used to ascertain intensity of instructor-perceived safety problems. The mean, mode, standard error, standard deviation, median, variance and missing cases were reported. Computation of absolute, relative, adjusted and cumulative frequencies were listed. The adjusted frequency percent was tabulated and arranged chronologically by percentage to measure intensity of needs and intensity of problems. An arbitrary lower limit was selected as a cutoff point in the needs determination. Needs were classified in administrator, instructor, and student categories. Further classification determined hardware, software, curriculum, policy, and media needs. These needs were used as the base line data to determine product specifications.

A systems approach to satisfy these identified needs was designed. The approach included research of the literature, research of developed models and conceptualized proposals. After problem identification was determined, a conceptual solution of need and problem removal was flow-charted by means of Program Evaluation Review Technique (PERT). The resolution of this conceptualization resulted in a demonstration model. The model was evaluated in terms of its capability of satisfying the previously identified problems.

Conclusions

A systems approach is an effective tool in the identification and resolution of broad base needs. A systems approach provides a base line data format from which global information may be visualized to better facilitate decision making. A systems approach for conceptualization to disposition of identifiable needs is demonstratable in product applicability. A product so designed, through a systems approach, may be improved, and evaluated in terms of its functions. A safety education delivery model is an essential tool for program development at the school district level.

Suggestions for Further Study and Development

This study should be extended to provide an operational model of general safety program implementation at the Local Education Agency level. A model should include: (1) policy development at the school board level; (2) program planning at the district administration level; (3) program support; (4) student services; (5) instructional support; and (6) program evaluation. A similar study should be conducted to determine support services necessary for local education agencies to reach compliance with Oregon Revised Statutes. A similar study should be conducted to ascertain the minimal organizational structure (personnel) needed for the maintenance of a local education agency's operational safety program. A similar study should be conducted to provide a documentation process for LEA's to assess their "safety condition" in relation to Oregon Administrative Rule mandates. A similar study should be conducted to provide information essential to the reporting and monitoring of safety programs.

Product development should be extended to include: (1) a radio controlled receiver/transmitter for machine interrupt; (2) a network design with central computer capacity for record keeping of machine use, maintenance, amortization, and expendable cost control; and (3) individualized instructional materials (by machine) for safety competence.

A Systems Approach to Organization, Control, and Instruction for Industrial Safety Education

by

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The largest locomotive in the world can be prevented from moving by placing a one-inch wedge in front of each of the drive wheels. The same locomotive encouraged to move at 100 miles per hour can crash through five feet of steel-reinforced concrete. A "head of steam" is needed by a person to produce the action necessary for accomplishments.

My personal gratitude to Joel Galloway and all the members of my committee who provided guidance, flexibility, and removed the obstacles while enhancing forward movement toward success. But, most of all provided was the "fifth point of the compass." It is possible to have a map and a compass and still be hopelessly lost. These tools are useless unless you know where you are now! These members encouraged that point of departure and embraced the vision necessary for achievement.

To Dr.'s Galloway, Ede, Keast, Enlows and Houston I dedicate the symbolism of Merle Travis' "Sixteen Tons" for their sincere guidance and effort.

DEDICATED TO

Mary, Steve, Kelly

who shared their selves, their time, their visions, so that I might succeed with my own!

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I. INTRODUCTION

Statement of the Problem

This investigation was directed to conceptualize, develop and demonstrate a systems approach, designed to integrate instructional products and procedures into a functional delivery model for industrial safety education purposes.

The term "systems approach" is most frequently employed in the sense of a total system. A systems approach seeks to deal with problems by methodologically analyzing cost, time, specifications and products as a whole. Consideration of alternatives, assumptions, criteria, and inherent risk in any acceptable choice is a part of the formal process. Butler (1972) explains a systems approach as the application of multiple disciplines in a scientific effort to determine the validity of content, objectives, sequences, method, media, product and achievement.

In safety education, a complex, interrelated set of goals, objectives, activities, organizations and functions must operate as a coordinated system to turn out a synergistic product. This product development requires a continuous process that deals with (1) problem identification, (2) solution requirements, (3) strategy implementation (outcomes), (4) performance effectiveness, and (5) process revision. The process provides the means to make useful, systematic, organized change and provides rationale for such change, while maintaining that which is worthwhile and useful in providing new and more successful ways and means to assist the learner.

The objectives of the total system define the purpose for which all the system and subsystem objects, attributes and relationships have been organized.

Objectives of the Study

This study was designed to meet the following specific needs:

1. To develop a research instrument capable of measuring the needs for instructional development.
2. To establish value priorities for product development.
3. To specify hardware, software, and curriculum components for the delivery system.
4. To design, develop and demonstrate a conceptualized electronic communicator for recognition and authorization of machine use.
5. To determine and develop peripheral media for instructional support.
6. To research, design and assemble a model for a student individualized instructional package.

7. To research, design and assemble a skeletal model for meeting in-service instructor needs in safety education.
8. To document the systems developmental processes for replication purposes.
9. To evaluate the potential of the systems model in satisfying identified instructional needs.
10. To make recommendations for the needs of further study and development.

Rationale for the Study

There is ample evidence to indicate that schools have a great interest in Industrial Safety Education (Kowalski, 1972). A review of the literature, visits to schools, discussions with administrators, instructors and students leave little doubt of the effort that schools expend in safety education. The issue is not whether the schools are cognizant of their responsibility but how the school can be more effective in view of new legislation, changing times and new challenges.

An analysis of the factors affecting industrial accidents may leave some apprehension for the future. Job injury rates take a jump when inexperienced workers take a new job. The rapid change of job skills resulting from advanced technology indicates that a greater and better safety effort must be expended because the very nature of the problem has become increasingly complex. The forward march of science and industry creates new hazards of environment. These new challenges call for evaluation of existing practices and the institution of new directions (Hannaford, 1972). Schools must recognize and understand the characteristics possessed by a safe and efficient worker and the educational technology that is necessary to develop these characteristics.

Total involvement in safety education is a must if it is to achieve results. Isolated activities conducted independent of a comprehensive plan will fall short of desired outcomes (Williams, 1972).

Safety is a way of life, conditioned by school experiences, and cannot be separated from education. Safety education requires a selective application, attitude, reason and judgment to provide proficiency of learning.

The shop instructor cannot escape the obvious responsibility that goes with teaching a skill--that of maintaining safe operating conditions and further complying with rules for the safe conduct of the work necessary to his student's instruction. Shop instructors throughout the nation have a responsibility for making a maximum contribution toward the safe well-being of their students. Each day in industry, more than 500,000 man days are lost because of on-the-job injuries (Bateson, 1972). According to the National Safety Council (1972), occupational fatalities in 1961 totaled 13,500. High concentration of injuries to young workers was found in industry. Injuries for youth under 18 years of age tend to concentrate in trade and agriculture. Manufacturing trades rank a close third. For the 18 through 20 year-olds, the heaviest concentration appeared in manufacturing trades, construction, and in agriculture (Hughs, 1972). This great concentration of accidents in youthful workers would lead one to doubt the effectiveness of safety education in our schools (Metropolitan Life Insurance, 1962). Metropolitan Life Insurance indicated that education is the cornerstone of accident prevention and the schools have numerous opportunities to develop those attitudes and practices that can prevent injury.

In shop practice, safety education is not specifically defined. Ordinarily, it refers to meetings, talks, personal contacts with teachers, posters, bulletins, reading materials, audio, video, and other oral and written instructions used in cultivating safe methods of doing work. The student may be talked to or talked at, he may read pages of printed matter, view pictures by the hundreds, and yet fail to apply the message to himself. This is particularly true when educational efforts are general in nature. When instructors preach safety, its value, its necessity, but fail to specify what, where and how they have limited the instructional value. Instructors deal largely with common matters, and though enthusiastic and determined to avoid accidents, they are often left to their own initiative and devices to teach safety (Heinrich, 1959).

With each instructor, organizing his own materials and presenting them in his own fashion, it is seldom that total success is achieved in delivery of safety outcomes. Best results may be achieved when, in addition to carrying out one's own instructional objectives in a self-contained environment, the program is expanded to include peripheral activities. Some common educational procedures are: (1) shared responsibility; (2) safety staff organization; (3) safety meetings; (4) student rule books; (5) policy manuals; (6) good organizational communications; (7) contests; (8) plays; (9) awards; (10) job safety analysis; (11) safe practice rules; (12) safety conferences; (13) industry tours; (14) standardized instructional materials; (15) legislative interpretation; (16) appropriate record keeping devices; (17) written goals, philosophy, emergency procedures; (18) budget for safety purposes; (19) access to exhibits, inspections, consultations, program development; (20) evaluation procedure; and (21) access to all available instructional media (Williams, 1972).

The implementation of new legislation is helping industrial safety "win its place in the sun." Industry has agreed that it is necessary. Public interest is aroused. Schools, communities, state and federal governments are active. National conferences have been called. All of the foregoing indicates that people, curricula, and products must organize to teach effective and practical methods of industrial safety instruction (Heinrich, 1959).

Stephen M. Corey (1953), a leader in the field of action research, stated the case in this way:

> . . . I have lost much of the faith I once had in the consequences of asking only the professional educational investigator to study the schools and to recommend what they should do. Incorporating these recommendations into the behavior pattern of practitioners involves some problems that so far have been insoluble. . . . Most of the study of what should go and what should be added must be done in thousands of classrooms and American communities. These studies must be undertaken by those who may have to change the way they do things as a result of the studies. Our schools cannot keep up with the life they are supposed to sustain and improve unless teachers, pupils, supervisors, administrators, and school patrons continuously examine what they are doing. Singly and in groups, they must use their imaginations creatively and constructively to identify the practices that must be changed to meet the needs and demands of modern life, courageously try out those practices that give better promise, and methodically and systematically gather evidence to test their worth (p. 7).

Product development must address the identified needs and interests of administrators, instructors and students if it is to be successful.

The model developed in this study was designed to:

1. Assist the teacher in the evaluation of students' safety competencies.
2. Assist the teacher in evaluating instructional competencies.
3. Assist the teacher in the organizational control of: record keeping, discipline, instructional duplication, individual

instruction, unauthorized use of machine, testing, compliance with mandates, standardization of instruction, and safety housekeeping.

One might claim that our modern industrial state depends upon, among other things, safe practices and procedures for human protection. It can hardly be denied that the surveyor without his transit, the doctor without his stethoscope, the instructor without his education would be as lost as the explorer in the Arctic without his compass. The instructor is in much the same position as the explorer, for it is possible to navigate using past experience, and the North Star, just the same as it is possible to use experience and common sense to evaluate student behavior in safety terms. There is room to believe, however, that the development of standardized teaching tools, more accurate measuring devices, and machine controllers would assist the teacher in personal and program effectiveness. This is particularly true in the field of shop safety--a field in which subjective judgment is sometimes the sole evaluation. It is possible also that the process of standardization might well assist administrators and evaluators to better appreciate the vision of what could be the potential of an "operationally safe" industrial program.

Adequate safety instruction and the accountability of this instructional process is becoming a critical issue as the Occupational Safety and Health Act is being implemented across the country.

> On December 29, 1970, the 91st Congress passed a bill which became a significant part of federal law. Public Law 91-596, known as the William-Stieger "Occupational Safety and Health Act of 1970" or OSHA, which became effective on April 28, 1971, was enacted in order. . .to assure safe and healthful working conditions for working men and women; by authorizing enforcement of the standards developed under the Act; by assisting and encouraging the states in their efforts to assure safe and healthful working conditions, by providing for research, information, education, and training in the field of occupational safety and health; and for other purposes.
>
> In Section 2(b) Congress declares the purpose of the Act. . . to assure so far as possible every working man and woman in the Nation, safe and healthful working conditions and to preserve our human resources. . . .
>
> This law resulted from a recognition of a significant deterioration in working conditions and practices which was accompanied by an unprecedented increase in occupational deaths and serious injuries (Johnston, 1975).

It is mandatory that the provisions of the Act be included in the curriculum for teacher education programs designed to prepare industrial-technical teachers. The preciseness of OSHA makes it both possible and necessary to develop new curriculum products so that present and future instructors may function in compliance with the law. New objectives and new approaches will be needed to prepare students to enter the world of work aware of their safety responsibilities and rights (King, 1975).

Although the Occupational Safety and Health Act is somewhat more than four years old, it is only recently that its impact has begun to be felt by industrial-technical educators. The days of "OSHA is coming" are behind us and the very real fact is that OSHA is here and shop teachers, administrators, and school officials had best begin to take appropriate action (Prakken, 1975). The Oregon legislature has passed specific laws that apply to schools in meeting safe standards for school personnel and students. These laws on safety have been interpreted by State Department of Education officials into Oregon Administrative Rules 581-22-280, Emergency Plans and Safety Programs; 581-22-281 Safety Inspection Practices; 581-22-286 Accident Reporting; and 581-22-282 Safety Devices (1975). The present delivery system of instruction is inadequate to meet this mandate of new rules and regulations.

Adequate preparation of personnel and students for meeting safe standards and practices of these new laws has been neglected. Mandates have been imposed with neither the financial resources nor the instructional support to implement the intended outcomes (Oregon State Department of Education, 1976). The success of the Local Education Agency (LEA) in meeting these mandates rests to a great extent upon its ability to provide in-service materials and media, safety devices and student curricular programs of instruction.

Every individual teacher has a prime objective of teaching safety in the shop. Safety is a most important objective. It is apparent that in order to be safe the student must be deliberately and systematically instructed in all aspects of shop safety. In the area of safety, the accent must be on prevention, as a student must "prove" that he knows how to act safely. Attitude development, standardized safety tests, curricula materials, and demonstrations should provide the student with the knowledge and experience to demonstrate proof that he knows how to act safely in all shop situations.

We need to define common safety procedures and practices and standardize a curriculum of safety to be taught in every school shop. In short, a systems approach is necessary to meet the needs of LEA's in their effort to comply with Oregon Administrative Rules and OSHA mandate.

Definition of Terms

Accountability - the ability to show that one has done what one has said can be done.

Applied Research - research process designed to improve a product or a process--to test concepts in actual problem situations.

Authorization - permission for machine activation (electronic controlled).

Conceptual Study - process of study to visualize and explain an original idea.

Control - an apparatus for the regulation of the switching mechanism of a hazardous machine.

Control Card - a punched card which requires basic information required for the operation of a processor program.

Cost Effectiveness - results or desired effects that regulate expenditures--reasonable costs.

Delivery System - an overall plan to accomplish meeting identified and documented needs.

Developmental Study - a study that defines products to be concurrently developed as the knowledge base of the study is expanded.

Electronic Communicator - a device designed to serve as a communication link between two or more machines.

Function Analysis - an analysis of elements within a profile to ascertain what is necessary to complete the function.

Hardware - mechanical devices that are designed to function in a specified mode.

Individualized Learning Package - instructional materials so organized to be tailored to the specific use requirements of an individual.

Instructional Support Package - a written guide to the development of effective instruction for safety purposes.

LEA (Local Education Agency) - a school or other public agency formed for educational purposes.

Micro-processor - a central processing unit of a computer.

Needs - the measurable discrepancy between "where we are now" and "where we should be" in terms of projected outcomes.

OSHA (Occupational Safety and Health Act) - a legislative act passed to improve safety and health conditions for employees, students and the general public.

Operations Analysis - stage in the product development cycle in which the adequacy of the procedures employed in preparing the product are appraised.

OAR (Oregon Administrative Rules) - rules and regulations interpreted from legislation for the operation of educational and other agencies.

Outcomes - planned results of instruction in product form.

Peripheral Media - media that are utilized in support of the (core) instructional materials.

Product Development - the stage of the product development cycle in which the instructional or hardware materials are prepared according to prototype specifications.

PERT (Program Evaluation Review Technique) - a network-based diagram used for planning the implementation of an educational system.

Recognition Equipment - equipment designed for the identification and transmission of certain digital or symbol information.

Software - process development of machine and program language statements to elicit or bring desired response from a microprocessor.

Standardized Instructional Materials - instructional materials that have been accepted as an efficient tool for use by all instructors of a system.

Syncretic - the blend of opposite and contradictory tenets into one system to produce unity.

Synergistic - the combination of two or more items whereby a greater effect is generated by the union than would be if the items were utilized as separate entities.

Systems Approach - a process by which needs are identified, problems are selected, requirements for problem solutions are identified, solutions are selected from alternatives, methods and means are implemented, results are evaluated and revisions to the system to facilitate need removal are identified.

II. REVIEW OF RELATED LITERATURE

Systems Approach

Within just a few short years, we have heard a great deal about systems; business systems, weapon systems, industrial systems, transportation systems, and educational systems are but a few. Webster tells us that a system is an assemblage of objects united to some regular form of interdependence and interaction. If we apply that definition, it is easy to visualize a group of men interacting with machines with purposeful organization. The organization has been designed with specific components that perform specialized functions. The purpose of the system is fulfilled through the application of basic design decisions, assignment of functions, and performance criteria for men and equipment so that all parts may work in harmonious syncronization (Folley, 1960).

Many definitions of system and related terms are current in science and engineering. Representative examples are:

1. Systems science. "The science that is common to all large collections of interacting functional units that are combined to achieve purposeful behavior" (Science Systems Committee, 1960).
2. Systems engineering. "A process in which complex systems are idealized, designed, and manipulated by conscious rational processes based upon the scientific method" (Salveson, 1956).

3. System: "A set of objects with relationship between the objects and their attributes" (Fagan and Hall, 1956).
4. System: "The sum total of parts working independently and working together to achieve required results or outcomes, based on needs" (Kaufman, 1972).
5. System: "An integrated assembly of interacting elements designed to carry out cooperatively a predetermined function" (Gibson, 1962).

In technology, an outstanding example is that of automatic control systems. These systems range in complexity from the elementary with only a few variables to the very sophisticated with many variables and multiple inputs and outputs. A well-delineated body of theory, design methods, and experience exists for effective application of control systems to diverse problems in many industries. Other examples in technology are power systems, communication systems, production processes, space systems, and the almost uncountable sub-systems of these (Tauber and White, 1969).

A systems development plan is the collection of all controlling data of any consequence for the conceptualization and design of products. A system methodology is necessary to provide a useful structure for solving awkward problems. An industrial problem-solving methodology must do three things: (1) prescribe a system that functionally organizes a general problem-solving process; (2)stipulate system parameters that provide the format necessary for the solution of problems; and (3) describe system models and capabilities that provide the means for the iteration of alternative outputs in the problem solving process (Optner, 1965).

The power and utility of systems concepts and methods in technology, management, economics, and other fields, although clearly traceable to the complex technical and scientific developments of World War II, have become generally recognized only since the mid-1950's. There has been a growing realization of the existence of an identifiable science of systems, comprising a body of concepts, methods, and above all, a philosophy of treating the whole rather than bits and pieces.

Systems analysis, by its very meaning, cuts across academic departmental barriers; an interdisciplinary approach is therefore necessary, both in the marshalling of varied resources and in the manifold applications. Systems theory, in the sense that is proceeds from concepts to theory to application, is science-oriented. Nowhere has the need for such unification been greater than in industry (Tauber and White, 1969). The list of systems applications is already impressive, and is growing steadily. In addition to physical and engineering areas, where the greatest use has been made thus far, systems applications are established in biology, economics, and business administration. Systems work is also developing in education, psychology and sociology (Tauber and White, 1969).

The success of systems approaches and the validity of its solutions are influenced by the ability of experimenters to represent the real world of the problem in symbolic form. Computers have added fantastic speed, capacity, and versatility to problem solving. They enable man to attack new problems that were heretofore beyond his scope. However, computers cannot find the fresh, great problems of our day, nor are they equipped to conceive the areas of greatest potential gain from their use. This is man's sole prerogative and will be for some time to come (Optner, 1961).

The systems approach with its strong mathematical orientation provides the basis for the battery of new decision processes which have evolved in recent years. Among the more prominent of these processes are: (1) operations research; (2) mathematical programming (linear programming, nonlinear programming, dynamic programming, etc.); (3) econometric methods; (4) scheduling methods (PERT, CPM, etc.); (5) queueing theory and Markov processes; (6) computer simulation; (7) industrial dynamics (application of engineering control theory to industrial problems; and (8) engineering-economic systems methods (a blend of engineering and economics methods, particularly as applied to industries based on science and advanced technology, e.g., aerospace, communications, automation, computers) (Tauber and White, 1969).

The distinguishing feature of a system is the interaction among its various components. The structure of the system is determined by this interaction. It is implicit that the problems to be attacked are complex and not trivial; also, that the time horizon is generally not immediate, but intermediate to long-range.

Management conceives a requirement based upon an existing state. This state is to be changed, based upon some proposed state that is known. The question is how to bring about the proposed change. The problem is to evaluate the means by which the change may be brought about.

Alternatives are evaluated, one at a time. Assumptions are stated and their basis defined (Whitehouse, 1973).

Morris (1973) has suggested the following steps for constructing models:

1. Identify and formulate the manager's decision in writing.
2. Identify the constants, parameters, and variables involved.
3. Select the variables that appear to be most influential so that the model may be kept as simple as possible.
4. State verbal relationships among the variables based upon known principles, specially gathered data, intuition, and reflection.

5. Construct the model by combining all relationships into a system of symbolic relationships.
6. Perform symbolic manipulations.
7. Derive solutions from the model.
8. Test the model by making predictions from it and checking against real-world data.
9. Revise the model as necessary.

Educational systems planning places the emphasis on "planning what to do" rather than "doing what is planned." A process, a way of thinking that brings outcomes to the forefront, an action-oriented systems approach to education requires that systematic and formal planning, design, implementation, production and evaluation take place (Kaufman, 1972)(Figure 1).

While normal science continues to serve the cause of analysis *per se*, which often results in a knowledge about isolated parts at the expense of a comprehension of entities as operating wholes, the systems approach seeks to give some attention to that other major aspect of science, synthesis and synergistics.

Thus, the models that the system scientist builds will be syncretic, as fully as possible exploiting opportunities for quantification.

In a word, what the system approach demands of its practitioners on the methodological dimension is congruence (Brazeller, 1973).

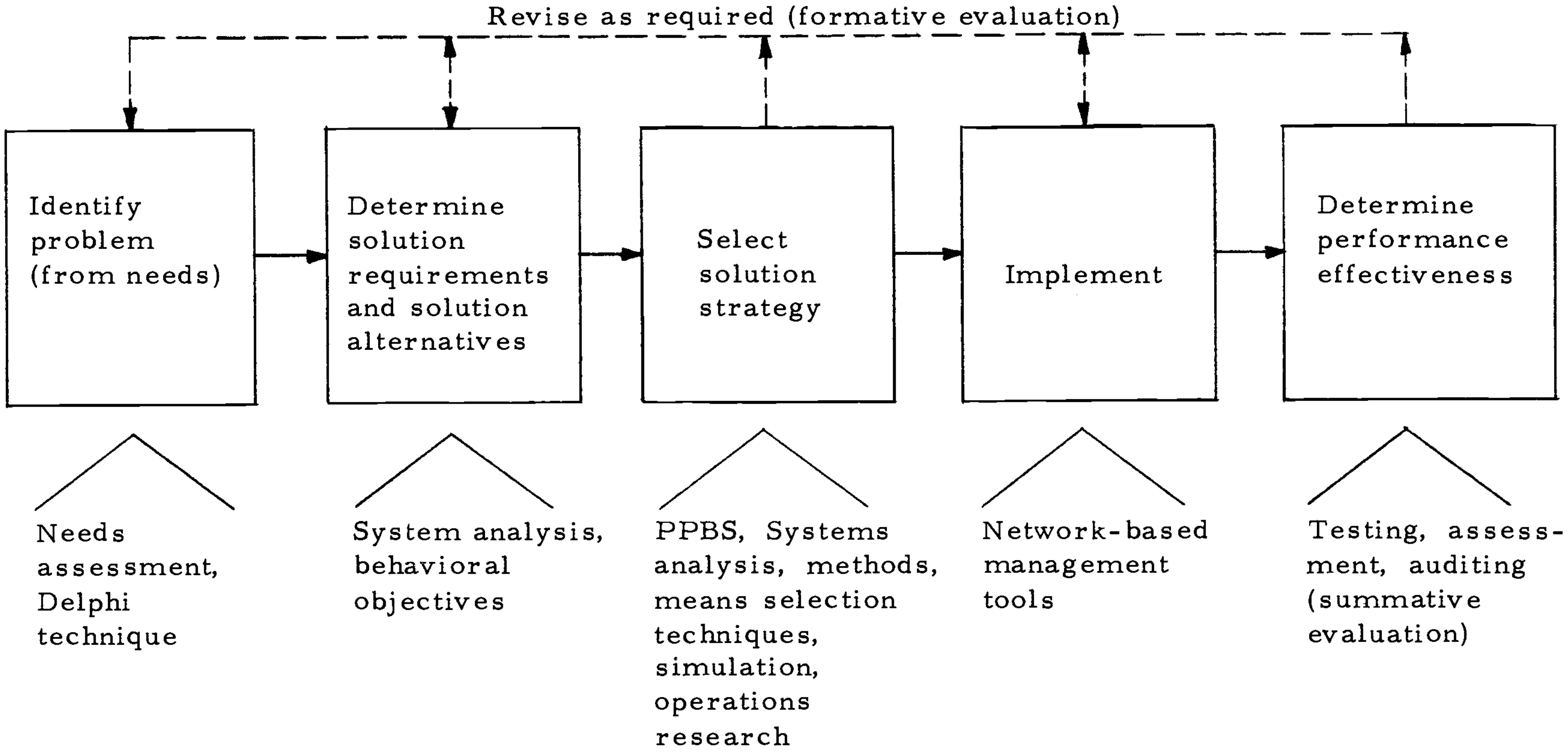

Figure 1. Systems approach (from Kauffman, 1973).

Subsystem (1)

Forces Influencing the Growth of Safety

> Go reckon our dead by the forges red
> and the factories where we spin.
> If blood is the price of our cursed wealth
> Good God we have paid it in.
>
> Anonymous (quoted in Scott, 1974)

Willard M. Bateson (1972) discussed "Safety Education" as a term that has very broad meaning. Its definition includes many techniques, both formal and informal, but its essential goal is the production of accident-free individuals. The most common types of accidents are related to handling of materials. It seems appropriate then to provide young people with instruction on how to lift and move materials safely. They need training in the safe use of hand tools and they need to know that they have physical limits and that it is not "chicken" to ask for help (De Reamer, 1959). This role for education is vividly portrayed in Muscle and Blood (Rachel Scott, 1974), as Scott uses a quotation from Upton Sinclair.

In his book, The Jungle, Upton Sinclair wrote of the Chicago slaughterhouse:

> There were the men in the pickle rooms for instance. . . scarce a one of these that had not some spot of horror on his person. Let a man so much as scrape his finger pushing a truck in the pickle-rooms, and like as not he would have a sore that would put him out of this world; all the joints in his fingers might be eaten by the acid, one by one. Of the butchers and floormen, the beef-boners and trimmers,

> and all those who used knives, you could scarcely find a person who had use of his thumb; time and time again the base of it had been slashed, till it was a mere lump of flesh against which the man pressed the knife to hold it. . . . There were men who worked in the cooking-rooms, in the midst of steam and sickening odors, by artificial light, in these rooms the germs of tuberculosis might live for two years, but the supply is renewed every hour. There were the beef-luggers, who carried two hundred-pound quarters into the refrigerator cars; this was a fearful kind of work that began at four o'clock in the morning, and that wore out the most powerful man in a few years. There were those that worked in the chilling rooms, and whose special disease was rheumatism; the time-limit that a man could work in the chilling-room was said to be five years. . . . There were those that made the tins for the canned-meat, and their hands too were a maze of cuts, and any cut might cause blood poisoning; some worked at the stamping machines, and it was very seldom that one could work long at these at the pace that was set, and not give out and forget himself, and have a part of his hand chopped off. . . . Worst of any, however, were the fertilizer-men, and those who served in the rendering rooms. Those could not be shown to the visitor--for the odor of the fertilizer-men would scare any ordinary visitor at a hundred yards, and as for the other men, who worked in the tank room full of steam, and in which there were open vats upon the level of the floor, their peculiar trouble was that they fell into the vats; and when they were fished out, there was never enough of them left to be worth exhibiting (p. 8, 9).

Most Americans believe, as of this day, that the sweatshop and the factories with their dangerous conditions are gone. The present environment of thousands of working persons rivals that of Sinclair's description. Hundreds of thousands of men and women are poisoned at work by fumes and solvents and suffocated by lung-filling dusts. Most of them die quietly from an expanding technology, their families accepting diagnoses of heart disease, cancer, emphysema (Scott, 1974).

Most recently we can blame radiation, chemical spray exposure, lead poisoning, Legionnaire's disease and swine flu shots. Even more serious perils have been added since Upton Sinclair's days. Countless new technological advances have had an effect in human devastation. The 1972 "President's Report on Occupational Safety and Health" made a conservative estimate of the toll to be 100,000 deaths a year from occupational diseases. The same report states that "at least 390,000 new cases of disabling occupational diseases occur each year."

Much has been promised but little has been done. Neither the Government, the Union nor the Employer are protecting working people. Laws have been passed, but with little effect. Most legislation in this country dealing with health and safety was passed as a result of our many major disasters. Effective laws that have been passed have been rendered ineffective by lack of appropriation of funds. There has been no sense of mission or of dedication to implement safety on behalf of the worker.

One might also ask, and what of the educational system, its role in educating workers of hazards and of their rights guaranteed by our Constitution? One might question the unions who purport to represent the worker. And what of industry and the employer who has the responsibility of providing a "safe work place" (Walsh, 1959).

We have not "arrived," we have not reached a period of far-reaching change. Old practices and attitudes have not been swept aside. Without a catalyst, to focus on preventive measures encompassing the total work environment and to secure the cooperation of everyone in improving the role of safety, it will remain as it has in the past--remain in the hands of advancing technology, in the hands of profit-motivated industry and in detrimental opposition to the worker.

> Perfection of means and confusion of goals seem, in my opinion, to characterize our age. If we desire sincere and passionately the safety, the welfare and the free development of the talents of men, we shall not be in want of the means to approach such a state (Albert Einstein, quoted in Heinrich, 1969).

The role of safety in society, then, is to protect the individual from accident and harm. The role of the individual, then, must be to organize those resources that are necessary to insure this right, that is guaranteed by the Constitution. Safety education is that vehicle that can provide a measure of insurance for a safe environment. Tomorrow's safe workers are now in our schools. Our managers, our organizers, our legislators of the future are now building an experience bank that, if properly designed, might well serve as the catalyst by which a revolution in safe practices and procedures could protect our human environment.

Evolution of Safety

Man has been recognized throughout the ages by his vocation. His industry has been exemplified by the pyramids, cliff dwellings, tapestries, artifacts and similar antiquities. His desire for self-preservation and his fear of injury existed then as they do now. Even in these early civilizations man must have practiced some sort of accident prevention. Those efforts were probably individual and of a defensive nature. The real need for safety organization became apparent with the advent of "the machine age."

From a standpoint of social organization, England is most noted for giving the world the art of self-government. England was almost wholly agricultural before 1500, but in the latter part of the eighteenth century progressed rapidly in craftsmanship. A high degree of skill was achieved by workers in woods, metal and textiles.

Mechanization of industry began with the steam engine and gained momentum in the textile factories. Riots broke out between hand spinners and factory workers. Hand workers destroyed machines and desperately tried to hinder plant operations. In the end, the hand worker lost the struggle and operated the spinning machine and power loom. Mechanized industry was accompanied by working and living conditions of debasement and social degradation. Although social conditions were bad in those days, plant conditions were much worse.

It was not until 1850 that actual improvements began to be implemented. These beginnings of improvement in industrial conditions provided some sanitary and safety benefits. Many benefits in the United States were being implemented in the form of shorter working hours, better plumbing, lighting, heating and transportation. Legislation was slow and "the doctrine of negligence of the fellow servant" was prevalent. Mining, river boats, railroads and the steel industry brought some legislation attacking definite physical and mechanical hazards.

England in 1880 made the first attempt to modify the common law of employer's liability. A personal representative was allowed to recover damages for death caused by negligence. In America, Alabama in 1885 defined employer's liability. Despite early legislation, employers were few in taking any safety initiative. Private insurance companies and workmen's compensation laws in 1911 produced another forward stride for safety in the United States. In 1912 the National Safety Council was organized and this was followed by local councils by 1918. The American Society of Safety Engineers was established in 1915. The society had its problems but made slow progress until 1940. Then the number of chapters and its membership rapidly expanded to 64 chapters and more than 7,000 members. The society, at the present time, reflects many of its inherent activities as influences in present-day safety standards (Handbook of Industrial Safety Standards, 1964).

The industrial safety movement can best be exemplified by a chronological listing of important dates.

1833	England--Government factory inspections established.
1844	England--Law enacted to provide fencing for mill gears and shafts. Lord Ashley's "Great Factory Act."
1867	Massachusetts--Instituted factory inspection.
1869	Germany--Acts passed providing that all employers furnish necessary appliances to safeguard health and life of employees.
	Massachusetts--Established the first state bureau of labor statistics in order to determine the kinds and causes of accidents.
1874	France--Law enacted providing for special inspection service of workshops.
1877	Massachusetts--Law passed compelling guarding of dangerous moving machinery.
1885	Alabama--Passed employer's liability law.
	Germany--Bismarck prepared and had enacted the first compulsory compensation act for workers.
1887	Massachusetts--Passed an employer's liability law.
1892	Safety Department of the Joliet Works of the Illinois Steel Company formed.
1909	First National Conference on Industrial Diseases held.
1911	New Jersey--First state workmen's compensation law passed.
	California--Passed the first American law for the compulsory reporting of occupational diseases.
1921	International Labour Organization at Geneva set up a safety service.
1922	Greenburg and Smith introduced the impinger, a dust-sampling device.
1926	"Benzol Poisoning Study"--In 1922 a paper on benzol poisoning was read at the National Safety Congress.
	"Four to one" accident-cost ratio established by Heinrich of The Travelers Insurance Company.
1927	A study of the relation between safety and production was made by the American Engineering Council in 1926 and 1927.
1929	"The Foundation of a Major Injury" published by The Travelers Insurance Company.

1933 The U.S. Public Health Service in cooperation with coal-mine operators, the United Mine Workers of America, and the Department of Labor and Industry of Pennsylvania, undertook a survey of pulmonary disease in the anthracite mines.

1935 The Air Hygiene Foundation was created to conduct scientific studies and investigations for finding ways and means of preventing occupational diseases.

1941 Industrial hygiene departments set up in 33 states.
At the beginning of 1941 all states except Mississippi had compensation laws in effect.
The Accident Cause Code was completed by the ASA.

1942 World War II government-operated plants and plants with prime government contracts were required by the War Department to carry on organized safety programs.

1949 Mississippi passed a compensation law, making such laws effective in all 48 states.

1956 Industrial organizations (about 9,000) reporting to the NSC lowered accident-frequency rates 78 percent and severity rates 67 percent since inception of reporting in 1926. Frequency rates decreased every year during the preceding 9 years.

(Heinrich, 1969)

1969 Construction Safety Act
Coal Mine Health and Safety Act

1970 Occupational Health and Safety Act
Consumer Product Safety Act

Lourance, 1976)

<u>Interfacing Safety Perspectives in Education</u>

Philosophy is the means by which man searches for the truth and the reasons for being. Philosophy is the guide for the development of goals and objectives that underlie the principles of life. A philosophy of life cannot be separated from a philosophy of safety, since both rely on values. Man must understand and believe that he has a responsibility to himself and others to preserve human life.

To function at full capacity man must preserve his health. He owes it to himself and others who depend upon him to be considerate of their lives, limbs and possessions (Horne, 1940).

Safe living is an important and complicated problem. Modern living demands a great knowledge of the hazards that surround us, as well as effective ways of coping with them. Only recently has the population begun to overcome the barriers to human and physical obstruction of safe living (Florio, 1969). In all realms of life, survival depends upon the anticipation and recognition of solutions to hazardous problems. The application of technology to the solution of problems in industrial education can achieve a safe environment for human use (Olson, 1972).

It must be kept in mind that man has not induced all hazards that exist. Even though technology cannot accept the total blame, we must consider that: (1) technology, as a mixed blessing, has enriched human existence; (2) many of our problems are technological in origin but may require technological as well as political solutions; (3) human activity will always be accompanied by unavoidable risk; and (4) our world can only be made safer by changing from where things are today.

Man has always had to contend with natural catastrophes, disease, malnutrition, polluted air and water, natural poisons, sun, wind, earthquakes, volcanic eruptions, flood, fire, frost and other impediments to his survival. Undesirable effects have also been produced by technological development; however, many of these must be viewed as the expense incurred to decrease our vulnerability to the hazards of nature. Technology, on the other hand, causes the many newspaper headlines that are so alarming, perplexing, and personal in their implication for safety for the population. There are so many frightening stories that we wonder if anything can be that bad. We are disturbed by what seems to be irresponsible regulatory actions, and suspicious of all the assaults on our freedoms and our pocketbooks in the name of safety. Who do we believe? What cries do we respond to? How do we know what is and is not hazardous? The issues: X-rays, DDT, cosmetics, lead, saccharin, intrauterine contraceptive devices, power lawn mowers, cigarettes, air pollutants, ozone layers, vitamins, fluorides, chlorides, mercury, sulfur dioxide, carbon monoxide, radiation, nuclear power plants, jute machinery, flu shots, Legionnaires disease, jets, LSD, 2, 4, 5-T, asbestos, cyclamates, glycerides, and the list continues (Lourance and Kaufman, 1976). These and many other technological advances may contribute to accidents. As long as accidents of all nature continue to be the leading cause of death, there will be a growing need for improved and expanded safety education in our schools.

There is no Salk vaccine for accidents, yet accidents are an epidemic, taking a tremendous toll in human resources. There is a cure, however, and that cure lies in the hands of education. Students from kindergarten through college must be taught how to prevent accidents (Worick, 1975).

The Department of Health, Education and Welfare reported in a safety bulletin for school shops (1960), that "public education has, for many years, recognized the importance of safety education and followed the lead taken by industry in adopting a positive approach to the problems of accident prevention" (Pfister, 1960). In a later analysis, he says that "unfortunately following the lead of industry is not good enough when it comes to the safety of youth. Industry is not employing the 14-17 year old. Teachers working with youth in the shop environment must be the leaders in safety and create an environment exceeding minimums applied to industry" (Pfister, 1970).

Unsafe behavior is considered to be the contributing factor in 85 percent of all accidents. This implies to the educator that there is a great possibility of reducing accidents--by teaching young people the correct way of doing things and develop in them positive attitudes toward safe practices in every living and learning situation (Safety Education Yearbook, 1960).

Our failure to teach these safe practices and attitudes is clearly indicated by the fact that each year nearly 75,000 teachers require medical attention for on-the-job accidents. In fact, teachers are twice as likely to be injured in the classroom as are steel mill workers. W. G. Johnson, a former general manager of the National Safety Council, in his remarks to the association of School Business Officials (1966) said:

> I truly believe that a school system with an employee and student population of 10,000 has a wider range of safety problems than a manufacturing plant with 10,000 employees. Yet in the manufacturing plant we would typically find several professional staff skilled in safety engineering, industrial hygiene, and employee training and motivation. We simply do not find this type of staff unit in a school system that size (p. 76).

Education managers and boards of education have, for whatever reasons, lagged far behind business and industry in the development of safety and accident prevention programs (Foster, 1972).

If man is not able to recognize the hazards in his environment, to remove the hazards, to compensate for those that he cannot remove, and avoid creating new hazards, the only way to insure his welfare is to curtail technological progress and thus deprive him of situations that involve greater risk than he can safely face (Dichl, 1971).

> Torch Explodes Gasoline Can in School Shop. A student who ignored the warnings of his teacher, touched off a blast that shattered 27 windows of the high school vocational agricultural workshop. Contrary to the instruction of the teacher, the student took an empty gasoline drum into the shop and began cutting the top with an acetylene torch. The top was blown against the ceiling and the concussion broke the windows and scattered debris over the shop. The torch operator and three other students escaped injury (Kansas City Times, 1967).

High School Lab Blast Injures Four. An explosion in a high school science laboratory injured four persons. Officials said the blast was set off when the teacher mixed potassium nitrate, Thermit, and red phosphate. The chairman of the chemistry department said the teacher 'had volunteered to give a dramatic demonstration of heat release and I'm afraid it turned out much too dramatic.' Two teachers and two students were injured while 24 other students in the classroom escaped injury (Tampa Tribune, 1967).

Teacher Sued in Fatal Shop-Class Accident. The parents of a 17-year-old boy killed in a shop accident have filed suit for $50, 000 against an industrial-arts teacher. The suit alleges the boy suffered fatal injuries when a laminated block of wood spinning on a wood-turning lathe flew apart. The suit further alleges that the teacher failed to properly instruct their son in the use of the lathe and was negligent in permitting him to use it since it was in a defective condition. The original suit was filed jointly against the school district and the teacher. The school system's insurance company made an undisclosed out-of-court settlement on behalf of the school only (Indianapolis Star, 1966).

Each of these actual situations depicted involves a school district and represents an unfortunate segment of school life. Personal injury was the result in two of the three illustrations, one serious enough to cause death. When injury is suffered in our society the possibility is good that satisfaction will be sought in a court of law.

This issue of the standard of care owed by teachers to pupils under their instruction is a question frequently placed before the courts. Teacher liability resulting from school-related student injuries is often the crux of the case. The Vermont Supreme Court said it well when it stated, "A teacher owes his pupils a duty of supervision, and if there is a failure to exercise reasonable care in carrying out this duty, either in the commission or omission of an act which results in injury, the teacher is liable to the pupil."

Negligence charges stemming from a lack of supervision and inadequate instruction constitute the basis for the majority of court cases brought against teachers and school districts when a student injury occurs. Foreseeability and proximate cause, the prime criteria in determining negligence, are immediately brought into consideration and many times form the background for the ultimate decision (The Indianapolis Star, 1965).

Safety is the perennial problem in any industrial education program. Every industrial education teacher regardless of the level of instruction faces a threat of serious injury either to his students or himself. A study of accident statistics in 1971 reveals that school shops and laboratories are outranked only by physical education in numbers of accidents. For example, in grades 10-12 the rate of accidents was 1.95 per 100,000 school days. The rate of 0.10 is equivalent to about 4,500 accidents among students enrolled. On an average, about two-thirds of one day was lost for each injury suffered in the shops and laboratory. Over 8,000 accidental deaths occur annually among school children aged 5 to 14 (Table 1).

Poorly developed or nonexistent safety programs exact a very high price in terms of loss of life, injury, and suffering. The public has the right and the responsibility to hold the board of education

Table 1. School accident rates by activities.

Location of accident	Rate	
	Boys	Girls
Total - school jurisdiction	9.11	4.57
Shops and labs	0.61	0.09
Buildings - general	1.60	0.98
Grounds - unorganized activities	1.68	0.94
Grounds - miscellaneous	0.43	0.24
Physical education	3.19	1.89
Intramural sports	0.22	0.04
Interscholastic sports	0.87	0.04
Special activities	0.06	0.05
Going to and from school (MV)	0.19	0.14
Going to and from school (not MV)	0.26	0.17

Source: Strasser _et al_. (1973).

accountable for these failures. As in industrial safety programs, the key to success is communication, responsibility, and accountability.

Despite legislation in every state, safety education and safe school environments are often only secondary considerations. For years, safety and safety education have received less attention than they deserve. This neglect results in the needless loss of thousands of lives annually through accidents. Although we do not know how many of these lives could have been saved with proper education, every fact points to the conclusion that failure to develop proper habits, skills, attitudes, and knowledge is the real culprit. How long can we afford this loss, when a few minutes daily in the classroom in well-planned safety education programs could probably save so many (Stack and Duke, 1966)?

The direction of the educational concern of the 70's appears to be directed toward the approximately 80 percent of the nation's youth who will not finish college. Since many in this group will become technical and industrial workers, industrial education instructors at the high school and post-high school levels will play a key role in imparting the positive safety attitudes that are essential in the world of work (Krejcie, 1972).

Any condition that inflicts more deaths, personal injuries, and destruction upon a nation than all the wars in history must be accepted as a prime social problem (Straussen, 1972). Safety education must meet the challenge of rapid social change. In fulfilling this objective, programs of safety education must offer an experience of greater depth than mere knowledge of safety do's and don't's for a given list of current activity. Safety education must build the basic concepts of safe behavior securely into the value system.

Considering all the possible sources of safety education in a community, the schools represent the only place with the potential for adequate personnel and facilities, plus access to millions of young children. The schools must bear a major share of responsibility for the safety education of our children. Safety education must start on the day the child enters school and must continue throughout his school career, for school safety education lays the foundation for the continuing safety education that takes place throughout life. Teacher education institutions need to step up their efforts to provide teachers at all levels equipped to handle safety education in the schools.

The responsibility for safety education, then, is shared, with the major portion taking place in the home and in the schools (Worick, 1975).

Although a vast amount of research has been conducted on accident prevention in industry, such effort has not been paralleled in studying accident prevention in educational laboratories. In addition, much of the information on accident prevention in industry cannot be directly applied to industrial education shops. This is because most industrial situations, unlike school situations, involve workers who are performing similar tasks or duties day after day, year after year.

Students continually participate in new and varied activities with numerous tools, facilities, and equipment. Each term the instructor must orient a new group of students to the learning environment. Therefore, industrial educators must continually strive to discover and develop new methods of attacking the problem of preventing accidents in educational laboratories.

The problem of reducing environmental hazards is one of engineering and design; whereas the problem of developing the safe behavior of students involves numerous psychological factors underlying this behavior. These psychological factors are: (1) ability to perceive hazards; (2) aspiration to behave safely; (3) intelligence; (4) work experience; (5) spatial perception; (6) mechanical comprehension; (7) safety attitude; (8) knowledge of safety, and (9) work achievement (Nichols, 1972).

A good safety program is more than just sets of rules, mimeographed handouts, and posters. Safety is an attitude which must be developed in students, not only in the industrial arts area, but also in the home, and anywhere potential hazards exist.

The prime ingredient in any safety program is the instructor himself. The industrial arts instructor must practice what he preaches. He must be safety conscious, dress safely and appropriately, and be able to use his "safety sense" to carry out a sound program.

In an era of technological expertise, industrial educators must adopt some type of educational system for curriculum development. Once the instructor has identified behavioral outcomes, based upon the rationale of the selected concept to be taught, content and activity experiences can be structured to fit the system's needs. By studying the behavioral specifications, he can create a learning environment that will meet the system requirements (Lawson, 1972).

The industrial safety professional might ask what all this "systems analysis" has to do with him. Anyone can use and profit from the systems approach to safety. The systems approach helps to enlarge one's viewpoint. Becoming oriented in terms of task performance and being forced to visualize the interrelationships of all the components of a system helps to bring most accident possibilities into consideration automatically and in an orderly manner.

The systems approach to safety can help to change the safety profession from an art to a science by codifying much of our knowledge. It helps change the application of safety from piecemeal problem solving to an organized plan of attack (National Safety Council, 1974).

Subsystem (2)

Technological Processor Developments

Jonathan A. Titus (1976), in the special hardware edition of *Interface*, says:

> I must admit that I am disappointed. I see about 80% of microprocesser users playing games in BASIC or some other high level language. While it may be fun and it doesn't require much digital experience I think that it will grow old quickly. It surprises me that people aren't very interested in using their computers for non-data processing tasks or for control applications. There doesn't seem to be much interest in model railway control, automated darkrooms or the super home controller that people always talk about. This is where the future of microprocessers is (p. 37).

Ten months later, in *Popular Science* (May, 1977) William J. Hawkins tells "What it's like to build and use your own home computer."

> I didn't send Christmas cards last year; my homemade computer did the job for me. And I no longer need a personal phone book. This box of blinking lights gives me any name, address, or phone number I want instantly, just for the asking. Mathematics? Give it the problem, old math or new, difficult or easy and the answer appears on a television screen without hesitation (p. 102).

Tomei and Miller (1976) state:

> The development of the modern microprocessor would, at first glance, appear to be a backward step. The general trend over past decades in the computing industry has been to develop general-purpose computers that are larger, faster, and more expensive. Microprocessors, on the other hand, are a revolutionary idea in that they are small, inexpensive, single-purpose machines that may someday become expendable throw-away units (some microprocessor chips have already dropped to $10 each, in quantity). The potential for these miniature computers is staggering to the imagination--they undoubtedly will be used by nearly everyone to fill nearly every conceivable need (p. 9).

Events that culminated with the development of the first true microcomputer began with Datapoint Corporation of San Antonio, Texas. Datapoint is a manufacturer of "intelligent terminals and small computer systems." In 1969, Datapoint, Cobar and Viatron attempted to make "a great leap forward." Datapoint designed an elementary computer and contracted with Intel and Texas Instrument to reduce the computer to a single logic chip. Intel succeeded, but the product was ten times slower than the contract specified. Datapoint declined to buy the slow chip.

Intel decided to market their paid for, computer-like, logic device. They called it the Intel 8008 and the microcomputer had arrived (Osborn, 1975).

Optner (1965) defined a process as a phenomenon that manifests continuous change over time. Kaufman (1972) defines process as the application of ways and means of achieving any result or outcome. The former definition was used in the confines of an industrial context while the latter was used to explain educational systems planning. Both definitions relate to man, computer and system development. A man may be utilized as a processor; a machine may be used as a processor. The combination of the two may result in a man-machine system.

With a computer, an analyst may process a problem and solve it. From the solutions, he may choose the three best solutions and offer them as alternatives for a given project. The analyst may estimate the reliability of any one solution by establishing its confidence limits. The analyst may establish the critical state of a value mathematically with a finesse unequaled in art. Representations of the results of processes (symbols or numbers) are of a different order than the actual results that grow out of judgment, experience, intuition and human decision.

Whenever man is employed as a processor, his total human experience is employed in a role (as a computer) to accept input and produce output. A graphic representation of man's logical problem-solving from input to output would constitute a methodology. In fact, any tightly-woven logical, reiterable, procedural process, whose alternative paths are carefully identified and whose options are known, may qualify as a methodology (Optner, 1965) (Figure 2).

Although man-machine systems have been evolving over many years, modern complexity requires that careful attention be given to the problem of mutual compatibility between man and the equipment with which he works. By first considering system functions rather than components, proposed designs can be efficiently evaluated. Each of the functional building blocks that comprise a system can be examined in simulated form. Design and appraisal of systems calls for the efforts of many specialists.

The problem is coordinated with system engineering, and provides inputs when needed in the design of equipment and job aids and in development of the curriculum subsystem (Folley, 1960). A decision model for a man-machine curriculum implementation is illustrated in Figure 3.

In the man-machine system, the role of each function is defined. Either man or machine may be central to the operation. The machine performs the function of processor with the human introducing the input. As the machine increases in flexibility, it may do many processing steps and provide more than one output. In special-purpose models that have been automated, it is possible to design a sensor (an instrument) capable of "reading" an ongoing process. This reading may be automatically transmitted to a central processor.

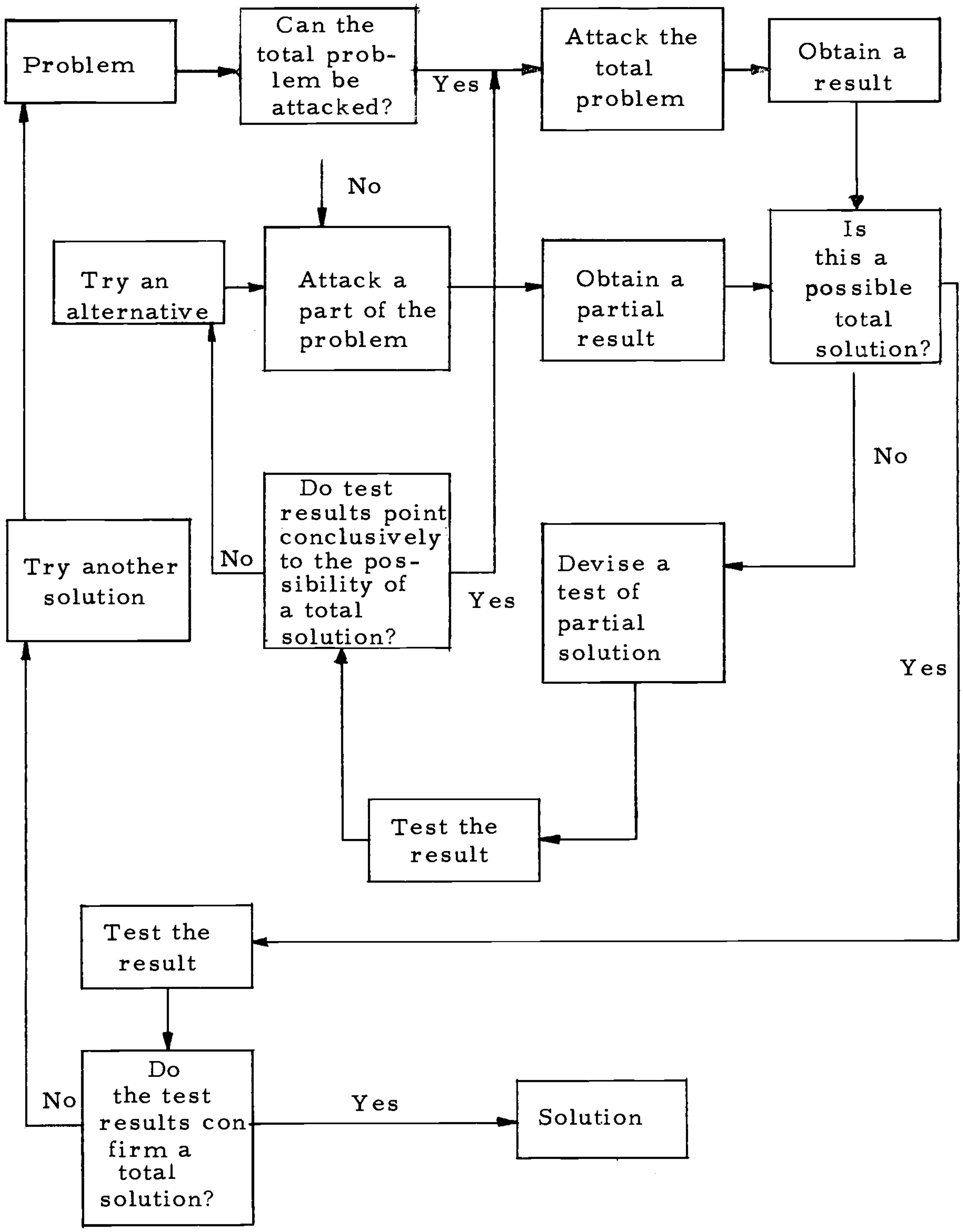

Figure 2. Problem solving sequence (adapted from Kaufman, 1973).

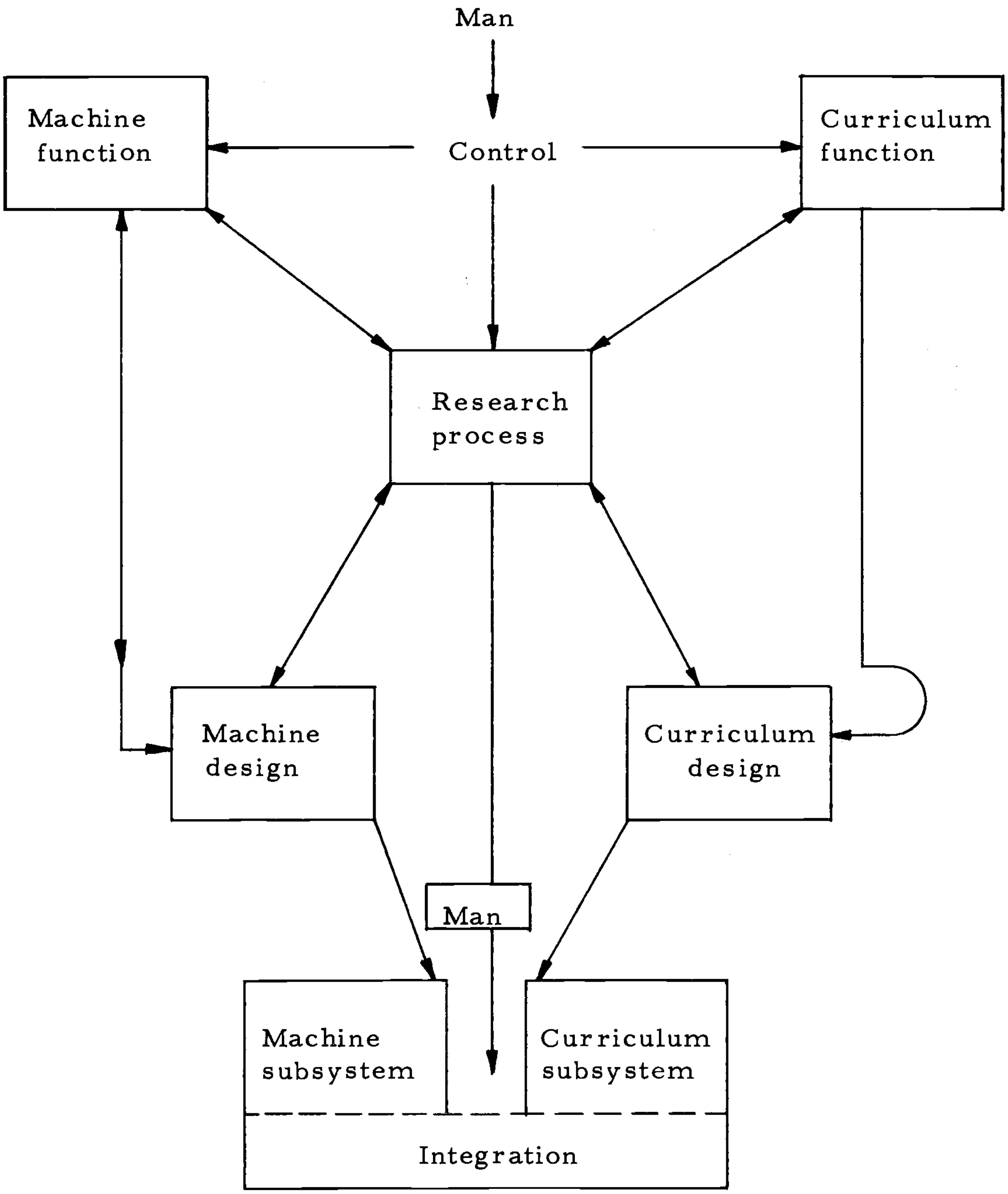

Figure 3. Man-machine system (adapted from Design for Decision, Bross, 1953).

Both men and machines are similar in that they both use languages. However, man's language takes three forms: thought, spoken, and written. The machine's language is a formal, systematic, logical, mathematically-based symbology. It has none of man's language forms; its own form may be characterized as automatic, programmed, and outcome-oriented. It is automatic because it may be energized to execute steps with or without human intervention. It is programmed in that it "thinks" along logically preplanned lines.

A second distinction between men and machines recognizes that men are fully adaptive and that machines are not. A machine solution is the end of the operation for the machine. But for man, solution is the means by which he makes steady improvements in process problem solving; the solution finds utility. This points to another important advantage of combining men and machines in problem solving. Machines are fast and sure; they can speed up the problem-solving process, bringing improved products to consumers. Machines can examine a number of alternative solutions rapidly and systematically. Man can study the best of these solutions. He deduces their impact and applies the best solution to reducing needs.

There is a third distinction between man and machines: man can easily override the machine. He can discard all its solutions and substitute his own, which may be empirical or intuitive. In so doing, he may be forced to trade the machine's answers, which are unambiguous and precise, for a human solution, which is not necessarily of this quality. Although high confidence may be placed in the automated output, the machine is seldom, if ever, seen as the summit of decision making (Optner, 1965).

A First Class Electrician's Mate tells a Navy Board of Inquiry he caused the power failure of the submarine Stickleback by turning a rheostat the wrong way. As long as machinery and tools remained simple, the problem of describing them and the tasks of designing, manufacturing, operating, and maintaining them were also simple. But, as machines have increased in complexity and scope of functions, we have had to think about them in new ways and invent new concepts to assist us in their development and use.

Man-machine systems are not new. They have been known and used by man since ancient times. Aristotle described the principle of self-regulation and organization in living systems. Even earlier the Egyptians had constructed semi-automatic systems for hauling water. Automatic time-keeping devices have existed since the fourteenth century. Windmills have long employed a system that turns their sails into the wind and adjusts their bite to alter their speed. Many other systems can be cited: the Jacquard loom, the Ure temperature thermostat, the Papin steam safety valve, and Watt's steam governor. But the formal concept of a system as a device for processing information or materials is a relatively new one. And the concept of man as a system component is even newer (Folley, 1960).

Manufacturing uses of computers include the running of many complicated machines (numerical control), operating complete factories (automation), and computers communicating with each other between factories by the use of telephone wires and microwaves (School Shop, 1972).

The three main categories of operations and devices that comprise a modern digital system are processors, memories, and interfaces. Processors perform arithmetic and logic operations, memories enable the digital machine to store and retrieve information, and interface devices permit the various digital components and subsystems to transfer information between each other and to communicate with the external world (Kenny, 1973).

A microprocessor is easiest to describe in terms of its functional blocks rather than the actual logic devices and circuits that it contains (Figure 4). There is great inventiveness among manufacturers in designing microprocessor circuits, but the functional operation of all microprocessors is much the same. Very simply, the microprocessor is a computer or more precisely, the central processing unit CPU of a computer. This means that it can do whatever a computer does; perform computations, control activities of pieces of equipment, make simple decisions, and perform

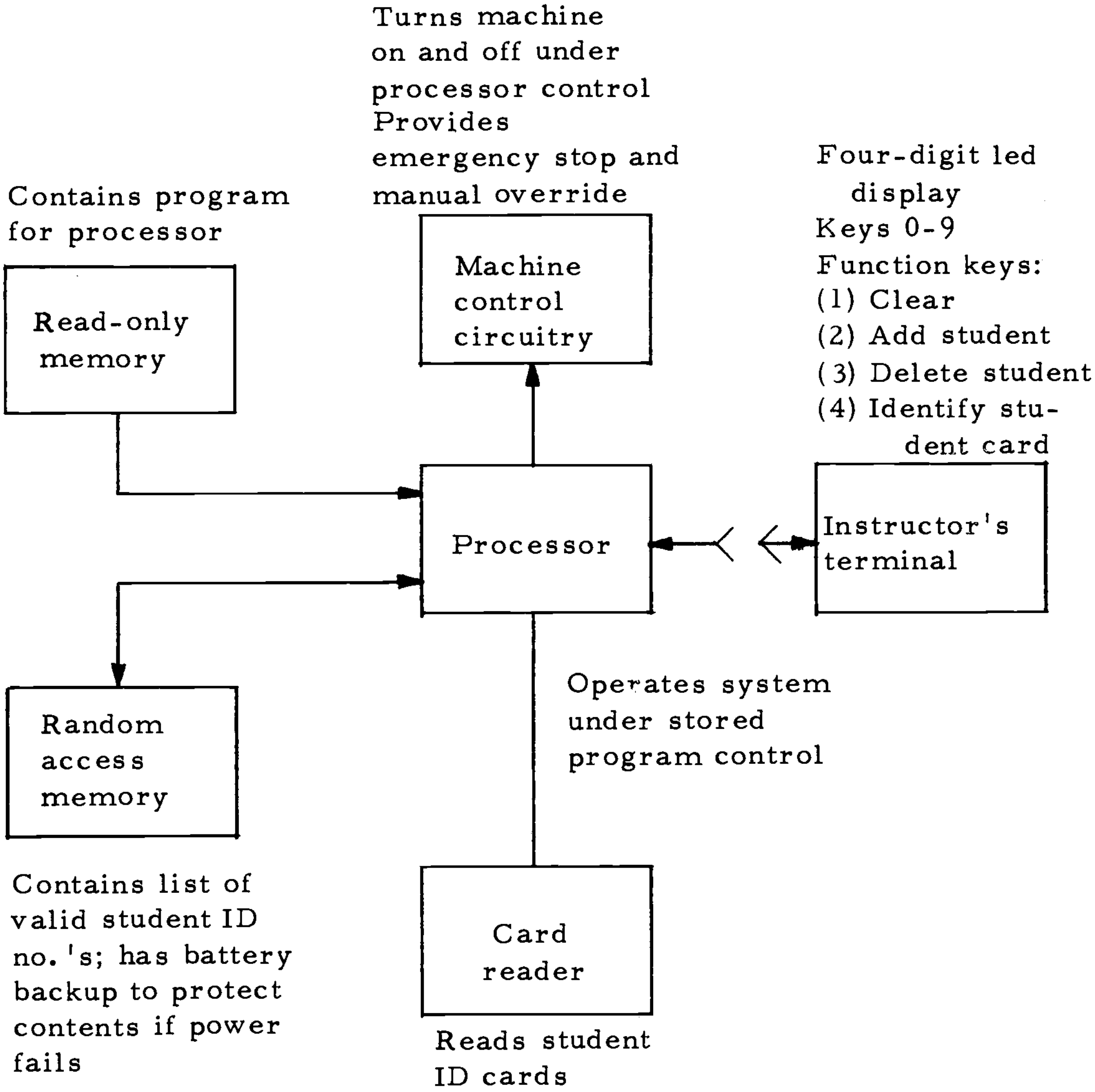

Figure 4. System block diagram.

recognition/authorization operations. The microprocessor can be used as a building block to accommodate semiconductor memory and interface with a great variety of peripheral devices, yet it can remain very small. For the first time, computer power can be distributed rather than centralized. This is very significant for applications where the computer is designed as a controller. The microprocessor now makes it possible to use computers in places not previously possible because of network, size or cost constraints.

As designs for end equipment evolve and new applications for processors are developed, new function products will emerge to support these applications. The capabilities of the microprocessor are two-fold: the ability to handle data processing tasks and more importantly to act as a controller. The processor becomes a decision making tool by first testing whether a current condition is congruent to its instructions. Then, it carries out subsequent tasks as a result of the test. The controller applies its decision-making ability to any external hardware to which it is connected. For example, the microprocessor could poll an encoded student card by use of a photoelectric cell device and transmit a digital readout to the memory. the memory having been previously encoded with the same digits would then be compared by the central processing unit. A one-to-one match of digit response would activate a switching device. In this case, the processor does both the decision making (the controller task) and the data processing. In essence, the microprocessor based computer is a tool whose function can be changed under the control of a set of instructions. The memory part of the computer stores the program and the data. The microprocessor portion of the computer executes the stored instructions (Cragon and Housey, 1976).

Subsystem (3)

Elements of Structure in Safety Programs

According to the philosopher, Ralph Barton Perry (as cited in Optner, 1965), a specialist is a person who knows more and more about less and less, until he knows almost everything about nothing. Conversely, he defines a generalist as a person who knows less and less about more and more, until he knows practically nothing about everything.

In today's technically-oriented world, both specialists and generalists perform vital functions. When these functions must be integrated in the solution of problems, there is an important requirement for communication. For lack of a set of problem-solving rules, the problem may only be half solved or unduly complicated (Optner, 1965).

Neagley and Evans (1967) succinctly described the necessity of maintaining a current and modern curriculum when they said:

> Each generation believes its problems are more difficult than those faced by previous generations. Too frequently, man looks backward for solutions to present day problems and while he searches in the past other new problems arise. The world moves on, time passes swiftly by, and the environment of today's children is vastly different from that of yesterday's. Tomorrow's children will feel the influences of even more fantastic changes (p. 35).

Safety, as a part of a person's philosophy of life, becomes a way of responding to new experiences and a way of approaching the unknown rather than following a set of safety rules or slogans (Morris, 1967).

Willard Kerr (1964) hypothesizes that a work climate characterized by great freedom to set reasonably attainable goals will result in fewer accidents. Such freedom is said to increase the worker's sense of responsibility and, therefore, his alertness in preventing accidents.

Research findings reported by Kimbrell and Blake (1958) indicate that students upon seeing someone else break a rule are more likely to do the same than students that have not seen the rule broken. A person's attitudes and behavior are strongly influenced by the people with whom he associates. Behavior is learned through imitating others.

Brody (1958) reinforced this behavior problem by stating: "At least 85% of our behavior on a given day is dictated by habit. Then the development of good safety practices in the beginning can become habitual and help insure desirable behavior" (p. 24). As a result of Kerlinger's (1965) research, he feels that attitudes are by far the most important psychological aspect of safety in any endeavor. He further qualifies this statement by saying that for every stimulus there is a response, and in human behavior this response is tempered by the attitudes, habits and values that are learned through education.

Human behavior in relation to accident prevention must be considered as dependent upon the attitudes and values a person brings to each situation. Since situations involving the choice of a safe or unsafe behavior are always present, people must be educated to help guide them to appropriate responses. Future decision making and action regarding the object of the attitude are easily determined and are consistent with the attitude. That is, a person with a developed safe attitude will have a tendency to avoid dangerous situations and practice safe procedures (Krech and Crutchfield, 1968) (Figure 5).

A concept is based upon the belief that all learning comes from the reaction of the individual to the total situation in which he finds himself. Faunce and Clute (1961) point out that "The theory of learning most prominently advanced in our time holds that learning consists of modification of behavior through experience" (p. 56). This theory contends that the quality of the experience is the most important factor in learning, and thus selected experiences are educationally

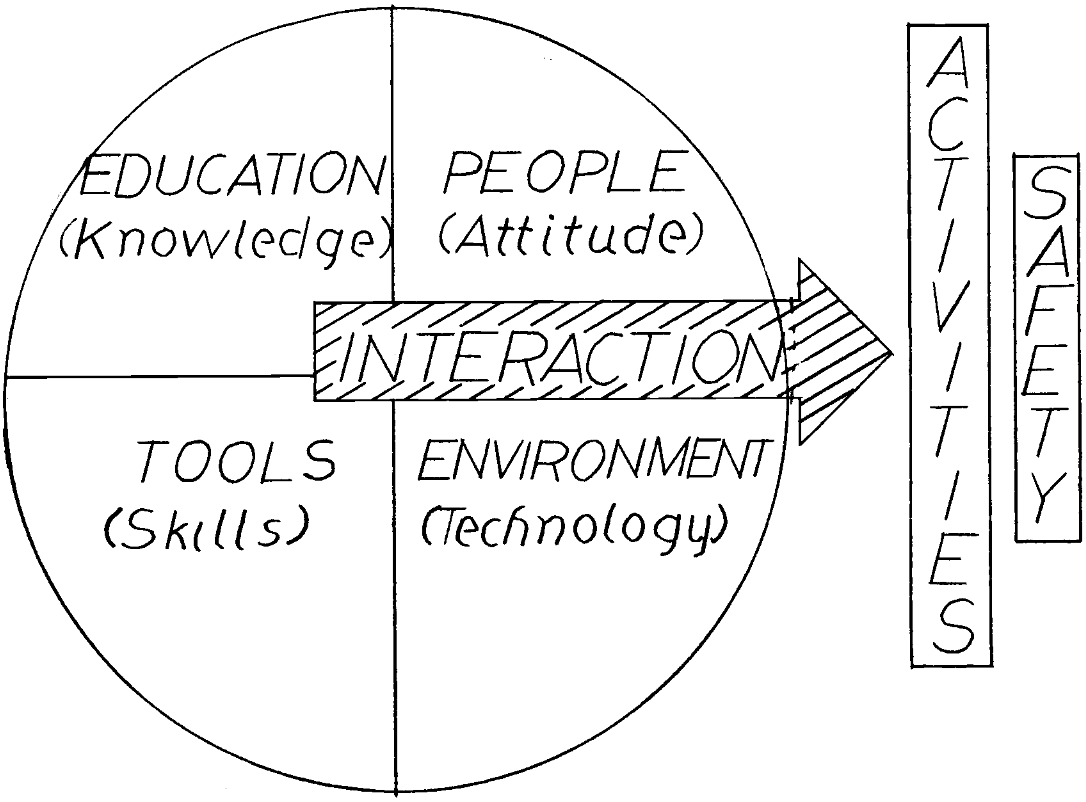

Figure 5. Industrial safety system interrelationships.

important. If the experience does not move the learner toward a worthwhile goal, no real learning will be effected.

Schools must refine and upgrade their safety education curriculum. The development of desirable safety habits, attitudes, skills, and knowledge can make tremendous strides in accident prevention. The safety education curriculum must be constantly revised to keep pace with today's rapidly growing technology.

Schools hold a great potential for the development of safe and self-reliant people. They must place more emphasis on safety education. We cannot afford the "trade off" of human lives for a few minutes spent daily in the classroom on safety education.

It seems inconceivable that any school administrator could ignore a major problem of the scope and magnitude of accidental deaths and injuries, especially since the school is in a position to make a major contribution to the reduction of these accidents. Strasser _et al_. (1973) state:

> School safety is a management function just as it is in industry, public agencies, or any other type of organization. And, as in any organization, a school safety program must be based upon sound principles or educational organization and administration if it is to be effective. Within the educational structure the functions of management are vested in the school administration. Thus, it becomes the responsibility of the school board and the superintendent to develop the organizational pattern for the total school safety program and to provide the administrative machinery to carry the organizational program through to purposeful achievement (p. 42).

The functions of organization and administration of a good safety program include the planning, organizing, staffing, directing, coordinating, budgeting, reporting and evaluation of its activities.

> Basically, the responsibility for the total safety program for school youth rests with school management--the school board and the superintendent. They control the budget, select building sites, build and maintain the school plants, establish policies, promulgate rules and regulations, define responsibility, designate authority, employ teachers and noninstructional personnel, provide in-service training and establish the program, both curricular and cocurricular, for the school. However, every employee has his own specific area of safety responsibility (Strasser et al., 1973, p. 17).

Laun (1960) in "Needed: Handbooks," clearly states that "It is essential that all responsibility for all aspects of safety education be clearly delineated." The primary responsibility for a program must be identified and individual responsibility and authority designated if functions are to be carried out successfully. Clearly stated policies and clarifications of duties govern safety activities and provide the operating rules and regulations from which a foundation of safety success may be built. All functions of the program must be precisely written. A safety program will be successful only to the degree that the persons for whom it is intended cooperate in giving it their support.

Although schools have recognized their moral and ethical responsibility for the safety and welfare of their students (and their employees, although less frequently), they have seldom established a system or program to execute that responsibility. This is probably because safety is barely mentioned in the graduate training programs for school administrators. And yet, safety is one of those things which begins at the top; it is an unavoidable management function and responsibility. Thus, the first thing that needs to be done in establishing a district-wide school safety program is a statement of policy by the board and superintendent setting forth management's safety philosophy.

School districts must meet at least six responsibilities in an adequate manner if a safety education program of high quality is to be included in the curriculum. They are:

1. The development of a statement of district policies and procedures for handling safety and safety instruction.
2. The selection of a person, trained in safety education, to become responsible for directing and supervising the program.
3. The keeping of adequate accident reports and the use of these reports in developing the course of study for safety education.
4. The development of an adequate plan for safety instruction.
5. The creation of a safe environment for adults and children while at school.
6. The provision of adequate insurance protection.

Roden (1963) eludes further to the specific responsibilities necessary for achieving safety objectives: "Good administration is required to ensure continuous realization of the possibilities of good organization" (p. 246). In carrying out the administrative aspects of the school safety program, the superintendent should:

1. Employ teachers with safety training and conduct inservice safety training for all school personnel to meet the needs of their job functions.
2. Provide for cooperative, democratic participation of all school employees and students in the conduct of safety instruction and activities. Define authority and responsibility of each person.

It is the responsibility of the teacher to develop the course of study used in the classroom. In this way, the teacher has the final decision in identifying course content, teaching methods, and evaluation procedures. Leonard (1953) points out that "Each generation of teachers has fashioned the curriculum upon the goals of society and their prevailing belief in the nature of learning" (p. 99). The teacher, as he identifies the needs of the students, must plan a course of study designed to fulfill the objectives established for the course.

Pfister (1972) expresses a belief that most every shop instructor feels his interest in safety is rather unique. He further states: "Not one educator I know intentionally trains students to make errors. Yet, accident studies show a degree of failure on behalf of teachers to develop attitudes and abilities that prevent students from making errors that lead to physical disability" (p. 58).

We must make people sufficiently concerned to take action. Safety must contribute to the activities of people in a positive manner--it cannot be properly taught negatively. Education is not a protective device--it must promote improvement and advancement beyond present conditions. The safe way is always the correct way, as safety does lend order to activities (Dawson, 1968).

People do not know how to avoid accidents. Properly planned programs can provide (1) ability, (2) knowledge, and (3) design, and the initiation of responses that will lead to socially accepted patterns of behavior for avoiding accidents.

The establishment of educational objectives is the most important part of planning. Tyler (1969) emphasizes the importance of these objectives when he states educational objectives are the criteria by which materials are selected, content is outlined, instructional procedures are developed and testing is designed.

In order to select the proper course content and teaching materials, one should understand the "process" involved in developing safe behavior, which is the ultimate goal of safety education. Safe behavior is the optimum performance of a progression of seven dynamic processes: (1) identification; (2) assessment; (3) decision; (4) performance; (5) evaluation; (6) modification; and (7) application. This list explains what happens when a person is developing self-reliance and safe behavior. First, he identifies the hazards inherent in a given activity. He must understand how these relate to himself, to others, and to the environment. Then he "assesses" the risks in terms of his own mental, physical, and emotional capabilities, and in relation to others and to the environment. He "decides" which actions he must take to perform safely and which actions will allow the maximum fulfillment of his goals. He is then ready to "perform" in the safest possible manner.

After performance he must "evaluate" his actions and their outcome. He may then "modify" them in accordance with safe behavioral principles and try to make them even more safe (Seder, 1973).

Summary

A "systems approach" is a successful tool in dealing with complex relationships; this approach facilitates: (1) problem identification and resolution; (2) setting of performance objectives; (3) application of logic and analysis techniques; (4) function and specification of product design; (5) the measurement of the product against performance objectives; (6) management and monitoring processes; and (7) man-machine integrations of solution. The same systems concept so successfully applied by industry to products is an efficient tool for the solving of vocational course development problems. As a result, a methodology for the analysis, design, development, management and evaluation of curriculum is at hand. Thus, the developer has a tool for determination of validity of objectives, content, sequence, method, product and achievement.

Viewing a problem as a system demands identification of problem parameters, properties and relationships. A subsystem supplies a necessary condition that all parts of a problem are functionally related. Intuition logically applied is a valuable tool as problems become increasingly complex. Experience patterns may be structured into systems approaches to produce models of broad flexibility and more completeness than those that a machine could produce.

Subsystem (1)

Safe living is the keystone by which survival is insured for the enjoyment of the technological advantages of the future. Safety needs for the protection of the individual have been identified through suffering and pain that man has been subjected to. Both industrial and natural disasters have served as focal points for development of safer living and working conditions.

Human behavior is the most often cause of accidents. Safety properly taught to and practiced by our youth produces beneficial "side effects" to society. The failure to take personal responsibility for safe behavior is a critical social problem of today.

Communications of the risks inherent in specific technologic advances must be screened and reported as fact to controlling agencies and the population as a whole. Our educational programs concerning safety need reevaluation and redesigning to enlist public support.

Subsystem (2)

Technological developments have introduced many hazards as well as the means to make man's life better. A symbolic model of industrial safety education can be utilized to describe the real world problems. Specialized system models can be utilized for applications to unique problems. A deterministic model dealing with only machine processes having specific input values results in predetermined output that represents the solution of the model. Man-machine integration as the central point in the systems development plan produces a greater capacity for solving industrial/social safety problems. Man-machine processes can produce synergistics results of achievement.

The processor concept, whether integrated into man's mind, programmed into machine memory, or utilized as a man-machine process is a valuable tool for industrial education problem solving. A large number of solutions would be unavailable without the benefit of man-machine systems. Specific safety problems of magnitude that cross interdisciplinary lines can only be solved by man-machine processes integrated through a systems approach.

Subsystem (3)

Research is the only avenue that we can pursue to find accident causes and workable solutions for safe living. Safety implementation begins at the "top," with a sound philosophical base. Elemental to safety program survival are policy statements, responsibility determinants, organization, coordination, management, monitoring, evaluation and process change. Management can use the systems approach for effective decision making. A comprehensive program is only as effective as its stated policies and goals. Lack of communication and cooperation are the greatest determinants of failure in program efficiency. Safety should no longer be fragmented and compartmentalized but combined in a system of effectiveness. Curriculum development must eliminate "don't" rules and proceed in positive behavior development terms of analytical safe living. Resolution of the various elements of a comprehensive industrial education safety system can identify safety answers before accidents occur instead of after the damage has been done.

III. RESEARCH METHOD AND DESIGN

Design of the Study

Selection of the size and the limits of the research were governed by several technical problems. The writer having experienced a perennial teaching frustration of unauthorized use of machinery, included a generalized assumption that was translated to objective #4. Having made this assumption along with the assumption of need, the objectives were then formulated. An analysis of the objectives indicated that a systems approach was necessary to achieve the stated objectives. The multi-disciplinary facet of the systems approach was a major technical problem.

It was necessary to first have a total perspective of industrial education safety problems that exist in Oregon. A comprehensive questionnaire was designed to accomplish this purpose (Appendix B).

Population Selection

This study involved administrators and instructors in 92 secondary school districts in the state of Oregon. All schools that were accredited through the Northwest Accrediting Agency were selected. The schools represented a cross-section of Oregon schools both in size and geographic distribution.

Socio-economic and ethnic breakdown were of no consequence to the study. The data collection and its computerization were utilized as a vehicle for the collection of baseline information critical to problem solving processes for industrial safety applications.

Returns and Tabulations

A return of 50 percent of the questionnaires formed the base from which information was tabulated. A computer printout provided summations for absolute frequency, relative frequency (percent), adjusted frequency (percent), and cumulative adjusted frequency (percent). Missing cases were reported in the tabulations. The mean and the mode, standard error and standard deviation, median and variance were computed. This statistical information was utilized to chronologically rank the needs in a priority listing for product development.

The ranked needs were organized into administrative, instructional and media needs, service needs, safety problem areas, in-service and pre-service needs.

The study was limited to a manageable structure by the arbitrary exclusion of lower limit values. These lower limit need items were not utilized as data in the determination of product applicability (Appendix C).

Subsystem (4)

Management Methodology

These problems, properly classified, set the direction for the research. This research direction led to a broad base research of the literature in four areas. The four disciplines, systems, management, processes, and programs, were integrated to solve industrial education safety problems.

The systems research was utilized as a basis for the employment of the management techniques necessary to achieve the product development. Product development to achieve operator recognition and machine control spanned the fields of digital design and electronics engineering. A need for a processor to accomplish these tasks brought in the consideration of both software and hardware developments in a micro size.

The writer conceptualized a design and wrote the functions for a processor as a controller in industrial safety applications. Since the development of the processor and the recognition/controller were beyond the technological expertise of the writer, the achievement of this objective was dependent upon the organization, management and direction of personnal and resources at his disposal. The writer formulated a total systems plan and utilized the plan to achieve all stated objectives.

A preliminary system approach was utilized in the decision making process for phasing into appropriate management activities.

Product Design

Two products had been conceptualized: (1) a processor with recognition/authorization capability as illustrated by function block diagram in Figure 6; and (2) a student individualized curriculum sub-system plan as illustrated in Figure 7. Both of the projected products were routed through a developmental analysis (Figure 8). A system integration utilizing research as a developmental vehicle was visualized to include man, processor and curriculum in an integrated product (Figure 9). The specifications and functions of the processor were generalized for visualization purposes. A standard student identification card (Figure 10) can be utilized as the recognition device in operating machines in the industrial shop. A selection of 16 position points on a card will result in approximately ten thousand possible use combinations of photoelectric cell and light source switching devices. It is necessary to replace the standard electric (push botton) control box that activates and stops the machine operation with a new controller.

The new controller will be housed in a similar electric box with a receiving slot for the student identification card as shown in Figure 11. The student will be issued a card upon certification or proof by

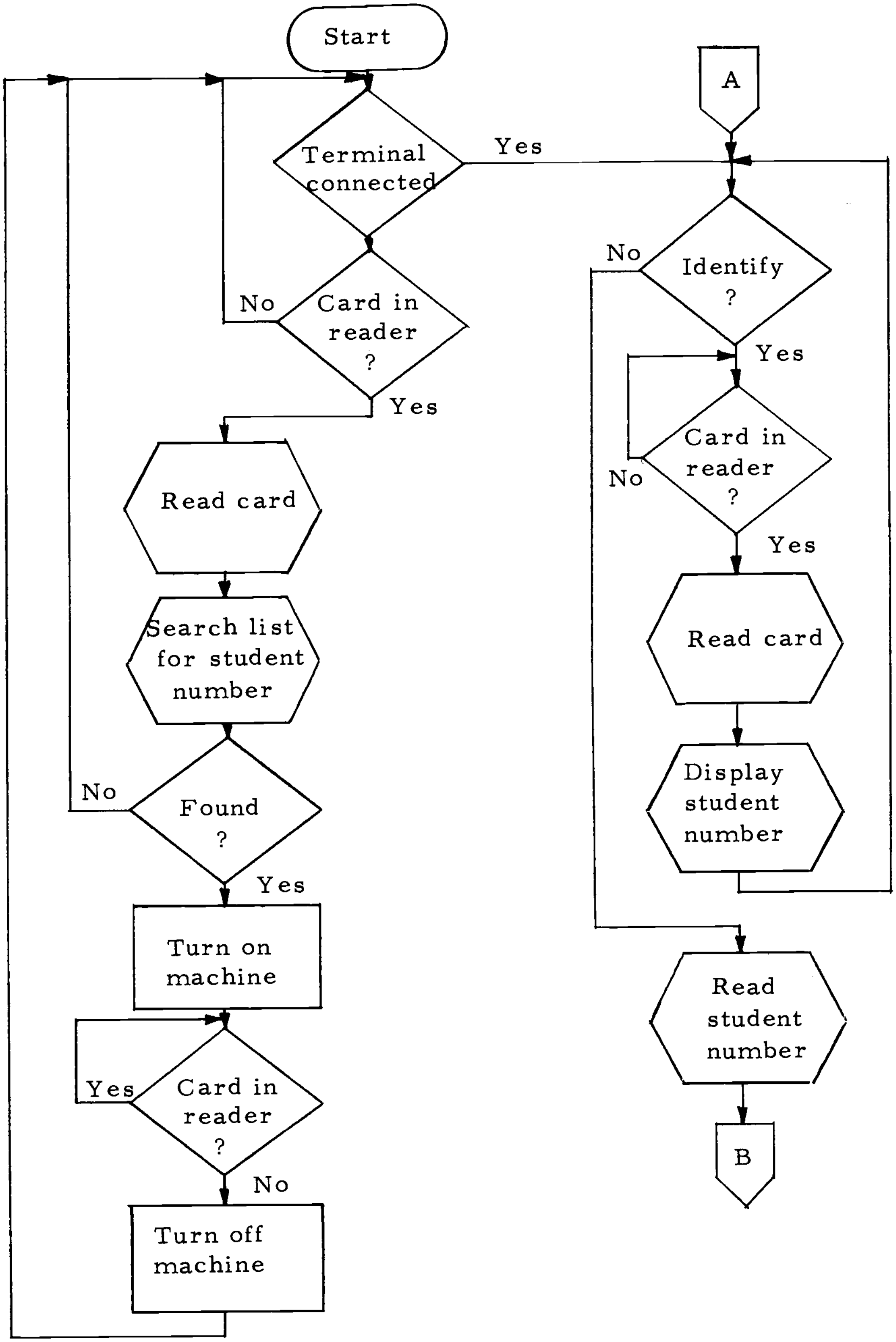

Figure 6. Man system component microprocessor functions.

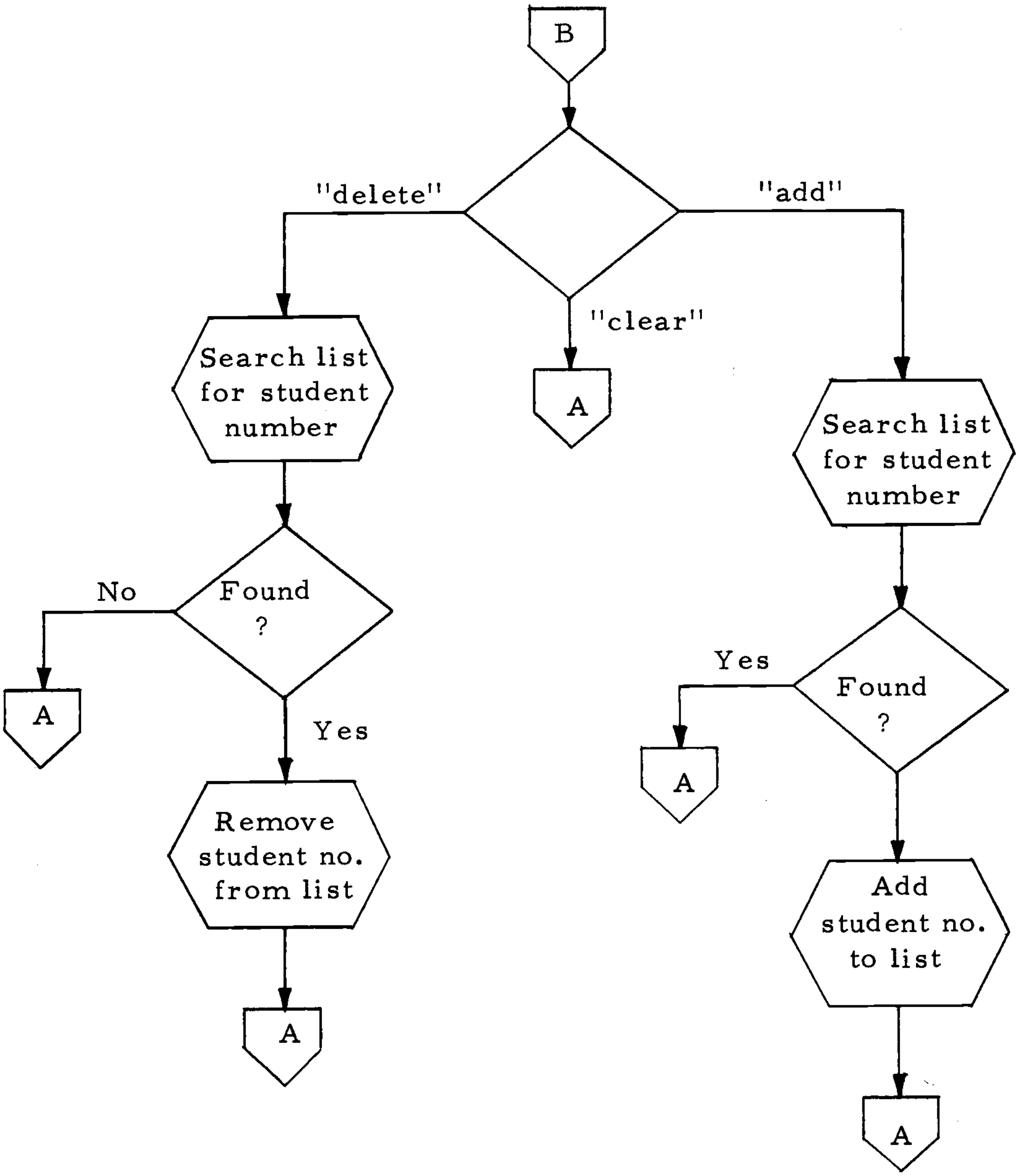

Figure 6. (Continued)

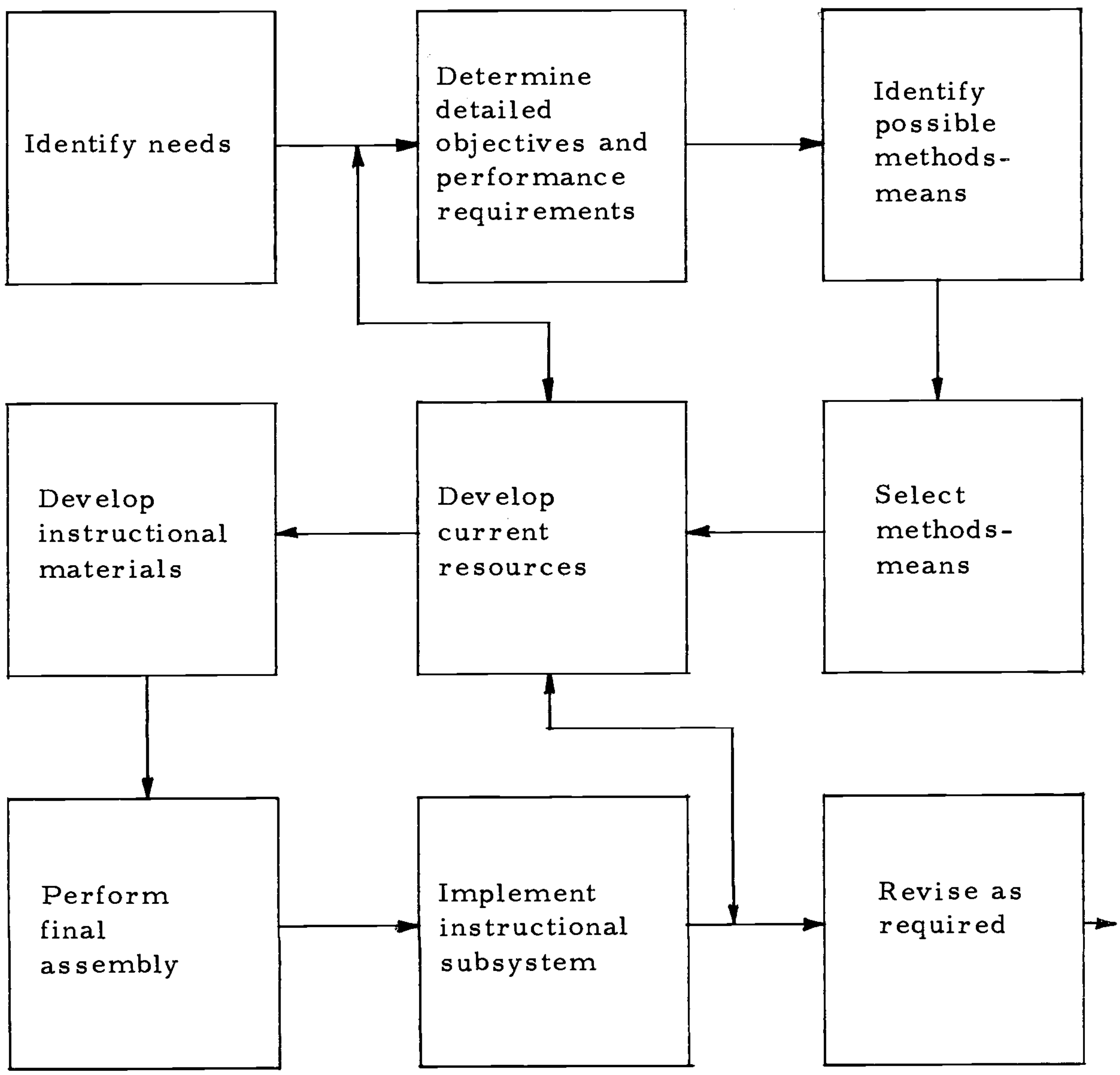

Figure 7. Man system component curriculum functions.

PROCESS		OUTCOME
Function Analysis Function allocation Mission analysis Contingency analysis	Requires data on system performance requirements and system functions needed to meet them	System functions allocated to systems personnel
Task Derivation Extraction of tasks from functions	Requires equipment information to the unit or subunit level	List of tasks to be performed by system personnel
Task Analysis Subtask derivation Error prediction Skill and knowledge identification	Requires equipment information detailed to components, parts etc., as provided by the final design specifications	List of subtasks and the physical and psychological requirements for performing them
		Fed into design of equipment and job aids, and development of the personnel subsystem

Figure 8. Developmental analysis.

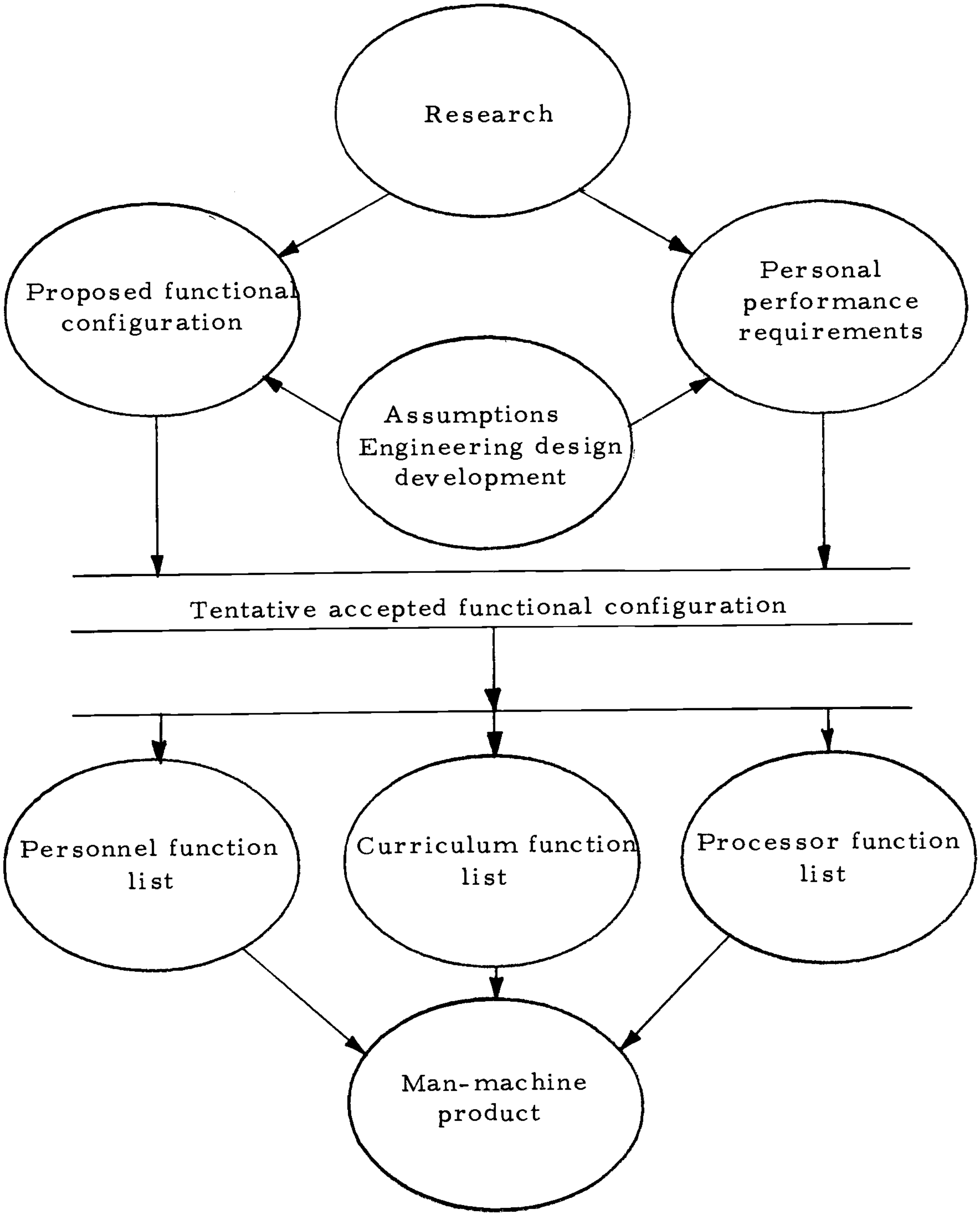

Figure 9. System integration.

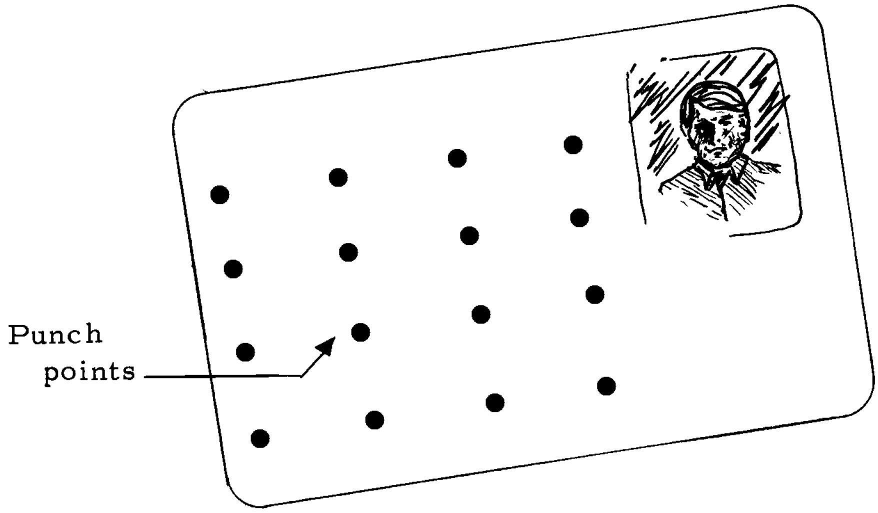

Figure 10. Student identification card.

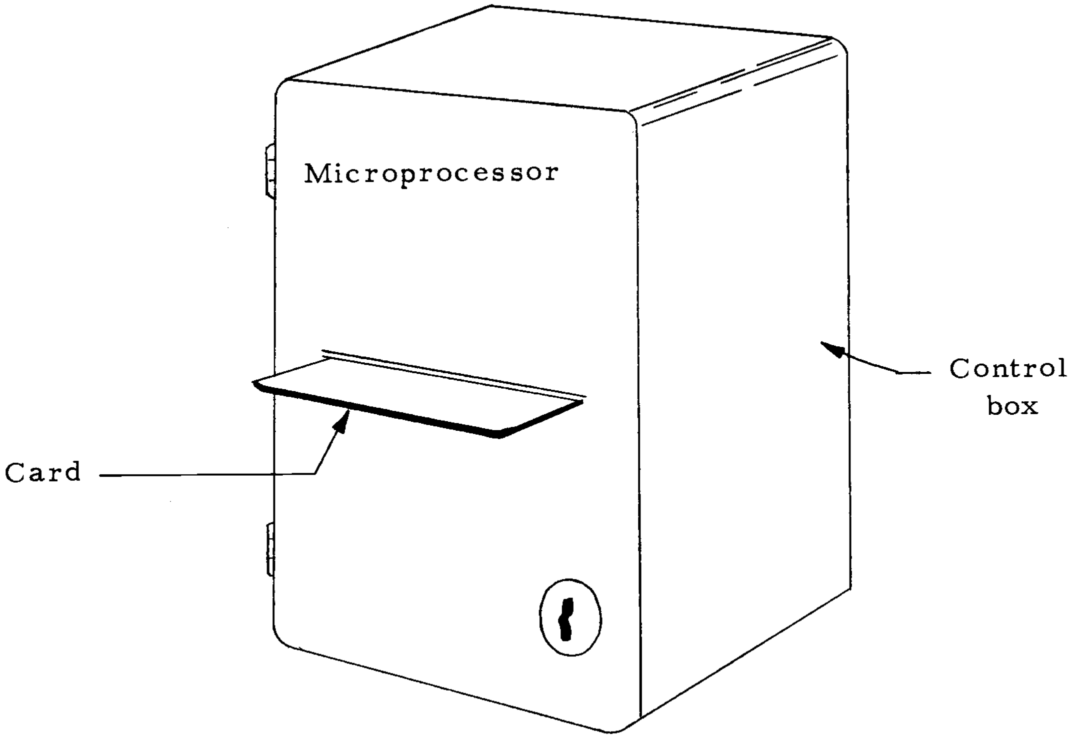

Figure 11. Machine controller housing.

the student (i.e., pretests-posttests, demonstrations, knowledge acquisition) of safe practices and procedures for the appropriate machine use. As an example, numbers 1, 3, 7 might be punched on the student card. Upon insertion into the control box the numerical control sequence would allow a light source to energize photoelectric cells 1, 3, 7 and thus communicate with a microprocessor. The microprocessor would have previously been encoded with an authorized student identification symbol. A match between student card symbols and encoded processor memory symbols would command the processor to activate the machine--removal of the card would cause machine shutdown.

As the student completes his individualized instruction for each machine and shows proof of safety competency, his number is programmed into the new processor.

The back of the student card would contain a list of numbers corresponding to the combinations of numbers on the punched card. This card would indicate what machines the student has a certified competency for safe operation. The same card might operate a like machine in a different location. Student "A" then enrolling in another class with a like machine would not have to be instructed a second time for the same machine. The student now has a calling card that can be used for the next class and eventually for industry.

Figure 12 shows the template holders for light sources and photoelectric cells. The card would fit between these templates. The same size template would be utilized in Figure 13 to house slip-in projections within the punch--to punch the numerical control for each student. A management system to facilitate design and specification was flow charted (Figure 14). Both products were integrated into a PERT chart (Figure 15A).

A system plan for the developmental sequence was reduced to a written format which included goal statements, objectives, events and activities to be accomplished (Figure 15B). An Oregon corporation was formed to facilitate the development of equipment and curriculum. Financial and personnel considerations precipitated this arrangement of expediency (see Appendix A). Personnel to develop the hardware and software subsystems were employed. Total subsystem (5) was implemented. A format for informal review was implemented to assess whether specified tasks were completed (Table 2).

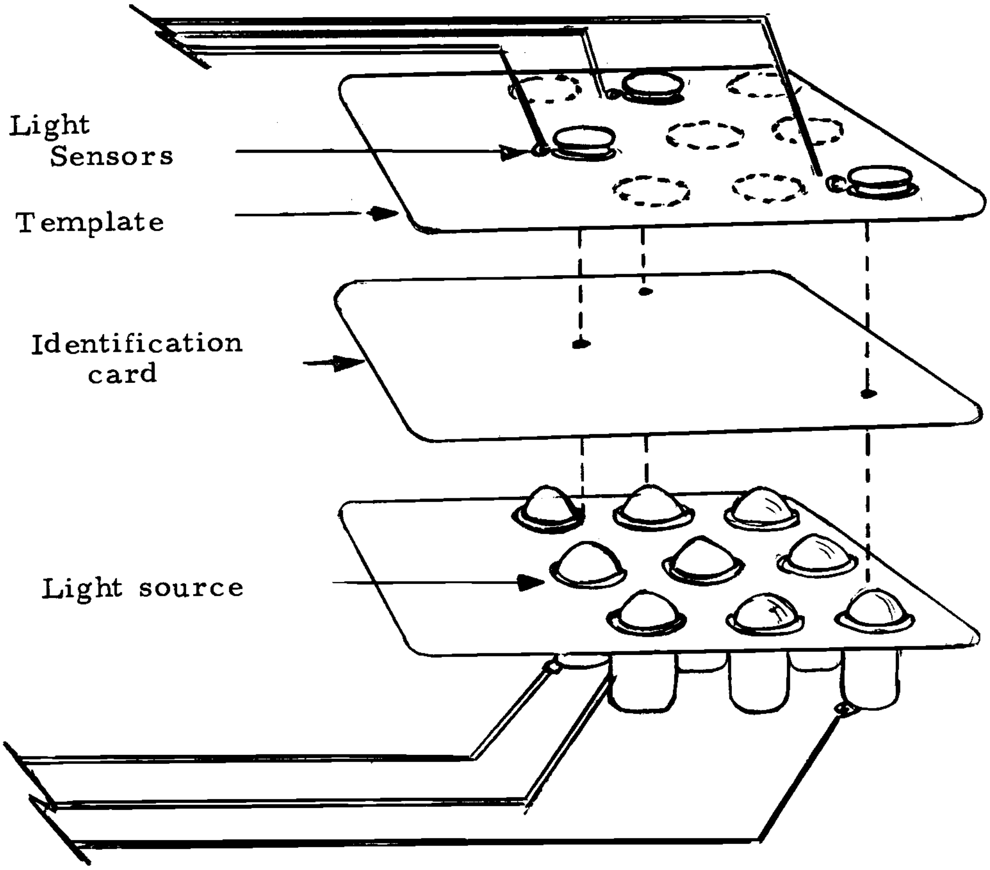

Figure 12. Photoelectric reader.

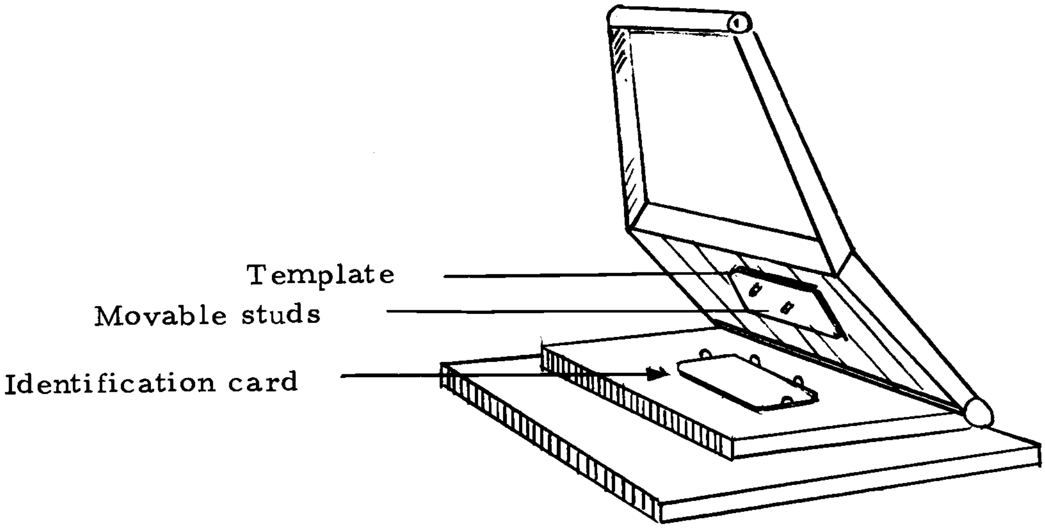

Figure 13. Card punch.

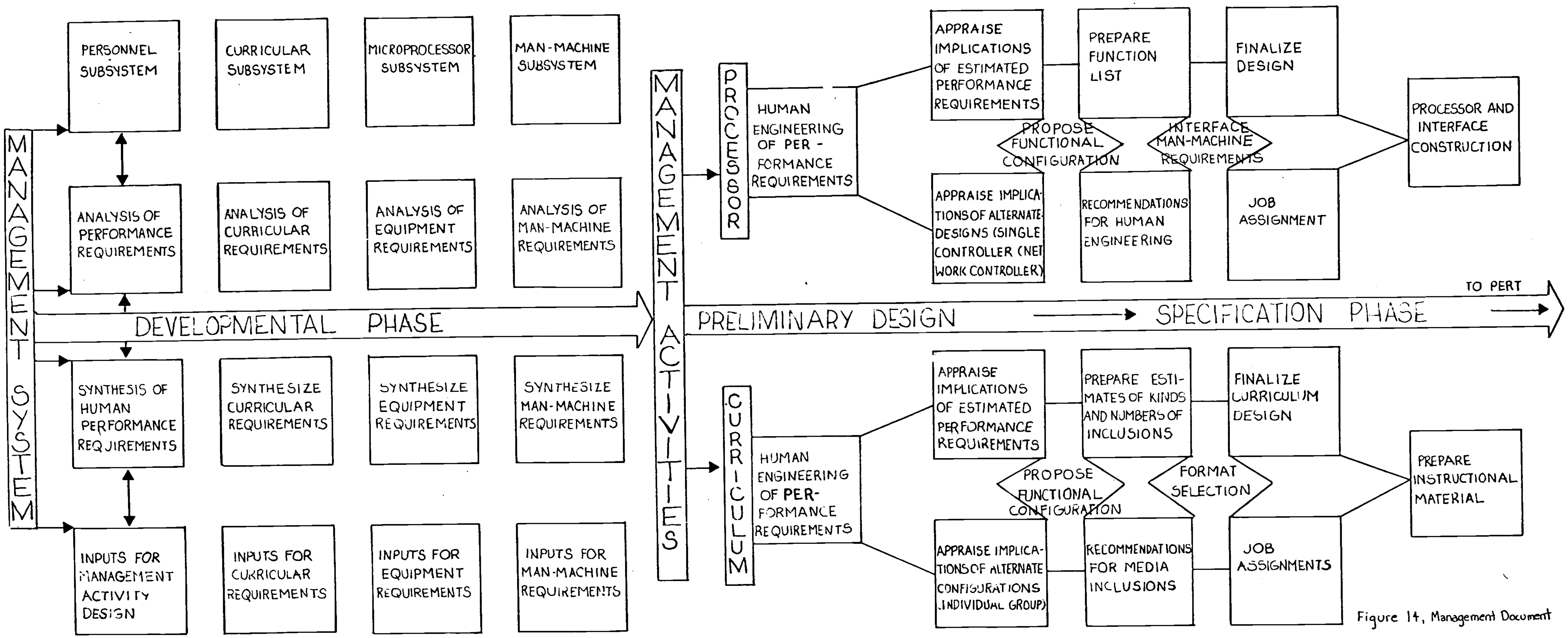

Figure 14, Management Document

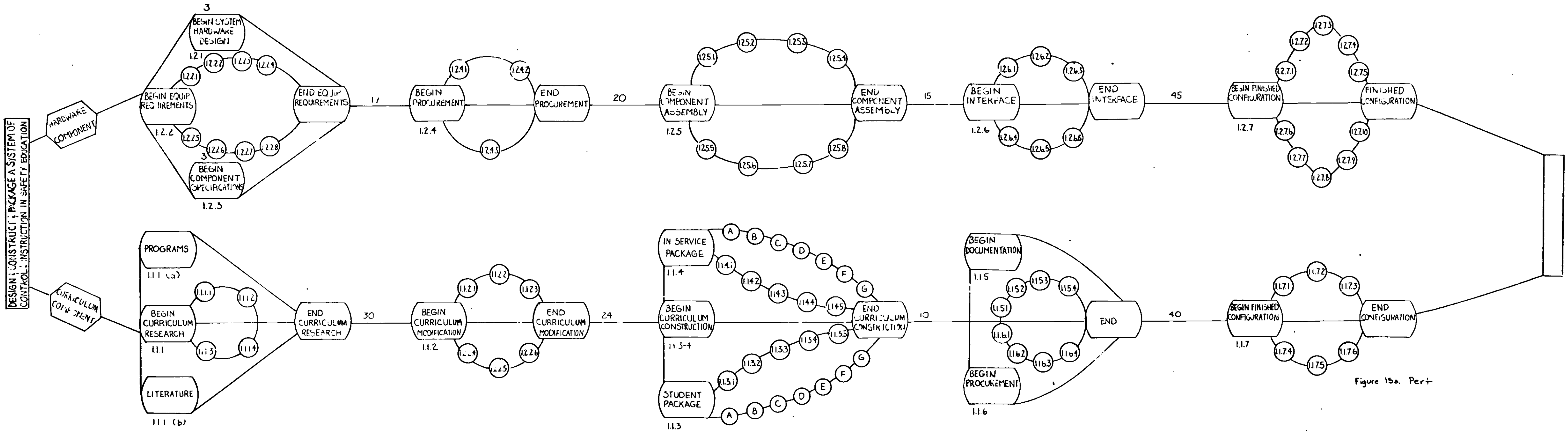

Figure 15a. Pert

Figure 15B. Systems plan.

Goal 1.0 To design, construct and package a system of control and instruction in Industrial Safety

Objective 1.1 To complete a student and a teacher instructional package designed for Industrial Safety

Event 1.1.1 Curriculum Research (a) programs (b) literature

Activities	Begin date	End date	Duration
1.1.1.1 Survey schools for safety instruction materials and standardized programs	October 22	December 30	
1.1.1.2 Survey business and industry for materials and programs			
1.1.1.3 Research literature OSU computer			
1.1.1.4 Limit selection of media, materials and programs to specialized application of safety			
Event 1.1.2 Curriculum Modification			
1.1.2.1 Synthesize curriculum			
1.1.2.2 Organize			
1.1.2.3 Edit			

(Continued on next page)

Figure 15B (Continued)

Event 1.1.2 (Continued)

Activities		Begin date	End date	Duration
1.1.2.4	Limit			
1.1.2.5	Refine			
1.1.2.6	Adapt		December 31	
				Total 44 days

Event 1.1.3 Curriculum Construction (student package)

1.1.3.1	Story board	January 3	January 17	6
1.1.3.2	Instructor objectives	January 17	January 20	2
1.1.3.3	Student directions	January 21	January 22	1
1.1.3.4	Instructional product	January 22	January 24	4
1.1.3.5	Peripheral materials (a) pretest, (b) posttest, (c) visuals, (d) audio, (e) student book, (f) operation card, (g) forms	January 25	February 28	11
				Total 24 working days

(Continued on next page)

Figure 15B (Continued)

Event 1.1.4 Curriculum Construction (teacher in-service)

Activities		Begin date	End date	Duration
1.1.4.1	Story board	January 3	January 17	Concurrent
1.1.4.2	Instructor objectives (methods)	January 17	January 20	
1.1.4.3	Instructor strategies	January 21	January 22	
1.1.4.4	Instructional product	January 22	January 24	
1.1.4.5	Peripheral materials (a) pretests, (b) posttests, (c) visuals, (d) audio, (e) resource list, (f) policy determinations, (g) record keeping, (h) house keeping	January 25	February 28	
				Total 24 days
Event 1.1.5	Curriculum procedures (documentation)			
1.1.5.1	Format			
1.1.5.2	Inventory	February 16	February 28	10 days
1.1.5.3	Delivery			
1.1.5.4	Development			

(Continued on next page)

Figure 15B (Continued)

Event 1.1.6 Procurement

Activities		Begin date	End date	Duration
1.1.6.1	Purchase (a) equipment, (b) audio, (c) visual, (d) materials	January 25	January 26	Concurrent
Event 1.1.7	Curriculum Support Package			
1.1.7.1	Write introduction	January 26	January 31	
1.1.7.2	Assemble materials	February 1	February 16	
1.1.7.3	Sequence	February 16	February 22	
1.1.7.4	Interface	February 22	April 30	
1.1.7.5	Revise	May 10	June 10	
1.1.7.6	Finalize	June 10	July 10	
				Total 40 days

(Continued on next page)

Figure 15B (Continued)

Goal 1.0 To design, construct and package a system of control and instruction in Industrial Safety

Objective 1.2 To complete a hardware-software machine control designed for Industrial Safety

Activities	Begin date	End date	Duration
Event 1.2.1 Write system hardward design package	October 25	November 3	5 days
Event 1.2.2 Critique of equipment availability and requirements	November 3	November 19	9 days
1.2.2.1 Microprocessor kit and accessories			
1.2.2.2 Interface materials logic circuit and power components			
1.2.2.3 Input requirements with readout components			
1.2.2.4 Reader card selection and design			
1.2.2.5 Card coding hardware			
1.2.2.6 Communication device			
1.2.2.7 Visual board display			
1.2.2.8 Packaging and housing			

(Continued on next page)

Figure 15B (Continued)

Activities	Begin date	End date	Duration
Event 1.2.3 Written component specifications			Total 14 days
Event 1.2.4 Begin procurement			
1.2.4.1 Ordering	November 30	December 23	
1.2.4.2 Cost effective control			
1.2.4.3 Inventory control			
			Total 19 days
Event 1.2.5 Hardware component assembly			
1.2.5.1 Microprocessor	January 1	January 31	
1.2.5.2 Interface mechanism			
1.2.5.3 Input and readout			
1.2.5.4 Reader card			
1.2.5.5 Card coding apparatus			
1.2.5.6 Communication device			

(Continued on next page)

Figure 15B (Continued)

Activities	Begin date	End date	Duration
1.2.5.7 Visual board display			
1.2.5.8 Packaging housing			
			Total 20 days
Event 1.2.6 Interface of systems			
1.2.6.1 Equipment	February 1	February 18	
1.2.6.2 Accessories	February 20	March 1	
1.2.6.3 Logic circuitry	March 2	March 22	
1.2.6.4 Power requirements	March 24	April 16	
1.2.6.5 Input-readout			
			Total 57 days
Event 1.2.7 Finished configuration			
1.2.7.1 Program unit	April 17	May 31	
1.2.7.2 Verify	June 1	June 10	
1.2.7.3 Revise			

(Continued on next page)

Figure 15B (Continued)

Event 1.2.7 (Continued)

Activities		Begin date	End date	Duration
1.2.7.4	Logic circuitry and power requirements			
1.2.7.5	Design			
1.2.7.6	Test-revise	June 11	June 30	
1.2.7.7	Housing and packaging			
1.2.7.8	Determine capabilities			
1.2.7.9	Write specifications and list applications			
1.2.7.10	Document process and compile-write literature	July 1	July 27	
				Total 45 days

Table 2. System design review checklist.

<u>General</u>

	Yes	No
1.0 System Operational Requirements		
1.1 Has the mission been defined?		
1.2 Have all basic system performance parameters been defined?		
1.3 Has the planned operational deployment been defined?		
1.4 Has the system life-cycle been defined?		
1.5 Have system utilization requirements been defined?		
1.6 Has the operational environment been defined in terms of temperature extremes, humidity, shock and vibration, storage, transportation, and handling?		
2.0 Effectiveness Factors		
2.1 Have system availability, dependability, readiness, or equivalent operational effectiveness factors been identified?		
2.2 Have quantitative reliability and maintainability factors been specified?		
3.0 Functional Analysis		
3.1 Have system operational and maintenance functions been defined?		
3.2 Have reliability and maintainability factors been allocated to the appropriate system elements?		
3.3 Have cost factors been allocated to the appropriate system elements?		
4.0 Logistic Support Analysis		
4.1 Have trade-off evaluations and analyses been accomplished to support all logistic support requirements?		

<u>Logistic Support Elements</u>

	Yes	No
1.0 Test and Support Equipment		
1.1 Have the test and support equipment requirements been defined for each echelon?		

(Continued on next page)

Table 2. (Continued)

	Yes	No
1.0 (continued)		
1.2 Have standard test and support equipment items been selected?		
1.3 Are the selected test and support equipment items compatible with the prime equipment?		
1.4 Have test and support equipment requirements (both in terms of variety and quantity) been minimized to the greatest extent possible?		
1.5 Have logistic support requirements for the selected test and support equipment been defined? This includes maintenance tasks, test equipment, spare/repair parts, personnel and training, data, and facilities.		
1.6 Is the test and support equipment selection process based on cost-effectiveness considerations?		
2.0 Supply Support (spare/repair parts)		
2.1 Are spare/repair part provisioning factors consistent with the Logistic Support Analysis?		
2.2 Are spare/repair part provisioning factors directly traceable to reliability and maintainability predictions?		
2.3 Are the specified logistics pipeline times compatible with effective supply support?		
2.4 Have spare/repair parts been identified and provisioned for preoperational support activities?		
2.5 Have spare/repair part requirements been minimized to the maximum extent possible?		
2.6 Have test and acceptance procedures been developed for spare/repair parts? Spare/repair parts should be processed, produced, and accepted on a similar basis with their equivalent components in the prime equipment.		
2.7 Have the consequences (risks) of stockout been defined in terms of effect on mission requirements and cost?		
2.8 Has an inventory safety stock level been defined?		

(Continued on next page)

Table 2. (Continued)

	Yes	No
2.0 (continued)		
2.9 Has a provisioning or procurement cycle been defined (procurement or order frequency)?		
2.10 Has a supply availability requirement been established (the probability of having a spare available when required)?		
3.0 Personnel and Training		
3.1 Have operational and maintenance personnel requirements (quantity and skill levels) been defined?		
3.2 Are operational and maintenance personnel requirements minimized to the greatest extent possible?		
3.3 Are the planned personnel skill levels at each location compatible with the complexity of the operational and maintenance tasks specified?		
Design Features		
1.0 Selection of Parts		
1.1 Have appropriate standards been consulted for the selection of components?		
1.2 Have all component parts and materials selected for the design been adequately evaluated prior to their procurement and application?		
1.3 Have supplier sources for component part procurement been established?		
1.4 Are the established supplier sources reliable in terms of quality level, ability to deliver on time, and willingness to accept part warranty provisions?		
2.0 Standardization		
2.1 Are standard equipment items and parts incorporated in the design to the maximum extent possible (except for items not compatible with effectiveness factors)?		

(Continued on next page)

Table 2. (Continued)

	Yes	No
2.0 (continued)		
2.2 Are the number of different part types used throughout the design minimized?		
2.3 Are equipment control panel positions and layouts (from panel to panel) the same or similar when a number of panels are incorporated and provide comparable functions?		
3.0 Test Provisions		
3.1 Have self-test provisions been incorporated where appropriate?		
3.2 Are self-test provisions automatic?		
3.3 Have direct fault indicators been provided (either a fault light, an audio signal, or a means of determining that a malfunction positively exists)? Are continuous performance monitoring provisions incorporated where appropriate?		
3.4 Are test points accessible?		
3.5 Are test points functionally and conveniently grouped to allow for sequential testing (following a signal flow), testing of similar functions, or frequency of use when access is limited?		
3.6 Are test points provided for a direct test of all replaceable items?		
4.0 Packaging and Mounting		
4.1 Is functional packaging incorporated to the maximum extent possible?		
4.2 Are disposable modules incorporated to the maximum extent practical?		
4.3 Are plug-in modules and components utilized to the maximum extent possible?		
4.4 Are accesses between modules adequate to allow for hand grasping?		
4.5 Are modules and components mounted such that the removal of any single item for maintenance will not require the removal of other items?		

(Continued on next page)

Table 2. (Continued)

4.0 (continued)	Yes	No
4.6 Are shock mounting provisions incorporated where shock and vibration requirements are excessive?		
4.7 Are provisions incorporated to preclude installation of the wrong module?		
4.8 Are plug-in modules and components removable without the use of tools?		
4.9 Are guides (slides or pins) provided to facilitate module installation?		
4.10 Are modules and components labeled?		
5.0 Panel Displays and Controls		
5.1 Are controls standardized?		
5.2 Have the proper control/display relationships been incorporated?		
5.3 Is the control panel lighting adequate?		
5.4 Are the controls placed according to frequency of use?		
6.0 Cables and Connectors		
6.1 Are cables fabricated in removable sections?		
6.2 Is cable labeling adequate?		
6.3 Are connectors of the quick-disconnect variety?		
6.4 Are connectors standardized?		
7.0 Environment		
7.1 Has the equipment design considered the following: temperature; shock; vibration; humidity; pressure; wind, and dust? Have the ranges and extreme conditions been specified and properly addressed in design?		
7.2 Have provisions been made to specify and control noise, illumination, humidity, and temperature in areas where personnel are required to perform operating and maintenance functions?		

(Continued on next page)

Table 2. (Continued)

	Yes	No
8.0 Producibility		
8.1 Has the design stabilized (minimum change)?		
8.2 Has the design been verified through prototype and qualification testing?		
8.3 Is the design such that many models of the same item can be produced with identical results?		
8.4 Are the production drawings and material lists adequate?		
8.5 Are common materials used (in lieu of special materials)?		
8.6 Can standard tooling and existing facilities be used for fabrication, assembly, and test operations?		
8.7 Is the design such that rework requirements are minimized? Are spoilage factors held to a minimum?		
8.8 Are standard fabrication, assembly, test, and inspection procedures applicable?		
8.9 Is the design such that automated manufacturing processes (e.g., numerical control techniques) can be applied for repetitive functions?		
8.10 Is the design definition such that two or more suppliers can produce the equipment from a set of drawings with identical results?		
9.0 Safety		
9.1 Have fail-safe provisions been incorporated in the design?		
9.2 Have protruding devices been eliminated or are they suitable protected?		
9.3 Have provisions been incorporated for protection against high voltages? Are all external metal parts adequately grounded?		
9.4 Are sharp metal edges, access openings, and corners protected with rubber, fillets, fiber, or plastic coating?		
9.5 Are standoffs or handles provided to protect equipment from damage during the performance of bench maintenance?		

(Continued on next page)

Table 2. (Continued)

10.0 Reliability	Yes	No
10.1 Has the system/equipment wearout period been defined?		
10.2 Have failure modes and effects been identified?		
10.3 Are item failure rates known?		
10.4 Has mean life been determined?		
10.5 Has equipment design complexity been minimized?		
10.6 Has the use of adjustable components been minimized?		

IV. PRESENTATION AND ANALYSIS OF DATA

Subsystem (5)

Instrument Design

The questionnaire contained a general data section that addressed size of schools, instructional and student population of industrial education/vocational education. Each section within the questionnaire contained some questions that were repeated. This technique was utilized throughout to cross-check the internal consistency of the question as it appeared in a different frame of reference. A cross-check of these questions indicated a high degree of congruence. The second part of the data section dealt with specifics in program organization: student responsibilities, course offerings, time spent in safety instruction, hazardous machines, degree of compliance with Oregon safety regulations and the Occupational Safety and Health Act. The district was then asked to rate and describe their program effectiveness.

A Likert-type rating scale with a range from 1 to 5 was utilized to identify problems in industrial education safety. Mean scores were recorded and utilized to rank the items. Items in this section were further subdivided into groups for (1) product development, and (2) instructional support materials. All items except the classification "other" were included in the problem solving system.

The next section of the questionnaire consisted in each case of a two-part question; one of factual nature--Do you have, require, issue, etc?--and the second part of the question--Is there a service need--addressed both product and program development. This section was designed to not only identify specific items but also to determine if the district had the expertise to solve that problem. A "yes" answer in the service need column would indicate a need for "outside" assistance. It was interesting to note that there was a consistent and large percentage drop in respondent participation between the first and second part of the question. This indicated either not knowing, indecision, or a hesitancy to indicate a service need because of some future outcome of the questionnaire.

Two lists were compiled from this section; one list of the part 1 questions and one list of the part 2 questions. These listed items were ranked and cross-checked for priority inclusion in the system plan.

The last section of the questionnaire approached pre-service and in-service needs of a generalized nature. Location, credit, and subject area were included as a part of each question. These responses were arranged by highest to lowest cumulative percent.

Respondent Population

The letter that accompanied the questionnaire was directed personally to the superintendent of the school district. The respondent population was determined, after evaluation of who could best supply the information, by the superintendent. Ninety-two schools returned the questionnaire. Forty-nine schools identified themselves (Figure 16). Forty-three schools chose to remain anonymous. The

Figure 16. Geographical location of schools responding to the safety survey.[a]

1. McLoughlin Jr. High, Milwaukie
2. Robert Sabin, Molalla
3. Seaside
4. Molalla
5. McMinnville High School
6. Springfield
7. Ashland
8. Astoria or vicinity
9. LaGrande
10. Salem
11. Eugene
12. Rockaway
13. Sherwood vicinity
14. Seaside - Smith
15. Pendleton
16. Klamath Falls
17. Tigard
18. Lake Oswego
19. Independence
20. Estacada
21. Phoenix
22. Lincoln High, Portland
23. Amity
24. Alsea
25. Forest Grove
26. David Douglas, Portland
27. Turner
28. Madison, Portland
29. Glide
30. Colton
31. Astoria
32. Portland, Columbia Blvd. Warner
33. Prineville
34. Clackamas High, Milwaukie
35. Grant High
36. Oregon City
37. Milwaukie, Harmony Rd.
38. Milwaukie, 23rd Ave.
39. North Bend
40. Rainier
41. Mill City, Santiam High
42. Junction City High
43. Newport
44. Glendale
45. West Linn
46. Benson, Portland
47. Gardiner Jr. High, Oregon City
48. Newburg
49. Lowell High

[a]Map showing geographical location may be found on following page.


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Figure 16

largest percentage of respondents were superintendents. There was a mixture of principals, assistant principals, career coordinators, and industrial education instructors that comprised the remainder of the respondents. Table 3 indicates the distribution of schools and instructional staff.

Table 3. Distribution of schools and instructional staff.

School size		Instructional staff	
0-99	= 0	0-2	= 21
100-199	= 0	3-5	= 30
200-399	= 12	6-9	= 14
400-599	= 15	10-16	= 14
600-999	= 15	17-24	= 5
1000-1499	= 25	25+	= 7
1500-1999	= 7	Missing	1
2000+	= 11		
Total	92		92

Description of Basic Findings

There were many surprises that came to light as a result of the questionnaire. The exclusion of some safety tools from a safety program not only weakens the program but could, in fact, become a critical point in a negligence suit. Some of these "critical" exclusions are shown in Table 4.

A critique of a few of these "critical" elements portrays some revealing weaknesses in the "state" of safety organization in Oregon. In comparing the 81.9 percent (1) of those who do not have a written program policy (Table 4) with those that perceive a need for service

Table 4. Critical safety exclusions.

	Percent	Do not have questions	Percent	Need questions
(1)	81.9	Do not have an organized and written safety education program policy and procedure that has been endorsed and accepted by the school board.	61.0	Indicate a service need for an organized and written safety education program policy and procedure endorsed by the school board.
(2)	61.4	Do not have a written policy concerning immediate correction for unsafe conduct.	38.6	Indicate a service need for a written policy concerning immediate correction for unsafe conduct.
(3)	65.5	Do not have a systematic and standardized procedure for instructing all VE and EI students in the safe operation and maintenance of all machines.	46.3	Indicate a service need for a systematic and standardized procedure for instructing all VE and IE students in the safe operation and maintenance of all machines.
(4)	78.0	Indicate that each instructor teaches safety in his own way, securing his own media.	44.9	Indicate a service need for having all instructors utilize the same safety curriculum materials for instructional purposes.
(5)	71.9	Do not utilize parent permission slips.	20.0	Indicate a service need to utilize parent permission slips.
(6)	88.6	Do not use a diagnostic questionnaire for determining student handicaps that could precipitate accidents.	50.0	Indicate a service need for diagnostic questionnaires for determining student handicaps that could precipitate accidents.

(Continued on next page)

Table 4. (Continued)

	Percent	Do not have questions	Percent	Need questions
(7)	64.4	Do not have written rules for student behavior in times of emergency.	53.7	Indicate a service need for written rules for student behavior in times of emergency.
(8)	80.7	Do not have an adopted, student safety rulebook.	61.0	Indicate a service need for a student safety rulebook.
(9)	60.7	Do not use a combined acknowledgement of safety instruction and safety pledge for each student as they reach safety competence.	39.2	Indicate a service need for utilizing a combined acknowledgement of safety instruction and safety pledge for each student as they reach safety competence.
(10)	89.9	Do not issue machine operator cards to safety-competent students.	30.8	Indicate a service need to issue machine operator cards to safety-competent students.
(11)	27.3	Do not use industrial injury reports.	28.2	Indicate a service need for utilizing industrial injury reports.

in achieving that state of organization, I think we could safely say that at least 61.0 percent are asking for help! Of course, this leaves only 18.1 percent having a written program of this extent.

A comparison of (3) pertaining to standardized procedures for instruction reveals essentially the same parallel between "Do not have" and "service need." This pattern of the organizational state of safety in Oregon is consistent throughout. Looking at (11) we find that only 27.3 percent of the respondent districts do not use industrial injury reports, however 28.2 percent are indicating service need. All of those that do not use them need help and even a few who do use them need help!

The selection of needs by percent was further categorized for use in the system plan (Table 5).

A common saying is, "get the right tool for the right job," and also "a craftsman is only as good as his tools." Many industrial educators are saying that the tool chest is sadly in need of being developed.

Problem Areas

Intensity problems was rated on a Likert-type scale (Table 6). Those that were conducive to product development were categorized by grouping. Limitations of the study dictated that some of these problems could not be a part of the system plan.

Table 5. Safety education tools.

Percent	
	a. Teacher tools
57.1	Is there a need for adequate written rules and regulations to guide safe student conduct?
62.0	Is there a need for each instructor having an adequate shop safety checklist?
49.0	Is there a need for general safety rules to be posted?
	b. Instructional tools
57.1	Is there a service need for pre/post tests?
65.5	Is there a need for slides and tapes for each hazardous machine?
43.7	Is there a service need for individual packets?
48.6	Is there a need for video tapes?
48.6	Is there a need for film strips?
	c. Visual tools
40.0	Is there a need to keep an accident-free, visual time chart?
49.3	Is there a need for charts?
56.6	Is there a need for safety slogans?
22.8	Is there a need to issue ID cards to students?
45.0	Is there a need for written safety rules for each hazardous machine?
	d. Activity tools
30.6	Is there a need for contests?
48.7	Is there a need for awards?
19.4	Is there a need for assemblies?
42.0	Is there a need for speakers?
40.5	Is there a need for field trips?

Table 6. Intensity of problem.

Mean	Group 1
2.747	Media development
2.663	Standardized instructor materials
2.337	Unauthorized use of machinery
	Group II
2.667	Machine maintenance
2.557	Safety identification zoned
2.420	Record keeping
2.393	Organizational control

Pre-service and In-service Education

Respondents indicated that workshops were needed in safety education (50.1 percent). Only one item (1), tours of innovative programs, was selected as a pre-service need. Table 7 ranks in-service needs in credit and non-credit categories.

Table 7. In-service needs.

	Percent	Credit
1.	47.8	Oregon administrative rules
2.	35.9	Program development
3.	34.8	Program writing
4.	25.2	Needs assessment
5.	23.9	Curriculum development
		Non-credit
1.	49.0	Occupational Safety Health Act
2.	34.8	Safety inspections
3.	33.0	Swap meets
4.	31.5	Consulting
5.	28.3	Conference
6.	23.9	Record keeping

The in-service and pre-service data served not only as a base for meeting objective number 7 stipulations but also as a base for visualizing implications for development of safety education in the state of Oregon.

Summary of Outcomes

The first objective called for a research instrument capable of measuring the needs for instructional development. The management system development concept, process and products have been documented in detail. Consideration was given to the fact that a system is a nucleus of elements structured to accomplish a function designed to satisfy identified needs. The questionnaire, then, was so designed to generate data for utilization in a systems approach.

Five outcomes were delineated in the letter of explanation to administrators explaining the purpose of the questionnaire (Appendix B). The first outcome proposed to assess the degree of formalization/ standardization of safety in the instructional shop. Service needs were prioritized then classified as to (A) administrator needs, (T) teacher needs, and (S) student needs.

A major administration concern was for the lack of a written safety education policy and procedure. Two other policy concerns were expressed as needs: a policy for immediate correction of unsafe conduct and a policy for standards of student supervision. A direct question on systematic and standardized instructional process as a need brought a 46.3 percent respondent affirmation. Fifty percent responded to the need for diagnostic questionnaires for determining student handicaps, a district, having reported needs in these four instances, certainly needs program development in industrial safety education.

In prioritizing teacher needs, three items scored in the mid 40 percent range. These were a need for: (1) written safety rules for each machine; (2) utilization by all instructors of standardized safety materials; and (3) individualized instructional packages. Other priority teacher needs centered around media and support activities for the instructional process.

Identified student needs were confined to a safety handbook and machine operator cards.

Outcome number 2 specified an intent to locate, identify and collect materials of value for improving safety instruction in other districts.

Six districts responded for requests for such materials if they were indeed located. Only two districts, however, volunteered materials that others might use. Of these, Springfield public schools has a well-written and organized set of rules and tests for industrial education.

Either schools do not want to share their curriculum developments in safety, or there is a great need in the state of Oregon for such development.

A section of the questionnaire was designed to identify methods and delivery of safety instruction. As a bit of background for this question, only 10 schools reported an individualized program, four indicated innovative programs, nine indicated standardized instructional processes, 16 indicated compliance with OSHA and Oregon rules and regulations (16 of 92). Fifteen schools ruled themselves excellent and had written programs. Fourteen would not share their materials.

Instructor lecture was utilized as the means of imparting safety to students by 98.9 percent of the respondents, demonstrations by 100 percent, handouts by 88.9 percent, textbooks by 71.9 percent, posters 86 percent, signs 83 percent, discussion 90 percent. Eighty-nine percent of the instructors report teaching in their own way, securing their own media. Only two percent of the instructional methods include plays and eight percent include essays while another 35 percent indicate they utilize safety awards. The "other" category reported zero percent.

The writer found no unique and innovative methods. In fact, safety education instruction tends to be somewhat apathetic toward anything out of the ordinary.

Outcome 4, to determine service and education needs of Local Education Agencies, is of major importance. A great majority of the respondents clearly identified needs in program and organizational development, in media and other teaching tools, as well as a variety of workshops dealing with OSHA and OAR regulations, needs assessments, record keeping, program and curriculum writing.

Outcome number 5, new product development, centered around media, curriculum, machine controls and brakes, unauthorized use of machines, organizational control and method of standardization of materials. These represent critical needs to be addressed for the full functioning of any "operational" industrial safety program.

V. CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

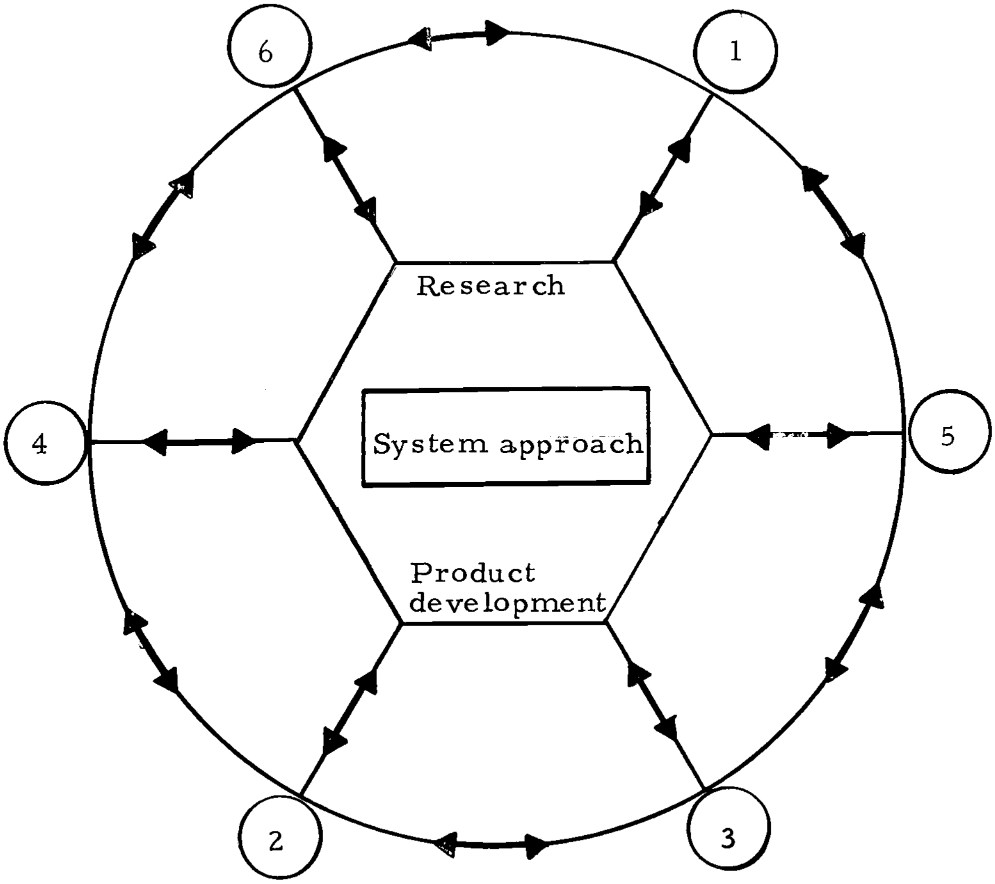
Conclusions

The purpose of the study was to demonstrate the effectiveness of a system approach, so designed, to reduce instructional needs by the application of research to the conceptualization and development of a final product.

The objectives of the study have been met and final products have been designed for the stated purposes. A management process was documented as a means of replicating the study. The interrelationships of the system approach are graphically illustrated in Figure 17.

As a result of the study some conclusions may be drawn:

1. Research is the only process by which safety needs can be effectively identified.
2. A systems approach is an effective tool in the identification and resolution of broad base needs.
3. A systems approach provides a baseline data format from which global information may be visualized to better facilitate decision making.
4. A systems approach for conceptualization to disposition of identifiable needs is demonstratable in product applicability.



Subsystem
(1) Related literature
(2) Processor and interface
(3) Curriculum and program structure
(4) Management methodology
(5) Man-machine integration
(6) Questionnaire

Figure 17. System cycle.

5. A product so designed, through a systems approach, may be improved, and evaluated in terms of its functions.

Implications

Certain implications concerning the "station" of safety education in the school setting may be inferred.

1. A safety education delivery model is an essential tool for program development at the school district level.
2. Safety implementation begins at the "top."
3. Safety legislation is ineffective without proper interpretation, budgeting, process identification and monitoring.
4. School personnel do not know the requirements of recent legislation.
5. Safety is an internal problem that can only be solved by cooperation of the entire personnel of an organization.
6. School districts lag behind industry in their development of safety managerial techniques.
7. Schools do not know the "what" or "how" of safety program development nor do they have trained personnel for such processes.
8. Prescriptive techniques of safety program development and implementation are, at best, in the embryonic stage.

9. Safety implementation is a process of changing human behavioral patterns and attitudes.
10. Accidents are caused by faulty human behavior.
11. Safety is imparted in a negative context of "don't" rules.
12. Accident reporting procedures for statewise accumulation are nonexistent.
13. In-service needs of industrial education instructors in safety education are not being met.

Recommendations

There are certain essentials that a functioning delivery model for industrial safety education should contain. Among these essentials are:

1. An organized and written safety education policy and procedure endorsed by the school board. This policy and procedure should contain, at the least, written policy statements concerning: philosophical foundations; administrative and staff responsibility; commitment for budget; provision for semi-annual reports; inspection procedures and times; current updating of staff and programs; standards of student supervision; rules and regulations for safe student conduct; correction for unsafe conduct; correction for unsafe hazards; rules for staff and students for emergency situations; general safety rules (to be posted);

student handbook of safety; diagnostic questionnaires for determining handicaps; and update of facilities and equipment.

2. Administrative and teaching personnel should consider these items as necessary inclusions in a district safety program: the development and adoption of a school safety model of operation; safety organization and control; student and staff safety management teams; product development or adaptation for safety purposes; evaluation and revision procedures of safety program; instructor exchange with industry for safety purposes; provision for budgets, for audio-visual support, published materials and in-service education; systematizing and standardizing instructional procedures; provision for teaching flexibility in the form of exhibits, plays, assemblies, field trips, banquets and awards; pretests and posttests, individualized instructional materials; method of certification for safety competent students and staff; forms for accident reporting, acknowledgement of safety instruction and pledge; parent permission slips; provision for safety signs, slogans, accident free visual time charts, safety bulletin board; adequate shop safety checklists; sufficient instructions and directions for the safe use of each hazardous machine, machine operator cards; and machine maintenance.

An instrument to compare current state school standard policy to safety practice in industrial education laboratories has been written by Havery, Little, Warren and Fessant (1977). This instrument should be a valuable aid in program evaluation or development (Appendix G).

Discussion

The methodology of a systems approach is available to anyone who wishes to use it. There is nothing mysterious about its properties and its objectivity reflects its purposes. In its simplest form the systems approach is a process designed to increase the efficiency of problem solving. The systems approach dictates that the investigator abide by three simple elements:

1. View the problem from a holistic focus; in that sense of visualizing the stream of determinants impinging upon it.
2. Pursue the problem in an eclectic and analytical dimension from both quantitative and qualitative method while treating theory and practice in the same frame of reference.
3. Search the "universe," generate broad significant analogies but isolate the elements. Certain concepts and methods can be applied, without alteration, in diverse areas of industry, business, science, engineering, humanities and the arts thus introducing links between disciplines, concepts, ideas, principles and models.

Figure 18 illustrates a matrix that models six essential safety conditions that must be considered in the development of any safety curriculum.

These explorations and developments need to be continued with precise techniques and specialized systems of the several intellectual disciplines to better bring technology and education into a harmonious relationship for man's continued safe welfare. Our society, at the worst, will be irresponsible, and at the least, inefficient, if it neglects the conceptual armament that is available to prepare man for his protection against the onrushing future. An established systems approach to quantify scientific-legal processes, adaptable to a variety of decisional situations, and designed to safeguard man explicitly from the harms of natural and technological disasters while achieving major social and industrial change, calls for absolute formulation.

Pervading these considerations is the perennial change of attitudes that segments of the society hold toward each other. We must hope that an appreciation of the capabilities of science and technology will be instilled in our youth. And that through education these youth in a display of diverse leadership may come together, be temperate, imaginative and effective in solving society's future safeliving problems.

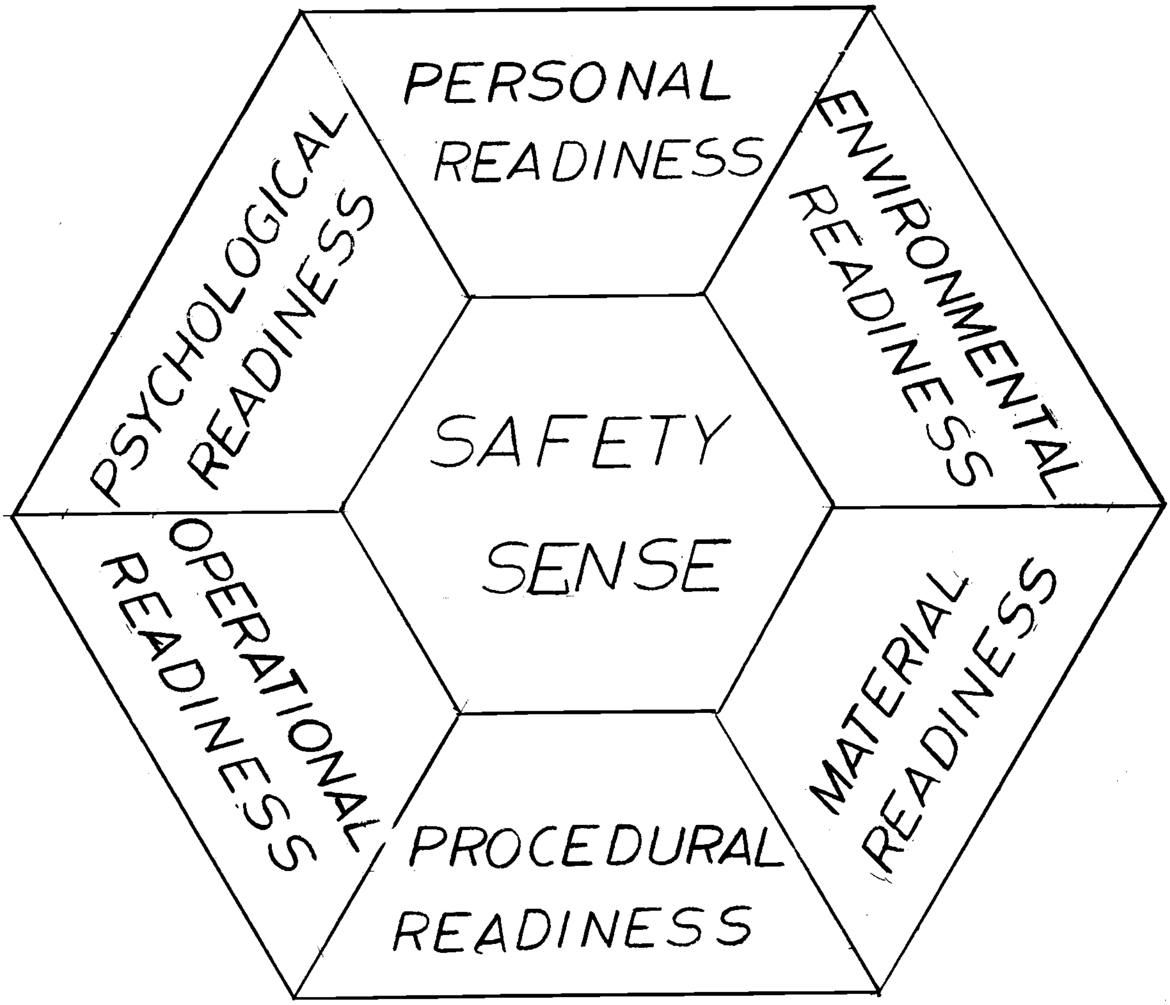


Figure 18. Curriculum format design.

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APPENDICES

APPENDIX A

CERTIFICATE OF INCORPORATION

State of Oregon

Department of Commerce
Corporation Division

Certificate of Incorporation

OF

INSTRUCTIONAL GENIE, INC.

The undersigned, *as Corporation Commissioner of the State of Oregon, hereby certifies that duplicate originals of Articles of Incorporation, duly signed and verified pursuant to the provisions of the Oregon* Business *Corporation Act, have been received in this office and are found to conform to law.*

Accordingly, *the undersigned, as such Corporation Commissioner, and by virtue of the authority vested in him by law, hereby issues this Certificate of Incorporation and attaches hereto a duplicate original of the Articles of Incorporation.*

In Testimony Whereof, *I have hereunto set my hand and affixed hereto the seal of the Corporation Division of the Department of Commerce of the State of Oregon this* 14th *day of* January *, 19*77 .

Frank J. Healy
Corporation Commissioner

By ______________ *Chief Clerk*

C-11-B/N/C
4-75

APPENDIX B

QUESTIONNAIRE

School of Education Oregon State University Corvallis, Oregon 97331 (503) 754-1661

April lo 1976

Dr. Charles E. Smith, Superintendent
1801 S. Franklin
Seaside, OR 97138

Dear Mr. Smith:

The purpose of this letter is to secure your participation in a state wide Safety Education Survey. The survey is designed to:

1.) Assess the degree of formalization/standardization of safety in our instruction shop programs.

2.) Locate, identify and collect materials that may be of value in improving safety instruction in other districts.

3.) Identify methods and delivery of safety instruction.

4.) Determine service and safety education needs of local educational agencies.

5.) Determine the need for new product development in safety education.

The survey instrument is organized to assist the Department of Industrial Education at Oregon State University in meeting the above five design components. The collected data will be key punched for computer entry, to better facilitate efficient and concise retrieval of information recording questions you may have concerning safety education instruction in Oregon.

May I request that you return this questionnaire and other district developed safety instructional materials, at your earliest convenience. Materials and informational requests should be returned in the enclosed self-addressed envelope. If you have need for additional materials or information, requests should be addressed to: Marvin E. Seeman
Vocational-Technical Unit
Batcheller Hall 100
Oregon State University
Corvallis, OR 97330

Thank you for your contribution.

Cordially,

Joel Galloway
Chairman, Department of Industrial Education

1

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OREGON STATE UNIVERSITY
INDUSTRIAL EDUCATION DEPARTMENT
SURVEY OF SAFETY EDUCATION

This section is optional if you wish to remain anonymous.

Name ______________________

Address ______________________

____

- -

Data Section

	Circle One Number		
School size	0 - 99	1	7/9
	100 - 199	2	
	200 - 399	3	
	400 - 599	4	
	600 - 999	5	
	1000 - 1499	6	
	1500 - 1999	7	
	2000 - +	8	
(a) Number of instructional staff teaching Industrial Education and Vocational Education.	0 - 2	1	8/9
	3 - 5	2	
	6 - 9	3	
	10 - 16	4	
	17 - 24	5	
	25 - +	6	
Number of special education student enrolled in Industrial Education/Vocational Education.	None	1	9/9
	1 - 4	2	
	5 - 10	3	
	11 - 17	4	
	18 - 25	5	
	26 - 32	6	
	33 - +	7	
(a) Special education students are instructed by:			
Group Instruction	Yes	1	10/9
	No	2	
Individual Instruction	Yes	1	11/9
	No	2	
Mainstreamed	Yes	1	12/9
	No	2	
Do you utilize a:			
Safety Director?	Yes	1	13/9
	No	2	
Safety Engineer?	Yes	1	14/9
	No	2	
Safety Management Team?	Yes	1	15/9
	No	2	
Student Safety Director?	Yes	1	16/9
	No	2	

Your Safety Program contains:		
Student Responsibilities	Yes 1	17/9
	No 2	
Philosophy Statement?	Yes 1	18/9
	No 2	
Goals?	Yes 1	19/9
	No 2	
Objectives	Yes 1	20/9
	No 2	
Activities	Yes 1	21/9
	No 2	
Administrator Responsibilities	Yes 1	22/9
	No 2	
Instructor Responsibilities	Yes 1	23/9
	No 2	
Program is written?	Yes 1	24/9
	No 2	
Industrial Education and Vocational Education course offerings.	None 1	25/9
	1 - 3 2	
	4 - 8 3	
	9 - 14 4	
	15 - + ... 5	
Average hours of time in each course spent in Safety Instruction.	None 1	26/9
	1 - 3 2	
	4 - 7 3	
	8 - 15 4	
	16 - + ... 5	
The number of times a student may be exposed to repeated safety instruction through various courses (duplication of instruction by other instructors).	None 1	27/9
	1 - 2 2	
	3 - 4 3	
	5 - 7 4	
The number of hazardous machines requiring Safety Education Instruction.		
a. Stationary	0 - 3 1	28/9
	4 - 8 2	
	9 - 12 3	
	13 - + ... 4	
b. Portable	0 - 3 1	29/9
	4 - 8 2	
	9 - 12 3	
	13 - + ... 4	

Rate your Safety Education Program by the following descriptors:	Totally				Partially	
Individualized	5	4	3	2	1	30/9
Innovative	5	4	3	2	1	31/9
Standardized	5	4	3	2	1	32/9
District Developed	5	4	3	2	1	33/9
Purchased Program	5	4	3	2	1	34/9
Unique	5	4	3	2	1	35/9
Other	5	4	3	2	1	36/9
The degree that your Safety Program Program meets or exceeds all OSHA requirements?	5	4	3	2	1	37/9
The degree that your Safety Program Program meets or exceeds all Oregon Safety Regulations?	5	4	3	2	1	38/9

The best description of your Safety Education Instruction.	5	4	3	2	1	39/9
Criterion that best describes the effectiveness of your Safety Education Program?	Excellent				Inadequate	
	5	4	3	2	1	40/9

Please rate the following as to being a problem within your district. Circle your response.

	Major Problem				No Problem	
Standardized Instructor Materials	5	4	3	2	1	41/9
Safety Glasses	5	4	3	2	1	42/9
Safety Machine Guards	5	4	3	2	1	43/9
Safety Identification Zones	5	4	3	2	1	44/9
Lighting	5	4	3	2	1	45/9
Noise Level (machine)	5	4	3	2	1	46/9
Dust Control	5	4	3	2	1	47/9
Factilites	5	4	3	2	1	48/9
Media Replacement	5	4	3	2	1	49/9
Media Development	5	4	3	2	1	50/9
Instructor Carried Remote Control for Machine Cut Out	5	4	3	2	1	51/9
Safety Brakes	5	4	3	2	1	52/9
Organizational Control	5	4	3	2	1	53/9
Safety Instruction Duplication Time by others	5	4	3	2	1	54/9
Unauthorized Use of Machines	5	4	3	2	1	55/9
Machine Maintenance	5	4	3	2	1	56/9
Instructor Preparation	5	4	3	2	1	57/9
Discipline Control	5	4	3	2	1	58/9
Record Keeping	5	4	3	2	1	59/9
Worn Out Machines	5	4	3	2	1	60/9
Other	5	4	3	2	1	61/9

Directions:
Two columns may be circled.
Note: If unsure, or in need of information, service, or developmental help, circle the need number.

	Yes	No	
Do you have an organized and written Safety Education Program policy and procedure that has been endorsed and accepted by the school board?	1	2	62/9
Is there a service need for the above?	1	2	63/9

	Yes	No	
Do you have a systematic and standardized procedura for instructing all V.E. and I.E. students in the safe operation and maintenance of all machines?	1	2	64/9
Is there a service need for the above?	1	2	65/9
Are general safety rules posted?	1	2	66/9
Is there a service need	1	2	67/9
Are there written safety rules for each hazardous machine?	1	2	68/9
Is there a service need for the above?	1	2	69/9
Are there slidea and tapes for each hazardous machine?	1	2	70/9
Is there a service need for the above?	1	2	71/9
Do you utilize a combined acknowledgment of safety instruction and safety pledge for each student as they reach safety competence?	1	2	72/9
Is there a service need for the above?	1	2	73/9
Do you utilize industrial injury reports?	1	2	74/9
Is there a service need for the above?	1	2	75/9
Do you keep an accident-free, visual time chart?	1	2	76/9
Is there a service need for the above?	1	2	77/9
Are students issued ID cards?	1	2	78/9
Is there a service need for the above?	1	2	79/9

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Directions: Two columns may be circled.
Note: If unaure, or in need of information, service, or developmental help, circle the need number.

	yes	no	
Do you require student safety certification for each machine?			7/9
Is there a service need for the above?	1	2	8/9
Do you issue machine operator cards to safety-competent students?	1	2	8/9
Is there a service need for the above?	1	2	9/9
Are accident-reporting procedures written and defined?	1	2	10/9
Is there a service need for the above?	1	2	11/9

	Yes	No	
Do you utilize parent permission slips?	1	2	12/9
Is there a service need for the above?	1	2	13/9
Is there a written policy concerning immediate correction for unsafe conduct?	1	2	14/9
Is there a service need for the above?	1	2	15/9
Are policies defined for standards of student supervision?	1	2	16/9
Is there a service need for the above?	1	2	17/9
Is there a diagnostic questionnaire for determining student handicaps that could precipitate accidents?	1	2	18/9
Is there a service need for the above?	1	2	19/9
Is there an adopted, student safety rule book?	1	2	20/9
Is there a service need for the above?	1	2	21/9
Is there adequate personnel to provide routine housekeeping for safety purposes?	1	2	22/9
Is there a service need for the above?	1	2	23/9
Are there written rules for student behavior in times of emergency?	1	2	24/9
Is there a service need for the above?	1	2	25/9
Safety is taught as a separate course?	1	2	26/9
Is there a service need for the above?	1	2	27/9
Safety Education is integrated within the subject matter in each course?	1	2	28/9
Is there a service need for the above?	1	2	29/9
All instructors utilize the same safety curriculum materials for instructional purposes?	1	2	30/9
Is there a service need for the above?	1	2	31/9
Directions: Two columns may be circled. Note: If unsure, or in need of information, service, or developmental help, circle the need number.			
Each instructor teaches safety in his own way--securing his own media?	1	2	32/9
Is there a service need for the above?	1	2	33/9
Each instructor has an adequate shop safety check list?	1	2	34/9
Is there a service need for the above?	1	2	35/9
There are adequate written rules and regulations to guide safe student conduct?	1	2	36/9
Is there a service need for the above?	1	2	37/9

Safety rules are imparted to students via:

	Yes	No	
Instructor Lecture	1	2	38/9
Is there a service need for the above?	1	2	39/9
Instructor Demonstration	1	2	40/9
Is there a service need for the above?	1	2	41/9
Hand Outs	1	2	42/9
Is there a service need for the above?	1	2	43/9
Textbooks	1	2	44/9
Is there a service need for the above?	1	2	45/9
Policy Statements	1	2	46/9
Is there a service need for the above?	1	2	47/9
Notices	1	2	48/9
Is there a service need for the above?	1	2	49/9
Audio Tapes	1	2	50/9
Is there a service need for the above?	1	2	51/9
Video Tapes	1	2	52/9
Is there a service need for the above?	1	2	53/9
Films	1	2	54/9
Is there a service need for the above?	1	2	55/9
Film Strips	1	2	56/9
Is there a service need for the above?	1	2	57/9
Individual Instructional Packets	1	2	58/9
Is there a service need for the above?	1	2	59/9
Slides	1	2	60/9
Is there a service need for the above?	1	2	61/9
Posters	1	2	62/9
Is there a service need for the above?	1	2	63/9
Student Handbook	1	2	64/9
Is there a service need for the above?	1	2	65/9
Charts	1	2	66/9
Is there a service need for the above?	1	2	67/9
Safety Slogans	1	2	68/9
Is there a service need for the above?	1	2	69/9
Safety Signs	1	2	70/9
Is there a service need for the above?	1	2	71/9

Directions: Two columns may be circled.
Note: If unsure, or in need of information, service, or developmental help, circle the need number.

	Yes	No	
Pre/Post Tests	1	2	72/9
Is there a service need for the above?	1	2	73/9
Discussion	1	2	74/9
Is there a service need for the above?	1	2	75/9
Other	1	2	76/9

Safety activities that are commonly utilized in my instructional process are:

Assemblies	1	2	77/9
Is there a service need for the above?	1	2	78/9

7

Field Trips	1	2	79/9
Is there a service need for the above?	1	2	80/9

Directions: Two columns may be circled.
Note: If unsure, or in need of information, service, or developmental help, circle the need number.

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Speakers	1	2	7/9
Is there a service need for the above?	1	2	8/9
Plays	1	2	9/9
Is there a service need for the above?	1	2	10/9
Contests	1	2	11/9
Is there a service need for the above?	1	2	12/9
Essays	1	2	13/9
Is there a service need for the above?	1	2	14/9
Exhibits	1	2	15/9
Is there a service need for the above?	1	2	16/9
Awards	1	2	17/9
Is there a service need for the above?	1	2	18/9
Other ________			19/9

Directions: Circle only those services you need and specify those services.

(Example) Workshops — Pre Service 1 / In Service (2) — On Site (1) / At University 2 — Credit (1) / Non Credit 2
Specify Weekly seminars - Safety-objective writing - 3 units credit

Workshops	Pre Service 1	On Site 1	Credit 1	20/9
	In Service 2	At University 2	Non Credit 2	21/9
Specify ________				22/9
Consultations	1	1	1	23/9
	2	2	2	24/9
Specify ________				25/9
Conference	1	1	1	26/9
	2	2	2	27/9
Specify ________				28/9
Inspection	1	1	1	29/9
	2	2	2	30/9
Specify ________				31/9
Program Writing	1	1	1	32/9
	2	2	2	33/9
Specify ________				34/9
Program	Pre Service 1	On Site 1	1	35/9
Development	In Service 2	At University 2	Non Credit 2	36/9
Specify ________				37/9
Certification	1	1	1	38/9
	2	2	2	39/9
Specify ________				40/9

Needs Assessment		1		1		1	34/9
		2		2		2	35/9

Specify ____________________

Directions:
Circle only those services that you need and specify these services.

Management by	Pre Service	1	On Site	1	Credit	1	36/9
Objective	In Service	2	At University	2	Non Credit	2	37/9
Specify ____________________							
Evaluation Services		1		1		1	38/9
		2		2		2	39/9
Specify ____________________							
Record Keeping		1		1		1	40/9
		2		2		2	41/9
Specify ____________________							
Media Show		1		1		1	42/9
		2		2		2	43/9
Specify ____________________							
OSHA Rules-Regulations		1		1		1	44/9
		2		2		2	45/9
Specify ____________________							
Oregon Safety Rules-		1		1		1	46/9
Regulations		2		2		2	47/9
Specify ____________________							
Tours of Innovative Programs		1		1		1	48/9
		2		2		2	49/9
Specify ____________________							
Industry Tours		1		1		1	50/9
		2		2		2	51/9
Specify ____________________							
Exchange Programs		1		1		1	52/9
		2		2		2	53/9
Specify ____________________							
Instructor Swapmeet of Ideas		1		1		1	54/9
		2		2		2	55/9
Specify ____________________							
Master Inventory of idle		1		1		1	56/9
equipment		2		2		2	57/9
Specify ____________________							
Curriculum Development		1		1		1	58/9
		2		2		2	59/9
Specify ____________________							
Facilities	Pre Service	1	On Site	1	Credit	1	60/9
	In Service	2	At University	2	Non Credit	2	61/9
Specify ____________________							
Other		1		1		1	62/9
		2		2		2	63/9
Specify ____________________							

APPENDIX C

QUESTIONNAIRE TABULATIONS

APPENDIX C

ADMINISTRATIVE INSTRUCTIONAL AND MEDIA NEEDS

Question no.		Adjusted frequency % of No answer	Question
1.	75	89.9	Do you issue machine operator cards for safety competent students?
2.	85	88.6	Is there a diagnostic questionnaire for determining student handicaps that could precipitate accidents?
3.	70	87.8	Do you keep an accident-free, visual time chart?
5.	72	85.0	Are students issued ID cards?
6.	64	82.0	Are there slides and tapes for each hazardous machine?
7.	56	81.9	Do you have an organized and written Safety Education Program policy and procedure that has been endorsed and accepted by the school board?
8.	87	80.7	Is there an adopted, student safety rule book?
12.	79	71.9	Do you utilize parent permission slips?
13.	59	65.5	Is there a systematic and standardized procedure for instructing all VE and IE students in the safe operation and maintenance of all machines?
14.	117	64.7	Audio tapes
15.	91	64.4	Are there written rules for student behavior in times of emergency?

Appendix C. (Continued)

Question no.		Adjusted frequency % of No answer	Question
16.	81	61.4	Is there a written policy concerning immediate correction for unsafe conduct?
17.	66	60.7	Do you utilize a combined acknowledgement of safety instruction and safety pledge for each student as they reach safety competence.
18.	148	54.0	Speakers
19.	156	52.3	Exhibits
20.	131	51.1	Student handbook

Service Needs

Question no.		Adjusted frequency % of Yes answer	Question
1.	65	65.5	Is there a need for slides and tapes for each hazardous machine?
2.	102	62.0	Is there a need for each instructor having an adequate shop safety checklist?
3.	88	61.0	Is there a need for a student safety rule book?
4.	57	61.0	Is there a need for an organized and written Safety Education Program policy and procedure endorsed by the school board?
5.	104	57.1	Is there a need for adequate written rules and regulations to guide safe student conduct?
5.	140	57.1	Is there a service need for pre/post tests?
6.	136	56.6	Is there a need for safety slogans?

Appendix C. (Continued)

Question no.		Adjusted frequency % of Yes answer	Question
7.	92	53.7	Is there a need for written rules for student behavior in times of emergency?
8.	132	52.1	Is there a need for a student handbook?
9.	157	50.7	Is there a need for exhibits?
10.	86	50.0	Is there a need for diagnostic questionnaires for determining student handicaps that could precipitate accidents?
11.	134	49.3	Is there a need for charts?
12.	61	49.0	Is there a need for general safety rules to be posted?
13.	159	48.7	Is there a need for awards?
14.	124	48.6	Is there a need for film strips?
14.	120	48.6	Is there a need for video tapes?
15.	59	46.3	Is there a need for a systematic and standardized procedure for instructing all VE and IE students in the safe operation and maintenance of all machines?
16.	114	45.1	Is there a need for policy statements?
17.	63	45.0	Is there a need for written safety rules for each hazardous machine?
18.	98	44.9	Is there a need for having all instructors utilize the same safety curriculum materials for instructional purposes?
19.	126	43.7	Is there a service need for individual packets?
20.	149	42.0	Is there a need for speakers?

Appendix C. (Continued)

Question no.		Adjusted frequency % of Yes answer	Question
21.	100	41.3	Is there a need for each instructor teaching safety in his own way--securing his own media?
22.	147	40.5	Is there a need for field trips?
23.	118	40.3	Is there a need for autio tapes?
23.	128	40.3	Is there a need for slides?
24.	71	40.0	Is there a need to keep an accident-free, visual time chart?
24.	96	40.0	Is there a service need to integrate Safety Education within the subject matter in each course?
25.	67	39.2	Is there a need for utilizing a combined acknowledgement of safety instruction and safety pledge for each student as they reach safety competence?
26.	82	38.6	Is there a need for a written policy concerning immediate correction for unsafe conduct?
26.	84	38.6	Is there a need to define policies for standards of student supervision?
27.	76	30.8	Is there a need to issue machine operator cards to safety-competent students?
28.	153	30.6	Is there a need for contests?
29.	69	27.2	Is there a need for utilizing industrial injury reports?
30.	73	22.8	Is there a need to issue ID cards to students?

Appendix C (Continued)

Question no.		Adjusted frequency % of Yes answer	Question
31.	80	20.0	Is there a need to utilize parent permission slips?
32.	145	19.4	Is there a need for assemblies?

PROBLEM AREAS

1.	3.157	Safety brakes
2.	3.045	Noise level
3.	2.868	Dust control
4.	2.747	Media development
5.	2.667	Machine maintenance
6.	2.663	Standardized instructor materials
7.	2.557	Safety ID zones
8.	2.420	Record keeping
9.	2.393	Organizational control
10.	2.393	Worn-out machines
11.	2.337	Unauthorized use

APPENDIX D

STUDENT INDIVIDUALIZED CURRICULUM

VISUALS	AUDIO
Slide #1	
Introduction to Machine Safety Safety Sense	The safe way is always the best way to do a task.
Slide #2	
Easel and realia Table Saw Safety Sense	How is your safety sense?
Slide #3	
Easel and realia Table saw with "Risk Arrows"	What are the risks concerning your safety?
Slide #4	
Art card Safety Matrix	Safety readiness can be divided into six categories: 1) Psychological 4) Materials 2) Personal 5) Procedural 3) Environmental 6) Operational
Slide #5	
Art card (Smile-Frown picture)	The first category to be considered is that of psychological readiness. Psychological conditions can be hazardous. What is your mental set now? How do you feel?
Slide #6	
Realia (Students fighting over a board)	Your behavior is determined by your attitudes. Some attitudes can cause accidents.
Slide #7	
Realia (Students cooperating)	A positive attitude leads the way to safety.

VISUALS	AUDIO
Slide #8	
Art card (Attitudes scale)	Consider all your attitudes. Where are you on the scale? You are the best judge of your attitude readiness. You are the only one who can improve your attitudes.
Slide #9	
Art card (Attitudes, emotions, perceptions)	How is your emotional set? Are you irritable, stirred up, moody, depressed, tired?
Slide #10	
Realia (Student at starting line)	Or are you rested, healthy, and ready for the job at hand?
Slide #11	
Art card (Emotional indicator)	Can you gauge your condition on the emotional stress indicator?
Slide #12	
Art card (Perception)	How are your perceptions today? Do things seem to be moving slowly? . . . not going right? Is this one of those dull, listless, hazy days?
Slide #13	
Realia (Smiling student)	Or is everything sharp, bright, in focus? Are you alert and aware of everything that is happening around you.
Slide #14	
Art card (Perception indicator)	Check the perception indicator. How aware are you now?
Slide #15	
Art card (Attitudes, emotions, perceptions)	Attitudes, emotions, perceptions, these are the four factors that help prevent accidents.

VISUALS	AUDIO
Slide #16 Art card (human error chart)	In fact, human error is the cause of 80% of all accidents. Accidents happen when the worker is in an unstable condition.
Slide #17 Realia (four scowling faces)	When you are in an unstable state, you are four times more likely to have an accident.
Slide #18 Art card Matrix (personal)	Another major category of risk deals with your personal condition. What you wear may determine your personal safety.
Slide #19 Realia (student depicting poor attire)	Are you dressed for the job? What personal protective equipment is necessary for your safety?
Slide #20 Realia (Display of safety devices)	What are the most effective devices for protecting feet, body, head, eyes, ears and lungs?
Slide #21 Art card (Personal indicator)	Analyze the risk and visualize where you fit on the personal condition indicator.
Slide #22 Art card Matrix (Environment)	Can environmental conditions be a hazard? What about your immediate environment?

VISUALS	AUDIO
Slide #23	
Realia (Four photo hazards)	Can you foresee the possibility of an accident due to some potential problem? An ordered and clean environment reduces the possibility of accidents.
Slide #24	
Art card (Environment indicator)	Visualize your environmental condition indicator each time you prepare to start a task.
Slide #25	
Art card Matrix (material)	Can materials condition be a hazard? Are your materials ready to be processed? Are they clean, free of paint nails, and other dangerous material?
Slide #26	
Easel card (Four photos material condition)	Are any materials warped, irregular, too small, or too large? Are they properly organized according to use?
Slide #27	
Art card (material indicator)	Mentally check your "materials condition" indicator before proceding with any machine process.
Slide #28	
Art card Matrix (procedural)	Can procedural conditions be hazardous? The proper sequence of activities is the safe way to accomplish a task.
Slide #29	
Easel card (student questions)	What are the necessary and sequential steps; do you need help, instructor permission, or can you do it safely by yourself?

VISUALS	AUDIO
Slide #30 Art card (procedural indicator)	Is your procedure organized or disorganized? Think of the procedural condition indicator in preparation for safe machine operation.
Slide #31 Art card Matrix (operational)	Can operational conditions be hazardous? Is your machine ready for use?
Slide #32 Easel card (safety pointers)	Are all safety devices in place and operational? Is the blade sharp and designed for the job you wish to do?
Slide #33 Art card (operational indicator)	You must be knowledgeable of all aspects of the machine operation. Check the operational condition indicator to determine a safe readiness for machine use.
Slide #34 Easel Card (student and machine)	Machines never make mistakes...people do.
Slide #35 Art card (readiness checklist)	You must always ask yourself: Should I be operating a machine in my present condition? All aspects of your condition must be considered.
Slide #36 Art card Matrix (complete)	Any abnormal condition in the psychological, personal, environmental, material, procedural and operational areas constitutes a hazard to you and everyone around you. Readiness is safety sense.

VISUALS	AUDIO
Slide #37 Art card (hazard awareness)	Hazard removal is a logical sequence. An awareness of an existing hazard is the first step.
Slide #38 Art card (hazard understanding)	Understanding the nature of the hazard and its consequences is necessary.
Slide #39 Art card Hazard removal	Systematic removal of the hazard completes the necessary steps to Safety Sense.
Slide #40 Realia (machine operator)	Remember, you are the machine operator! Treat the machine with respect and work with confidence. Be cautious and deliberate.
Slide #41 Realia (10" table saw)	What are the operational safety checks necessary when using the 10" table saw for a crosscut or ripping?
Slide #42 Easel card (student review)	Before operating the saw, review and analyze your condition in the six categories of safety readiness.
Slide #43 Easel card (pilot check)	Go through a machine condition check list much as a good pilot would do.
Slide #44 Realia (student hand)	First turn off the power.

VISUALS	AUDIO
Slide #45	
Realia Condition suitability (blade)	Check and correct blade condition and suitability. Is it the correct blade for the sawing you plan to do?
Slide #46	
Easel card (control arrows)	Check all machine controls.
Slide #47	
Realia (blade height)	Adjust blade height to a maximum of 1/8" or 3 mm above the stock to be cut.
Slide #48	
Realia (safety guard)	Verify that the safety guard works and put it in place.
Slide #49	
Realia (mitre gauge)	Check the mitre gauge for squareness.
Slide #50	
Realia (rip fence)	Check the alignment of the rip fence.
Slide #51	
Realia (push stick)	Make sure that the push stick is within reach.
Slide #52	
Realia (clamps, blocks)	Check all clamps and locks for cut off clearance.
Slide #53	
Realia (student-instructor)	Determine whether you need help or further instruction before operating the saw.

VISUALS	AUDIO
Slide #54 Art card (Operational precheck)	Operational prechecks are now completed. Safe operation of the machine involves these steps.
Slide #55 Realia (two students)	First, ask all persons to move out of the danger area.
Slide #56 Realia (see fingers)	It is necessary to be able to see all the fingers on your hands. Fingers tucked out of sight may be more easily cut.
Slide #57 Realia (student in correct position)	Hands and body should always be placed a safe distance away from and out of direct line of the blade.
Slide #58 Easel card (student reaching)	Reaching across the blade may result in a serious injury.
Slide #59 Realia (hand grip)	Grip all materials and accessories firmly.
Slide #60 Art card (material length/width ratio)	Insure that a proper length to width ratio insures a safe handling size of materials.
Slide #61 Realia (proper clearance)	Proper clearance for hands and materials should be absolutely maintained.

VISUALS	AUDIO
Slide #62	
Easel card (material save/reject)	Stock to be saved should be positioned so that it passes between the blade and the fence.
Slide #63	
Realia (material position)	Move materials completely past the blade before releasing them.
Slide #64	
Easel card--realia (kick backs)	A major danger in the use of the table saw is from kick backs. Kick backs can occur . . . .
Slide #65	
Realia (free hand sawing)	when you free hand saw.
Slide #66	
Realia (force materials)	when you force materials at the blade.
Slide #67	
Realia (wedging)	when you wedge materials between the blade and the fence.
Slide #68	
Realia (blade condition)	when you use dull or defective blades.
Slide #69	
Realia (set or tighten)	or when you improperly set or tighten mitre gauges or rip fences.
Slide #70	
Easel card--realia (clean operation)	The Safety Sense approach to the operation of the 10" table saw insures your safety. Start with a clean operation...

VISUALS	AUDIO
Slide #71	
Realia (clean operation)	End with a clean operation.
Slide #72	
Art card Safety Sense (end)	

APPENDIX E

PRETEST-POSTTEST

P R E - T E S T

TRUE-FALSE

_____ 1. A good worker should observe all safety signs and follow the instructions.

_____ 2. Personal protective equipment is mandatory where it is impractical to eliminate a cause of accidents by engineering revision or by guarding.

_____ 3. If a student is to operate a piece of mechanical equipment, he should be instructed in all the safety precautions connected with the safe operation of the machine after being permitted to run it.

_____ 4. Of all accidents, 80 percent are caused by human error.

_____ 5. Accidents cannot be prevented.

_____ 6. Safety is mainly a state of mind (attitude).

_____ 7. The student has no responsibility for safety in his work area.

_____ 8. Accident prevention is a management function. An accident is an operational failure.

_____ 9. If you have made a mistake and done nothing to correct it, a second error has already been committed by you.

_____ 10. Safety is no accident.

_____ 11. A negative attitude can cause an accident.

_____ 12. An unstable emotional state can cause an accident.

_____ 13. Risk means there is an element of danger in a projected activity.

_____ 14. Being psychologically ready means you are unstable.

_____ 15. Your attitude can determine the degree of your personal safety.

_____ 16. Depression or tiredness can result in your having an accident.

_____ 17. It is not necessary to dress for the job.

_____ 18. A hazard is something that does not cause an accident.

_____ 19. Hazards can be identified.

_____ 20. Hazards cannot be removed.

_____ 21. Environmental conditions cannot cause you harm.

_____ 22. Improper procedures can cause an accident.

_____ 23. You should adjust the table saw only while it is running.

_____ 24. No special blade is necessary for ripping.

_____ 25. Machine controls are always accurate.

_____ 26. Safety guards may be removed when you can't see the blade.

_____ 27. When a mitre gage is set by the dial it is always square.

_____ 28. Push sticks were designed for very wide pieces of stock.

_____ 29. A "cut off block" is a block that falls on the floor when it is cut.

_____ 30. If you are unsure about the operation of a machine it's alright to ask another student to show you.

_____ 31. Standing directly behind the saw blade is a dangerous position.

_____ 32. Reaching across the saw blade is a safe practice.

_____ 33. Any size stock may be safely cut on the table saw.

_____ 34. Loose controls are not considered a hazard.

MULTIPLE CHOICE

_____ 35. Safety is:

a. man's mastery over his environment.
b. a safety committee with a program.
c. management means of controlling accidents
d. common sense.

_____ 36. The guard must always be in place over the saw blade of the circular saw except when:

a. cutting stock with a thickness of more than one inch.
b. short pieces tend to catch under the guard.
c. using a thick blade.
d. the instructor has authorized its removal for special set-ups.

_____ 37. All adjustments on the circular saw are made:

a. while the machine is coasting.
b. by the shop foreman.
c. while the machine is at a dead stop.
d. while the power is on.

____ 38. You should use a push stick between the blade and the fence when running the circular saw to:

a. rip short and narrow pieces of stock.
b. prevent kick back.
c. prevent injury to operator.
d. all the above.

____ 39. You should limit the extension of the circular saw blade above the stock being cut to:

a. one inch.
b. one-fourth inch.
c. one-eighth inch.
d. one-half inch.

____ 40. An accident is:

a. a management function.
b. an unplanned event that interrupts normal procedure.
c. an injury on the job.
d. unpredictable.

____ 41. Prevention of accidents is most beneficial to:

a. management.
b. the public
c. students
d. medical profession.

____ 42. The best safety device in any plant is a:

a. safe worker.
b. safety committee.
c. safety minded supervisor.
d. safety law.

COMPLETION

43. Adjustments on the circular saw are made only when the saw blade has

______________________.

44. Dadoing and tilting the arbor are special set-ups; therefore you must obtain the approval of your ________________.

45. To avoid being hit by flying materials, you should stand to one side of the line of the saw ____.

46. You should limit the extension of the circular saw blade above your work to ____________ inch.

47. When using the table saw always place the piece of wood you want to save between the ____________ and ____________________.

48. What three factors are very necessary in accident prevention?

________________. ____________________. ________________.

49. Human error causes ____% of all accidents.

50. When you are in an unstable state you are ________more times more likely to have an accident.

51. Name six personal protective devices: 1. ____________ 2.__________ 3. ____________ 4.____________ 5. ____________ 6.__________

52. A hazard is a potential problem that can cause an ______________.

53. Name three environmental hazards that you might commonly find in the school shop. 1. ______________________________.

2. ______________________________________.

3. ______________________________________.

54. Name three ways that materials could cause an accident.

1. ______________________________________.

2. ______________________________________.

3. ______________________________________.

55. Hazard awareness, hazard understanding, and hazard removal are the three steps necessary for _______ _________.

56. Name four causes of kick backs. 1. ____________________

2. ______________________ 3. ____________________

4. ______________________.

57. There are six conditions the student should be concerned with. they are:

1. ____________________ 2. ____________________

3. ____________________ 4. ____________________

5. ____________________ 6. ____________________

APPENDIX F

INSTRUCTIONAL SUPPORT PACKAGE

INSTRUCTIONAL SUPPORT PACKAGE

The responsibility for the prevention of school accidents rests with the Administration. The Industrial Education instructor, by the very nature of his position, has an obligation to his students to provide a safe working environment.

The instructor can enhance the safety of students by attitude development. Attitudes are contagious, particularly in young people. The attitude of one person may be conditioned by the attitude of another. The instructor can impart attitudes in a direct manner, much the same way as skills are taught. Attitudes are acquired in a harmonious learning environment.

Safety consciousness is a mental awareness which serves as the students' guide in freedom from personal injury. This mental-emotional set is a result of attitude development with a proper perception of hazards.

The instructor's obligation in safety education not only involves the psychological care of his students but also care in the reasonable operation, and supervision of all aspects of his instructional program. There are many organizational and managerial techniques that can greatly facilitate instructional efficiency.

The organizational tools of operation are a requisite to good management. The forms and formats of this instructional package are submitted for consideration as possible aids in the instructor's pursuit of leadership excellence.

FORMULA FOR SUPERVISION

1. Deal with students as human beings, not machines.
2. Lead, don't drive or push.
3. Get students to like and respect you, create loyalty, win cooperation, instill confidence, build morale, and make students feel that they belong.
4. Listen to grievances.
5. Give credit when due, and time it psychologically.
6. Explain changes in advance.
7. Give orders clearly and precisely.
8. Ask for opinions and suggestions.
9. Be patient and impartial, consistent, friendly, and courteous.
10. Display personal interest in the home life, the hobbies, avocations, recreations, and personal problems of your students.
11. Don't argue or be dogmatic when you disagree.
12. Get to know your own personal characteristics so as to avoid irritating or antagonizing others.
13. Get to know the personal characteristics, likes, dislikes, whimsies, convictions, idiosyncrasies, and motivating qualities, and fundamental instincts of your students.
14. Run your department as a business.
15. Find out what the students really need most.
16. Test your students to check attitude and ability.
17. Put the "team" and competitive spirit to work.
18. Learn to recognize symptoms of trouble.
19. Correct misdemeanors only when a student has cooled off.

An Accident Prevention Program for School Shops and Laboratories

U.S. Department of Health, Education and Welfare
Office of Education

Safety Inspections

1. Use a safety check list to assure that all safety factors are checked during safety inspections.

2. Use the American Vocational Association-National Safety Council's "National Standard School Shop Safety Inspection Check List" during shop safety inspections.

3. Have frequent safety inspections of the shop made by

   a. School personnel – state and/or local level

   b. A student safety committee

   c. A student inspector or foreman

   d. Industrial safety engineers

   e. Inspectors from the state departments of labor and industry

   f. State fire inspectors

4. Rotate assignments of students to the shop safety committee.

5. Rotate assignments of students as safety inspectors or safety foremen.

Accident Reports

1. Require students to report all accidents to the teacher, regardless of nature or severity.

2. Keep a record of all shop accidents resulting in injury to students, regardless of nature or severity.

3. Analyze all accident reports for the purpose of aiding in the prevention of other accidents.

4. Use a printed or duplicated form to record the details of shop accidents.

5. Make a report to the school administration on all shop accidents resulting in injury to students, regardless of nature or severity.

6. Prepare a monthly summary of all accidents in the shop for the director or principal for inclusion in a composite summary of all accidents in the school.

Instructional Techniques

1. Develop a permanent safety consciousness in students through teacher example – always doing things the safe way.

2. Teach accident prevention with a positive approach – stressing the right way to perform an operation.

3. Give shop demonstrations emphasizing the safe use of hazardous machines.

4. Give shop demonstrations emphasizing the safe use of specific hand tools.

5. Present safety instruction with the following objectives in mind:

   a. Developing in each student a sense of responsibility for his own safety and that of others.

   b. Helping students understand that the safe way of doing things is effective.

   c. Helping students recognize situations involving hazards.

   d. Helping students learn safe practices to use in their own day-to-day activities.

6. Provide instruction on what to do in case of a shop accident.

7. Use information sheets dealing with the safe use of specific hand tools.

8. Use information sheets dealing with the safe operation of hazardous machines.

9. Give periodic shop demonstrations on the proper use and care of personal protective devices.

10. Use information sheets dealing with the general safety rules of the shop.

11. Provide for safety instruction in the course of study.

12. Provide instruction in the maintenance of shop tools, machines and other equipment.

13. Provide instruction in the safe methods of lifting and/or moving heavy equipment or other loads.

14. Provide a bulletin board for safety bulletins, safety posters, and safety rules and regulations.

15. Give periodic shop talks to emphasize the importance of each student acquiring the proper attitude toward accident prevention.

16. Conduct field trips to industrial plants or construction jobs to study safety practices.

17. Send letters to parents when a student has exhibited a great degree of interest in safety or when he has successfully applied safety practices to handle a shop situation.

18. Require all beginning shop students to make a careful study of hazards in the shop during the first few days of the course.

19. Provide a safety suggestion box for student use.

20. Provide for visiting speakers from business and industry to speak on occupational safety and health practices.

21. Prepare a written safety education program for the shop – similar to a course of study.

22. Require each student to sign information sheets dealing with shop safety rules and regulations to indicate that he has read and understood the information. These sheets should be kept on file until the student completes his course of instruction.

23. Prepare a written safety education program for the shop and submit to the school administration for their information.

Equipment Care and Operation

1. Enclose all gears, moving belts, and other power transmission devices with permanent guards or barricades.

2. Permit each student to operate a hazardous machine only after demonstrating his ability to operate the machine safely.

3. Require a signed statement from a parent granting permission for students to operate power machines.

4. Permit students to operate a hazardous machine only after passing an examination on the safe operation of the machine.

5. Provide an operator's card or license to each student who successfully completes the necessary qualifications to operate power-driven machines.

6. Require that all hand tools are kept sharp, clean, and in safe working order.

7. Prohibit students from operating hazardous machines when the instructor is not present.

8. Prohibit the use of any defective tools, machines, or other equipment.

9. Maintain strict supervision of students who are using hazardous machines and dangerous tools.

10. Prohibit the removal of guards and safety devices, even for a brief interval, without the approval of the teachers.

11. Prohibit students not enrolled in shop classes from operating any of the machines of the shop.

12. Prohibit more than one operator from using the hazardous machine at one time.

13. Provide and require the use of point-of-operation guards for operations involving machine cutting, drilling, shaping, planing, boring and forming.

14. Maintain an awareness of the effective use of safeguards against the special hazards associated with the shop instruction.

15. Use painted lines on the floor around each hazardous item of equipment.

16. Place a warning sign on equipment that is unsafe to operate.

17. Prohibit conversations between machine operators and other students while using hazardous machines.

18. Fasten all machines securely to the floor.

19. Post safety rules at or near each hazardous machine or danger area.

20. Use standardized color coding on hazardous machines to emphasize danger areas.

21. Fasten all benches securely to the floor.

22. Accept personal responsibility for all students using machines or hand tools in the shop.

23. Disconnect the main power line when the teacher leaves the shop for any period of time.

Housekeeping Practices

1. Provide for the daily removal of all sawdust, shavings, metal cuttings, and other waste material.

2. Provide a toeboard and railing around all balconies used for overhead storage of supplies, equipment, or shop projects.

3. Provide properly marked boxes or bins for various kinds of scrap stock.

4. Employ a standard procedure to keep floors free of oil, water, and foreign material.

5. Provide brushes for the cleaning of equipment after each use.

6. Provide for the sweeping of the shop floors at least once each day depending on the rate of scrap accumulation.

Electrical Safety

1. Make all equipment control switches easily accessible to the operator.

2. Provide a ground on all motors, fuse boxes, switch boxes, and other electrical equipment.

3. Teach students to assume that all electrical apparatus is "hot" and must be treated as such.

4. Provide overload protection on all motors.

5. Provide sub-master switches for disconnecting power-driven machines at convenient locations throughout the shop.

6. Provide fluorescent lights for the general lighting of the shop.

7. Provide individual cut-off switches for each machine – separate from operator control switch.

8. Prohibit use of temporary wiring of any kind in the shop area.

9. Provide individual lights at each machine.

Fire Safety

1. Provide fire extinguishers in the shop area.

2. Store flammable liquids in approved safety containers.

3. Provide for the inspection and testing of fire extinguishers at regular intervals to ascertain if they are fully charged and in proper working condition.

4. Provide instruction in the location and proper use of fire extinguishers and other fire-fighting equipment.

5. Provide instruction in the prevention of fires in the school shop.

6. Provide periodic instruction and practice in the proper procedure for evacuating the shop in case of fire or other emergency situations.

7. Provide for the bulk storage of flammable materials in an area removed from the main school building.

8. Mark the location of fire-fighting equipment in the shop with a large bright red square, arrow, or bar high enough to be visible from any part of the shop.

9. Inspect paint and chemical cabinets periodically, noting the date of inspection on or in the cabinet inspected.

10. Provide, in an easily accessible location in the shop, a large flame-proof blanket for use in the case that someone's clothes ignite.

11. Post instructions for evacuating the school shop in a conspicuous place where they can be seen and read.

12. Prohibit use of flammable liquids for cleaning purposes.

13. Inspect fire extinguishers and other fire fighting equipment at least once each week.

First Aid Practices

1. Provide a first aid kit in the shop.

2. Mark the location of the kit with a green cross large enough to be visible from any point in the shop area.

3. Inspect first aid cabinet periodically to determine condition and amount of supplies.

4. Post the policy of the school regarding the administration of first aid in a conspicuous place in the shop.

5. Enroll in and successfully complete American Red Cross first aid courses.

6. Provide only emergency first aid treatment for serious injuries and then refer to qualified medical personnel for treatment.

Personal Protection

1. Prohibit running in the shop at any time.

2. Prohibit horseplay or practical jokes of any kind within the shop area.

3. Require the wearing of appropriate safety goggles or glasses during any type of grinding operating.

4. Require students to observe prescribed rules in regard to proper clothing and protective devices when operating hazardous equipment.

5. Require the wearing of goggles with appropriate lens when danger from radiation or glare exists.

6. Stress the importance of shop sanitation.

7. Require the wearing of safety goggles or glasses when there is a danger of flying particles or chips.

8. Provide respirators for student use where harmful dusts or fumes exist.

9. Require the supplemental use of face shields during the hazardous operations in cutting metal, wood, or other similar materials.

10. Determine the physical defects and limitations of all students so that they will not be assigned tasks detrimental to their health or physical condition.

11. Provide "school purchased" safety goggles or glasses for student use.

12. Prohibit the wearing of four-in-hand ties in the shop.

13. Prohibit the students from wearing rings and other jewelry while working in the shop.

14. When such protective devices are furnished by the school, require sterilization of safety goggles or glasses before reissue.

15. Emphasize the importance of wearing coveralls as proper shop clothing.

General Practices

1. Make an analysis of all hazards in the shop involving machines, hand tools, and general environment.

2. Make regular written reports to the principal or director regarding any hazardous conditions in the shop.

3. Provide a non-skid floor surface in the operating area of all hazardous machines.

4. Use alternating yellow and black stripes on protruding parts, low beams, and tripping hazards.

5. Have the ventilation system in the shop checked at the beginning of each school year by a trained and experienced ventilation engineer to determine effectiveness.

6. Provide aisles at least four feet wide throughout the shop for general travel.

7. Use a bell, whistle, or some other type of alarm to command the attention of every student in the shop during emergency situations.

8. Require students to sign an acknowledgment of safety instruction and safety pledge.

9. Carry liability insurance as a protection against possible negligence charges brought by parents of injured students.

10. Encourage all students to carry accident insurance while enrolled in shop courses.

11. Require visitors to get approval from the director or principal before entering the shop.

SAFETY STANDARDS

Codes, standards, and rules must be considered by teachers as important factors in the development of an accident prevention program. As the future workers of business and industry, shop and laboratory students should be thoroughly aware of safety standards. They should be acquainted with the codes and regulations pertaining to machine guarding, industrial housekeeping, fire protection, dust removal, handling materials, personal protection, etc. Standards of safety have a direct bearing on the development of safe work habits and attitudes, and when individuals do not act in accordance with safety standards, accidents are liable to occur. Russell DeReamer[1] emphasized this point when he said: "Workers use the five primary senses, sight, smell, taste, touch, and hearing to perceive objects, signals, and changes in the work environment. Each perception is relayed through the nervous system to the brain, where the information is noted and evaluated. In making the evaluation, the worker is guided by past training and experience. When the perception is consistent with the worker's previous experience, a correct evaluation is made in a second. On the other hand, a new situation and in particular one which is inconsistent with previous established patterns may confuse the worker or at least slow up his reaction time." The consistent use of safety standards permits workers and students to rely on their past experiences and habits to contend with work hazards with a higher degree of safety.

Safety standards may be used by teachers to draw comparisons and make evaluations. The use of standards as a basis for evaluating shop elements, processes, and work practices is essential for the development of an effective accident prevention program. Such standards may be classified in two general categories: 1) regulatory standards, and 2) self-applied standards.

The following safety rules apply specifically to arc welding:

1. Perform arc welding only in a screened or enclosed force-ventilated area.

2. Be sure that screens, curtains, or other protective devices have been set up or drawn tight so that the arc flash can be seen only by students wearing a protective shield.

3. Wear an arc welding helmet with proper lens, treated gauntlet gloves, and treated leather apron as protection against ultra-violet and infra-red rays, flames, and hot metal.

4. Make certain that the shield has no openings.

5. Do not permit anyone in the welding booth unless he is wearing an arc welding helmet.

NATIONAL STANDARD SCHOOL SHOP SAFETY INSPECTION CHECK LIST
Prepared by the Joint Safety Commitee
of the
AMERICAN VOCATIONAL ASSOCATION--NATIONAL SAFETY COUNCIL

_______________________________ Date _______________

____

INTRODUCTION

A safe environment is an essential part of the school shop safety education program. The safe environment will exist only if hazards are discovered and corrected through regular and frequent inspections by school personnel... administrators, teachers and students. Safety inspections are to determine if everything is satisfactory.

Inspections may be made at the request of the board of education, the school administration or upon the initiative of the teacher. Some communities have drawn upon the cooperative service of professional safety engineers, inspectors of state labor departments, insurance companies and local safety councils to supplement and confirm inspections by school personnel.

The National Standard School Shop Safety Inspection Check List recommended by the President's Conference on Industrial Safety is an objective inspection procedure for the school shop.

DIRECTIONS

WHO INSPECTS?

This will depend upon local policies. It is recommended, however, that shop teachers, and students--the student safety engineer and/or student safety committee--participate in making regular inspections. This not only tends to share responsibility but stimulates a broader interest in the maintenance of a safe school shop.

WHEN TO INSPECT?

As a minimum,a safety inspection should be made at the beginning of every school term or semester. More frequent inspections may be adviseable.

HOW TO INSPECT?

Inspections should be well planned in advance. Inspections should be systematic and thorough. No location that may contain a hazard should be overlooked.

FOLLOW-UP

The current report should be compared with previous records to determine progress. The report should be studied in terms of the accident situation so that special attention can be given to those conditions and locations which are accident producers.

Each unsafe condition should be corrected as soon as possible in accordance with accepted local procedures.

A definite policy should be established in regard to taking materials and equipment out of service because of unsafe conditions. The inspection report can be used to advantage as the subject for staff and class discussion.

CHECKING PROCEDURE

Draw a circle around the appropriate letter, using the following letter scheme:

S -- Satisfactory (needs no attention)
A -- Acceptable (needs some attention)
U -- Unsatisfactory (needs immediate attention)

Recommendations should be made in all cases where a "U" is circled. Space is provided at the end of the form for such comments. Designate the items covered by the recommendations, using the code number applicable (as B-2).

In most categories, space is provided for listing of standards, requirements or regulations which have local applications only.

A. GENERAL PHYSICAL CONDITION

1.	Machines, benches, and other equipment are arranged so at to conform to good safety practices	S	A	U
2.	Conditions are stairways	S	A	U
3.	Condition of aisles	S	A	U
4.	Condition of floors	S	A	U
5.	Condition of walls, windows, and ceiling	S	A	U
6.	Illumination is safe, sufficient, and well placed . . .	S	A	U
7.	Ventilation is adequate and proper for condition	S	A	U
8.	Temperature control	S	A	U
9.	Fire extinguishers are of proper type, adequately supplied, properly located and maintained	S	A	U
10.	Teacher and pupils know location of and how to use proper type for various fires.	S	A	U
11.	Number and location of exits is adequate and properly identified.	S	A	U
12.	Proper procedures have been formulated for emptying the room of pupils and taking adequate precautions in case of emergency.	S	A	U
13.	Lockers are inspected regularly for cleanliness and fire hazards.	S	A	U
14.	Locker doors are kept closed.	S	A	U
15.	Walls are clear of objects that might fall	S	A	U
16.	Utility lines are properly identified.	S	A	U
17.	Teachers know the procedure in the event of fire including notification of the fire department and the evacuation of the building.	S	A	U
18.	Air in shop is free from excessive dust, smoke, etc.	S	A	U
19.	______________________________	S	A	U
20.	______________________________	S	A	U
21.	______________________________	S	A	U
22.	______________________________	S	A	U
23.	Evaluation for the total rating of A. GENERAL PHYSICAL CONDITION	S	A	U

CHECKING PROCEDURE, Page 2

B. HOUSEKEEPING

1.	General appearance as to orderliness	S	A	U
2.	Adequate and proper storage space for tools and materials . .	S	A	U
3.	Benches are kept orderly	S	A	U
4.	Corners are clean and clear	S	A	U
5.	Special tool racks, in orderly condition, and provided at benches and machines	S	A	U
6.	Tool, supply, and/or material room is orderly	S	A	U
7.	Sufficient scrap boxes are provided	S	A	U
8.	Scrap stock is put in scrap boxes promptly	S	A	U
9.	Materials are stored in an orderly and safe condition . . .	S	A	U
10.	A spring lid metal container is provided for waste and oily rags	S	A	U
11.	All waste materials and oily rags are promptly placed in the containers	S	A	U
12.	Containers for oily rags and waste materials are frequently and regularly emptied	S	A	U
13.	Dangerous materials are stored in metal cabinets	S	A	U
14.	Machines have been color conditioned	S	A	U
15.	Safety cans are provided for flammable liquids	S	A	U
16.	Bulk storage of dangerous materials is provided outside of the main building	S	A	U
17.	A toe-board or railing around a mezzanine used for storage or washing facilities	S	A	U
18.	Materials are stored in an orderly and safe condition on this mezzanine	S	A	U
19.	Flammable liquids are not used for cleaning purposes . . .	S	A	U
20.	Floors are free of oil, water and foreign material . . .	S	A	U
21.	Floors, walls, windows, and ceilings are cleaned periodically	S	A	U
22.	____________________	S	A	U
23.	____________________	S	A	U
24.	____________________	S	A	U
25.	____________________	S	A	U
26.	Evaluation for the total rating for B. HOUSEKEEPING . . .	S	A	U

C. EQUIPMENT

1.	Machines are arranged so that workers are protected from hazards of other machines, passing students, etc	S	A	U
2.	Danger zones are properly indicated and guarded	S	A	U
3.	All gears, moving belts, etc., are protected by permanent enclosure guards	S	A	U
4.	All guards are used as much as possible	S	A	U
5.	All equipment control switches are easily available to operator	S	A	U
6.	All machines are "locked off" when instructor is out of the room	S	A	U
7.	Brushes are used for cleaning equipment	S	A	U
8.	Nonskid areas are provided around machines	S	A	U
9.	Machines are in safe working condition	S	A	U
10.	Machines are guarded to comply with American Standards Association and local state code	S	A	U
11.	Adequate supervision is maintained when students are using machines and dangerous tools	S	A	U

CHECKING PROCEDURE, Page 3

C. Equipment (continued)

12.	Tools are kept sharp, clean and in safe working order . . .	S	A	U
13.	All hoisting devices are in safe operating condition . . .	S	A	U
14.	Machines are shut off while unattended	S	A	U
15.	Adequate storage facilities for tools, equipment, etc., not in immediate use	S	A	U
16.	__________	S	A	U
17.	__________	S	A	U
18.	__________	S	A	U
19.	__________	S	A	U
20.	Evaluation for the total rating for C. EQUIPMENT	S	A	U

D. ELECTRICAL INSTALLATION

1.	All switches are enclosed	S	A	U
2.	There is a master control switch for all of the electrical installations	S	A	U
3.	Electrical outlets and circuits are properly identified . .	S	A	U
4.	All electrical extension cords are in safe condition and are not carrying excessive loads	S	A	U
5.	All machine switches are within easy reach of the operators .	S	A	U
6.	Electrical motors and equipment are wired to comply with the National Electric Code	S	A	U
7.	Individual cut-off switches are provided for each machine . .	S	A	U
8.	Machines are provided with overload and underload controls by magnetic pushbutton controls	S	A	U
9.	No temporary wiring in evidence	S	A	U
10.	__________	S	A	U
11.	__________	S	A	U
12.	__________	S	A	U
13.	__________	S	A	U
14.	Evaluation for the total rating for D. ELECTRICAL INSTALLATION	S	A	U

E. GAS

1.	Gas flow to appliances is regulated so that when appliance valve is turned on full, the flames are not too high	S	A	U
2.	Gas appliances are properly insulated with asbestos or other insulating material from tables, benches, adjacent walls, or other flammable materials	S	A	U
3.	No gas hose is used where pipe connections could be made . .	S	A	U
4.	Gas appliances have been adjusted so that they may be lighted without undue hazard	S	A	U
5.	Students have been instructed when lighting gas appliances to light the match first before turning on the gas	S	A	U
6.	There are no gas leaks, nor is any odor of gas detectable in any part of the shop	S	A	U

CHECKING PROCEDURES, Page 4

E. Gas (continued)

7.	Shop instruction has been given concerning the lighting of gas furnaces operating with both air and gas under pressure . .	S	A	U
8.	When lighting the gas forge, goggles are worn	S	A	U
9.	When lighting the gas furnace, the following procedure is used: (a) light the match; (b) turn on the gas; (c) drop the match in the hole in top of the furnace	S	A	U
10.	In shutting down the gas furnace, the gas valve is cleaned before the air valve	S	A	U
11.	____________________	S	A	U
12.	____________________	S	A	U
13.	____________________	S	A	U
14.	____________________	S	A	U
15.	Evaluation for the total rating for E. GAS	S	A	U

F. PERSONAL PROTECTION

1.	Goggles or protective shields are provided and required for all work where eye hazards exist	S	A	U
2.	If individual goggles are not provided, hoods and goggles are properly disinfected before use	S	A	U
3.	Shields and goggles are provided for electric welding . . .	S	A	U
4.	Rings and other jewelry are removed by pupils when working in the shop	S	A	U
5.	Proper kind of wearing apparel is worn and worn properly for the job being done	S	A	U
6.	Leggings, safety shoes, etc., are worn in special classes such as foundry, etc., when needed	S	A	U
7.	Respirators are provided for dusty or toxic atmospheric conditions such as when spraying in the finishing room	S	A	U
8.	Provisions are made for cleaning and sterilizing respirators .	S	A	U
9.	Students are examined for safety knowledge ability . . .	S	A	U
10.	Sleeves are rolled above elbows when operating machines . .	S	A	U
11.	Clothing of students is free from loose sleeves, flopping ties, loose coats, etc.	S	A	U
12.	____________________	S	A	U
13.	____________________	S	A	U
14.	____________________	S	A	U
15.	____________________	S	A	U
16.	Evaluation for the total rating for F. PERSONAL PROTECTION .	S	A	U

CHECKING PROCEDURE, Page 5

G. INSTRUCTION

1.	Shop Safety is taught as an integral part of each teaching unit	S	A	U
2.	Safety rules are posted particularly at each danger station .	S	A	U
3.	Printed safety rules are given each student	S	A	U
4.	Pupils take a safety pledge	S	A	U
5.	Use of a safety inspector	S	A	U
6.	Use of a student shop safety committee	S	A	U
7.	Use of safety contents	S	A	U
8.	Motion and/or slide films on safety are used in the instruction	S	A	U
9.	Use of suggestion box	S	A	U
10.	Use of safety tests	S	A	U
11.	Use of safety posters	S	A	U
12.	Talks on safety are given to the classes by industrial men .	S	A	U
13.	Tours are taken of industrial plants as a means of studying safety practices	S	A	U
14.	Periodic safety inspections of the shop are made by a student committee	S	A	U
15.	Men from industry make safety inspections of the shop . . .	S	A	U
16.	Student shop safety committee investigates all accidents . .	S	A	U
17.	A proper record is kept of safety instructions which are given, preferably showing the signature of student on tests given in this area	S	A	U
18.	Rotate students on the Shop Safety Committee so that as many students as possible have an opportunity to participate . .	S	A	U
19.	______________________________	S	A	U
20.	______________________________	S	A	U
21.	______________________________	S	A	U
22.	______________________________	S	A	U
23.	Evaluation for the total rating of G. INSTRUCTION . . .	S	A	U

H. ACCIDENT RECORDS

1.	There is a written statement outlining the proper procedure when and if a student is seriously hurt	S	A	U
2.	Adequate accident statistics are kept	S	A	U
3.	Accidents are reported to the proper administrative authority by the instructor	S	A	U
4.	A copy of each accident report is filed with the State Department of Education	S	A	U
5.	Accident reports are analyzed for instructional purposes and to furnish the basis for elimination of hazards	S	A	U
6.	______________________________	S	A	U
7.	______________________________	S	A	U
8.	______________________________	S	A	U
9.	______________________________	S	A	U
10.	Evaluation for the total rating of H. ACCIDENT RECORDS . .	S	A	U

CHECKING PROCEDURES, Page 6

I. FIRST AID

1.	An adequately stocked first aid cabinet is provided . . .	S	A	U
2.	The first aid is administered by a qualified individual . .	S	A	U
3.	The school has individuals qualified to administer first aid . .	S	A	U
4.	____________________	S	A	U
5.	____________________	S	A	U
6.	____________________	S	A	U
7.	____________________	S	A	U
8.	Evaluation for the total rating of I. FIRST AID	S	A	U

A Check List for
Industrial Arts and
Elementary Crafts

School ____________ Shop ______

Teacher ____________ Date ______

Checked by _________ Total ______

EXPLANATION: This check list consists of items related to significant aspects of an Industrial Arts Program. It is intended for use in the evaluation and improvement in this subject field.

DIRECTIONS: Opposite each of the items to be checked, circle the number that indicates your evaluation with respect to the item. (5) outstanding; (4) above average; (3) average; (2) below average; (1) poor.

A. GENERAL CONDITION OF SHOP 5 4 3 2 1

Orderly-place for everything clean-locker space assigned-care or projects under way or completed lighting-status of pointing of finishing area.

B. HAND TOOLS 5 4 3 2 1

Condition-suitability-storage accessibility-method of checking

C. POWER EQUIPMENT

Safety features-use of guards regular oiling and care of motors-place for extra parts

D. SAFETY PROVISIONS AND PRACTICES 5 4 3 2 1

Pupils' clothing safety zones, location of tools and equipment, pupils' safety consciousness, power cords and outlets

E. HANDLING SUPPLIES 5 4 3 2 1

Ordering-storage-distribution

F. PUPIL PERSONNEL ORGANIZATION 5 4 3 2 1

Clean-up organization definite assignments

G. PUPIL PROJECTS 5 4 3 2 1

Selection-finish and workmanship careful planning

H. PUPIL INTEREST 5 4 3 2 1

Work habits, interest in projects interest in the shop, attitude toward school property, absence of unnecessary noise, horseplay everybody busy

I. PUPILS WORK HABITS 5 4 3 2 1

Care of tools, proper tool for the job, orderly attack, care of table and bench tops.

J. PUPIL RESPECT FOR TEACHER AND SHOP REGULATIONS 5 4 3 2 1

Willingness to cooperate with teacher and other class members

K. TEACHER'S DESK & LIBRARY FACILITIES 5 4 3 2 1

Place to work and plan, orderly teaching aids cost accounting

L. TEACHER INITIATIVE AND INTEREST 5 4 3 2 1

New project, interesting models, development of instruction sheets, participation in work of committees for the Industrial Arts Program, develops and shares suggestions that will benefit other teachers

M. PROFESSIONAL APPEARANCE OF TEACHER AND PUPILS 5 4 3 2 1

Suitably dressed for work-use of shop aprons-grooming, makes a favorable impression

N. TEACHING AIDS 5 4 3 2 1

Use and care of books, charts and display materials, use of film and slides, proper use of display models

O. COOPERATION 5 4 3 2 1

with fellow teachers, principal and building custodian.

P. TEACHERS' PERSONAL QUALITIES 5 4 3 2 1

Uses appropriate language
promptness, wholesome attitudes
reliability
efficiency
finishes what he begins

Q. SUBJECT PREPARATION AND QUALIFICATIONS 5 4 3 2 1

Schooling, teaching in areas of college preparation, reads and studies in his field of interest, has critical and analytical mind, not bound by tradition, open to convictions.

R. CLASS PREPARATION AND PRESENTATION 5 4 3 2 1

Well-planned demonstrations and discussions, follows course of study, holds interest during demonstrations, uses language effectively, knows subject matter.

ACKNOWLEDGEMENT OF SAFETY INSTRUCTION AND PLEDGE

I have received the SAFETY INSTRUCTIONS regarding the operation of the following power driven machines. I fully understand the importance of these rules and regulations and I am fully aware that the violation of any one of them may endanger myself and others.

My teacher has demonstrated to me the proper methods of using each machine listed below and has pointed out the safety precautions necessary to avoid injury.

I have demonstrated my ability to use each machine listed below in the presence of my teacher. I understand the safety precautions involved and understand how to insure my safety through the proper use of the machines. I am confident that I can operate these machines safely. When in doubt about the operation of any machine, or other equipment, I will consult the teacher before proceeding.

(Name of each machine to be written in by the pupil only after he has passed the safety tests and demonstrated his ability to use it.)

Name of Machine	Date	Student's Signature	Teacher's Initial
1			
2			
3			
4			
5			
6			
7			
8			

I have passed the tests covering safety in the shop and the use of the above listed machines.

I promise to observe the SAFETY INSTRUCTIONS and to follow the indstructions given in the demonstration. I may use the machines only after I have been properly instructed in their safe use, and have had the approval of the teacher. I understand that the use of machines in this shop is voluntary on my part.

School ______________________ Signed ______________________
Pupil

Date ____
Teacher

Date ____
Teacher

Ault & Williams, 1970

EVALUATION OF SHOP STUDENTS' ACTIVITY

Name ______________________

	Rate 1 to 5 1 2 3 4 5
1. He selects his projects intelligently	
a. considers costs and his ability to pay	______
b. selects useful projects	______
c. selects projects within his ability, a challenge.	______
d. considers time element	______
2. He plans his work systematically	
a. uses drawings or sketches	______
b. makes out bill of material	______
c. plans step by step procedure	______
d. selects suitable material	______
e. investigates the source of materials	______
3. He completes his project carefully	
a. follows definite procedures	______
b. thinks through each procedure	______
c. consults teacher when in doubt	______
d. uses the right tool at the right time	______
e. experiments on scrap material	______
f. studies informational material pertaining to work	______
g. provides protection when storing projects	______
4. He checks up on his work when completed	
a. estimates time in making project	______
b. points out places he could have improved	______
c. recognizes his good work	______
d. profits by his own mistakes	______
e. makes functional tests	______
5. He develops safe working habits	
a. uses sharp tools at all times	______
b. checks machines before using	______
c. follows safety instructions	______
d. consults instructor about machines	______
e. uses tools and machines correctly	______
f. reports hazards to instructor	______
g. remains with machines when it is in motion	______
h. reports accidents immediately to instructor	______
i. keeps floor clear of debris	______
j. washes machines before leaving shop	______

1 2 3 4 5

6. He appreciates good design, materials and workmanship.

   a. handles things with care __________
   b. uses good judgment when buying materials __________
   c. re-designs projects well __________
   d. compliments other students' designs __________
   e. compliments other students' workmanship __________
   f. brings to class good designs __________

7. He works effectively and pleasantly with others

   a. takes suggestions easily __________
   b. gives suggestions tactfully __________
   c. appreciates the other students' viewpoints __________
   d. contributes his share to a job __________
   e. helps others with a cheerful attitude __________
   f. accepts dirty or hard work __________
   g. considers the problems of others __________
   h. willing to share tools __________
   i. has high moral standards __________

8. He understands related industries and occupations

   a. reads about related materials __________
   b. reports on trips to industries __________
   c. makes class reports on related information __________
   d. understands industrial job opportunities __________

9. He develops skill in using tools and machines

   a. understands proper use of tools and machines __________
   b. keeps his tools sharp __________
   c. knowledge of setting machines for proper work __________
   d. accuracy in using tools and machines __________

10. He develops originality, self-reliance, resourcefulness, initiative, and leisure time interests.

   a. uses surplus or scrap materials __________
   b. does more than required work __________
   c. worked relatively independently __________
   d. develops and works at a hobby __________
   e. conserves unused materials __________
   f. contributes own ideas __________
   g. always reliable __________

This card certifies that

has successfully passed the operating and safety tests of the machines checked below.

Date ______________ ______________(Inst.)

Cutoff saw ______	Lathe ______
Jointer ______	Sander ______
Bandsaw ______	Shaper ______
Planer ______	Mortiser ______
Jigsaw ______	Tablesaw ______
Uniplane ______	

PARENT'S PERMISSION SLIP

Name ______________________________

has my permission to operate the machines and tools in the Industrial Arts shop for the year 19__ - 19__.

In case that an accident should occur we prefer that he receive medical attention from Dr. ______________.

Signed by parents or legal guardian:

____

____

Date______________

SOUTH-CENTRAL VOCATIONAL SCHOOL
WOODLAND, PENNA.

Accident - Injury Report

Name ______________________________ Date ____________

Address ____

Trade ______________________ Grade & Section ________ Age _____

Time accident occurred ___________________________________

Place of accident ____

Nature of Injury

Abrasion	___	Fracture	___
Bite	___	Laceration	___
Bruise	___	Poisoning	___
Burn	___	Scalds	___
Concussion	___	Scratches	___
Cut	___	Shock (el.)	___
Dislocation	___	Sprain	___
Invdection	___	Strain	___
Crush	___		
Other (specify)			

Part of Body Injured

Abdomen	___	Hand	___
Ankle	___	Head	___
Arm	___	Knee	___
Back	___	Leg	___
Chest	___	Mouth	___
Ear	___	Nose	___
Elbow	___	Scalp	___
Eye	___	Tooth	___
Face	___	Wrist	___
Finger	___	Tow	___
Foot	___		
Other (Specify			

Accident Source

___ Machine
Type ____________
___ Hand Tools
Type ____________
___ Hand Power Tool
Type ____________
___ Working Surfacers, (Floors, ladders, etc.) Type
___ Welding, cutting, soldering, brazing
___ Furnaces--Type ____________
___ Oils, Chemicals, Hot Subs.
___ Electrical Equipment
___ Miscellaneous Source
    ___ Handling Material
    ___ Particales in Eye
    ___ Walking, Bending, Straightening up
    ___ Placing Material
    ___ Non-Standard Working Surfaces (Table, Work Platforms, etc.)

Unsafe Practices*

___ Loose, Improper Clothing
___ No Goggles--Improper goggles
___ Defective, Improper Tool
___ Failure to Use or Tighten Clamps, Vise
___ Not Fitting Wrench Securely
___ Placing Tools, etc., Too Close to Edge
___ Gauging, Adjusting, Near Moving Parts
___ Tool Rest Loose, Too Far From Wheel
___ Guards--None, Inadequate, Failure to use
___ Placing Hands in Unsafe Position
___ Failure to Remove Handles, Loose Tools Before Starting Operation
___ Improper Gripping, Lifting, Placing, etc.
___ Poor Job Housekeeping
___ Oily, Wet, Greasy, Soapy Floors
___ Working in Awkward Position
___ Others ____________________

* Check one or more unsafe practice. Underline the part of each practice that applies.

Description of Accident--How did it happen?

____

____

____

____

Degree of Injury: ___ Permanent Impairment. ___ Temporary Disability, ___ Non disabling

Total number of days lost from school ____________.

Location of instructor when accident occurred. ____________________________

____

___ Yes ___ No First aid treatment given by ____________________________

___ Yes ___ No Sent to school nurse by ________________________________

___ Yes ___ No Sent to __________________ by _______________________
Physician

___ Yes ___ No Taken home by ____

___ Yes ___ No Taken to ____________________ hospital by _____________

Was Parent notified: ___ Yes ___ No

When ______________________ How ____________________ by whom ______

Witnesses to accident: 1 ______________________ 2 ______________________

Suggestions for prevention of similar accidents __________________________

____

____

____

Student signature ____________________ Instructor signature _____________

An accident report form may be developed for specialized schools. Courtesy, South-Central Vocational School, Woodland, Pa.

MINOR ACCIDENT REPORT FORM

Name	Type of Accident	Date	Time	Cause	Witness 1	Witness 2	First Aid Req.	Fore. Sig.

CLASS PROGRESS CHART

Grade ____________________

Section ____________________

Code ____________________

STUDENT PERSONNEL DUTY CHART

Superintendent

1. Oversees entire personnel system.
2. Calls clean-up.
3. Dismisses class.
4. Takes roll and keeps attendance records.
5. Receives ideas and suggestions from the class.
6. Suggests any possible shop improvements gained through experience as superintendent; also acts as class representative.
7. Responsible for the assignment or election of new personnel.
8.
9.

Safety Foreman

1. Is responsible for general safety program and its improvement.
2. Posts safety posters and information.
3. Keeps safety test record.
4. Keeps inventory of first aid supplies and notifies instructor when additional supplies are needed.
5. Fills out minor accident report forms.
6. Reports any injuries to the instructor immediately.
7.
8.

Supply Clerk

1. Is responsible for arrangement and storage of supplies.
2. Is responsible for issuing supplies and collecting material cards.
3. Keeps supply inventory.
4. Informs instructor of apparent needs and shortages.
5.
6.

Librarian

1. Keeps the planning center in good order.
2. Keeps supply of planning sheets on hand.
3. Checks out magazines, books and project files.
4. Keeps track of library check-out cards.
5.
6.

Clean-up Foreman

1. Oversees all clean-up personnel.
2. Makes substitutions for absent clean-up personnel.
3. Improvises and receives ideas for improving clean-up.
4. Reports to superintendent when the clean-up is satisfactorily completed.
5.
6.

Finishing Room Manager

1. Takes charge of all finishing supplies.
2. Keeps a constant check on all paint, varnish and shellac brushes to make sure they are in good order.
3. Keeps the finishing cabinets and benches in neat and proper order.
4. Reports any needed finishing supplies to the superintendent.
5.
6.

Maintenance Foreman

1. Maintains tools and equipment in use.
2. Conducts regular inspection of tools to determine condition.
3. Informs instructor of needed repairs.
4. Conducts regular and proper lubrication of tools and machines in use.
5.
6.

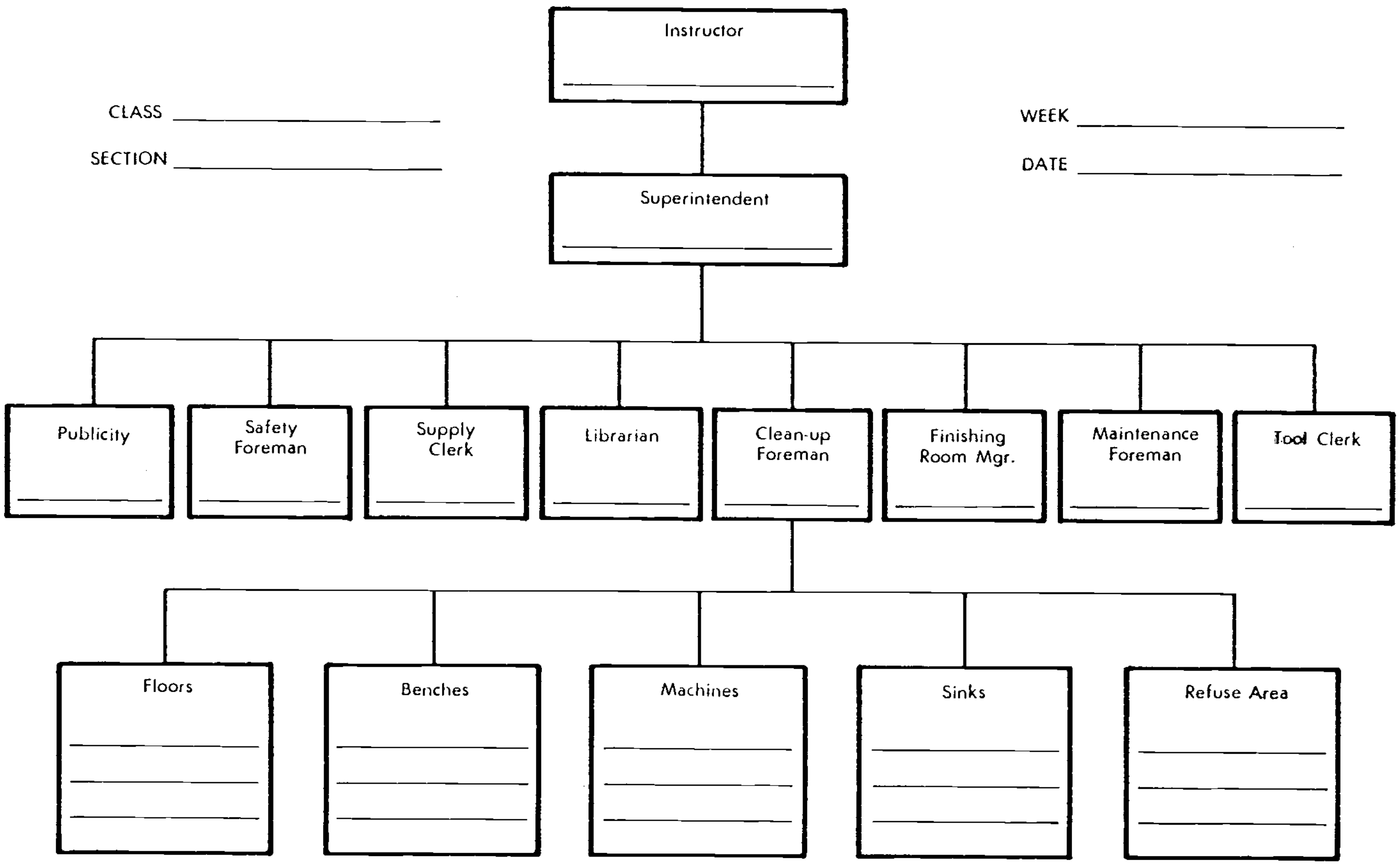
Tool Clerk

1. Checks all tool panels at the end of period and reports any missing tools to the superintendent.
2. Keeps track of tools checked out.
3. Keeps tool panels in good order.
4. Reports dull or broken tools to the maintenance foreman.
5. Keeps tool and equipment inventory.
6.
7.

Publicity

1. Is responsible for bulletin boards and display cases as assigned by instructor.
2. Writes and gives to school paper any articles for publication.
3.
4.

SHOP ORGANIZATION CHART



STUDENT ATTITUDE EVALUATION SHEET

	Cooperation			Attitude Toward Other Students			Effort and Initiative			Attitude Toward Safety			Neatness and Orderliness			Interest and Enthusiasm			Promptness			Reliability			Leadership		
Excellent (5)																											
Very Good (4)																											
Good (3)																											
Fair (2)																											
Failure (1)																											
Evaluator	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C

Self-Evaluation (A)	Foreman-Evaluation (B)	Instructor-Evaluation (C)
Total Points ______	Total Points ______	Total Points ______
Total Points/9 ______	Total Points/9 ______	Total Points/9 ______
Grade ______	Grade ______	Final Grade ______

FIRST AID EQUIPMENT AND SUPPLIES INVENTORY FORM

FIRST AID EQUIPMENT	DATE	CONDITION	COMMENTS
1. First Aid Cabinet (dust-proof, with labeled sections and directions for use of supplies)			
2. American Red Cross First Aid Textbook			
3. Civil Defense Supplement (to American Red Cross First Aid Textbook)			
4. Blanket (wrapped in cellophane to keep clean)			
5. Scissors			
6. Forceps, 3 inch size (for removing slivers)			
7. Ice Bag (for ice or hot water)			
8.			

FIRST AID SUPPLIES	DATE	CONDITION	COMMENTS
1. Petrolatum or Burn Ointment			
2. Assorted Bandage Compresses (in sterile pkgs.)			
3. Sterile Gauze (individual pkgs. one yd. sq.)			
4. Rolls of Bandage (one and two inch widths)			
5. Paper Cups			
6. One Roll ½" Adhesive Tape			
7. Triangular Bandages (in dust proof pkgs.)			
8. Aromatic Spirits of Ammonia (labeled with name, date and directions for use)			
9. Rubbing Alcohol, Benzine or Naphtha (for cleaning around wounds)			
10. Antiseptic (2% solution of iodine or merthiolate or mercurochrome)			
11. Applicators (stored in dust-proof jar)			
12. Adhesive Bandages (assorted sizes)			
13. Sterile Absorbent Cotton (for cleaning around wounds)			
14. Bath Towel (wrapped and sealed in cellophane)			
15.			
16.			
17.			
18.			

SAMPLE STUDENT PERSONNEL PLAN

INSTRUCTOR

GENERAL FOREMAN

Area Foreman	Area Foreman	Safety Foreman	Tool Foreman	Record Foreman	Clean-up Foreman
Students	Students				Clean-up Students

GENERAL FOREMAN

1. Calls class to order
2. Checks to see that all duties are performed
3. Appoints all substitute offices
4. Runs class under teacher's supervision
5. Acts as instructional assistant
6. Supervises area foreman
7. Takes care of class dismissal

AREA FOREMAN

1. Responsible for operation of his area
2. Has charge of all workers in his area
3. Sees that all students in area are supplied with materials, etc.
4. Keeps record of supplies individual pupil receives

SAFETY FOREMAN

1. Checks all machines and room in general at beginning and end of hour for safe operation
2. Posts safety material (posters, charts, slogans, etc.)
3. Reports safety violations to the general foreman
4. Gives safety instructions as the need arises
5. Works with instructor in making needed repairs
6. Administers first aid (minor injuries)

TOOL FOREMAN

1. Checks all tool cases or panels at beginning and end of each period for broken or missing tools.
2. Reports tools missing at end of period to general foreman
3. Checks out and keeps a record of tools taken out of the shop
4. Keeps tool inventory up to date

RECORD FOREMAN

1. Takes roll
2. Keeps record sheet
3. Takes care of folders which contain student work in graphic arts
4. Locks and unlocks lockers
5. Reports absentees to office

CLEAN-UP FOREMAN

1. Gives signal for clean-up period
2. Supervises clean-up of desks, machines, etc.
3. Supervises sweeping of floors
4. Arranges rotation plan for student helpers
5. Checks entire shop to see that it is in good order before class leaves
6. Reports to general foreman when shop is ready for class dismissal

____________________ SCHOOL

INDUSTRIAL ARTS DEPARTMENT

MACHINE MAINTENANCE RECORD

Date____________ Machine__________

					Week									
1. Guards in place & secure														
2. Cutter or blade shape and secure														
3. Blade runs true & properly adjusted														
4. Belts in good condition														
5. Belts run true (track)														
6. All guards, guides and parts secure														
7. Elec. connections secure and good														
8. All wiring in good condition														
9. Machine & motor free of dust, chips														
10. Paint in good condition														
11. No corrosion on machined surfaces														
12. Adjustments operate properly														
13. Machine & motor oiled or greased														
14. No excessive oil or grease														
15. All machine surfaces given light coat oil														
Other Accessories														
1. All are sharp														
2. No cracks or breaks														
3. No corrosion on machined surfaces														
4. Paint in good condition														
5. Machine surface given light coat of oil														

APPENDIX G

SAFETY EVALUATION INSTRUMENT

(State Department of Education)

INSTRUMENT TO COMPARE CURRENT STATE SCHOOL STANDARD POLICY TO SAFETY PRACTICE IN INDUSTRIAL EDUCATION LABORATORIES

NAME OF SCHOOL ____________________

ADDRESS ____________________

ENROLLMENT __________ DATE __________

INTRODUCTION

A safe environment is an essential part of the school program. The Industrial Education program provides opportunities for students to become acquainted with industrial processes as well as an introduction to the industrial environment. This environment is representative of the technical society of today. The industrial facilities should reflect the attitude and safety consciousness of the teacher and administrator responsible for the education of students.

The Minimum Standards for Oregon Schools - Part I, list five OARs that speak specifically to a safety program in all schools. With these standards as a basis this instrument is written to help the instructor and administrator to establish a minimum safety program for Industrial Education laboratories. This list is neither comprehensive nor complete. It is a beginning and the compliance of these suggestions would be a minimum effort on the part of the school. The district is encouraged to go beyond these suggestions in establishing a comprehensive safety program.

DIRECTIONS

Each item on the list should be checked. It is either YES or NO. Be careful of your personal interpretation. If a third party can be enlisted, this would help to remove personal bias.

NAME OF EVALUATOR ____________________

POSITION ____________________

CLASS PERIOD ____________________

John M. Fessant
Specialist
Industrial Arts
378-4156

John Havery
Specialist
Electricity and Graphics
378-8693

Ralph Little
Specialist
Metals and Construction
378-8693

George Warren
Specialist
Industrial Mechanics
378-8693

CURRENT MINIMUM SCHOOL STANDARDS FOR DISTRICT SAFETY

EMERGENCY PLANS AND SAFETY PROGRAMS

581-22-280 Each local district shall be responsible for management of a current comprehensive employee-student emergency plan and safety program for all departments and programs under its jurisdiction.

Statutory Authority: ORS 326.011; 326.051

SAFETY INSPECTION PRACTICES

581-22-282 Each local district shall conduct and document regularly scheduled safety inspections of all property under its jurisdiction.

Statutory Authority: ORS 326.011; 326.051

ACCIDENT PREVENTION IN-SERVICE

581-22-284 Each local district shall conduct an accident prevention in-service program for all employees.

Statutory Authority: ORS 326.011; 326.051

ACCIDENT REPORTING SYSTEMS

581-22-286 Each local district shall maintain an accident reporting system for accidents on district property, or involving employees, students or visiting public.

Statutory Authority: ORS 326.011; 326.051

SAFETY DEVICES

581-22-288 All schools shall provide necessary safety devices and instruction for their use for students and adults.

Statutory Authority: ORS 326.011; 326.051

EMERGENCY PLANS AND SAFETY PROGRAMS

Each local district shall be responsible for management of a current comprehensive employee-student emergency plan and safety program for all departments and programs under its jurisdiction. 581-22-280

	Compliance YES	Compliance NO
1. The school district has a printed overall safety policy.		
2. Policies concerning the organization and administration of the Industrial Education safety program are written and readily available for reference by all personnel.		
3. The responsibility for the administration of the Industrial Education safety program is with the same educational authorities who are responsible for all other phases of the educational program.		
4. Emergency evacuation procedures are posted specifically for the Industrial Education laboratories.		
5. Emergency information is kept on all students giving telephone number and address of both parents and place of employment of both and name and location of the family physician.		
6. Students with special medical problems are identified to alert instructor.		
7. A district administrator or appointed representative monitors all aspects of the Safety and Health Program within the district, implements policies and objectives, interprets regulations, provides leadership and counseling to teachers.		
8. A district administrator or an appointed representative prepares and oversees the maintenance of accurate records of accidents, injuries, corrective action taken, etc.		
9. Periodic safety inspections are made of all buildings and facilities under the control of the district. (Periodic means regular and frequent enough to maintain safe conditions.)		
10. The district Safety Officer attends local, regional and state safety meetings.		

ACCIDENT PREVENTION IN-SERVICE

Each local district shall conduct an accident prevention in-service program for all employees. 581-22-284

	Compliance	
	YES	NO
1. In-service education for all employees is provided which includes an orientation to the policies of the school safety program and no less than the following:		
a. Instruction on all equipment and vehicles and all safety regulations for each work area as assigned.		
b. Instruction and practice on the location and use of fire extinguishers, fire alarm signalling devices, first aid kits or supplies, telephones and telephone numbers for securing assistance.		
c. Employees are instructed to report unsafe conditions to their supervisor.		
d. Each employee is instructed to make full use of safeguards provided for his protection and refrain from operating equipment when safeguards are not in good working condition.		
e. Each employee is instructed to make full use of personal protective equipment (headgear, eyewear, clothing, etc.) when required by the school district or appropriate State of Oregon safety codes.		
f. Each employee is cautioned not to remove, deface or destroy any warning or danger sign or interfere with any form of accident prevention device.		
g. Employees are trained not to work in a dangerous manner which might cause immediate injury to themselves or others.		
h. All employees have been instructed in the practice of good housekeeping methods in all operations. (Materials shall be stored and handled so as to minimize falling, tripping or collision hazards.)		
i. Each employee is instructed to keep work areas free of scrap, waste material and debris.		
j. All employees are instructed to refrain from horseplay, scuffling, practical jokes or any other activity which has the possibility of causing injury.		
k. Teachers are instructed to assist students and other in implementing safety objectives as outlined in a district program.		

Accident Prevention In-Service
Page 2

	Compliance YES	NO
l. Teachers are instructed in the proper procedures to be followed in the event of fire, including notification of fire department and evacuation of buildings.		
m. Each employee is instructed on the proper procedures in completing accident reports.		

ACCIDENT REPORTING SYSTEM

Each local district shall maintain an accident reporting system for accidents on district property, or involving employees, students or visiting public. 581-22-286

Item	Compliance YES	Compliance NO
1. In the event of an accident or injury, the district safety officer, building safety officer and/or the principal should be notified as soon as possible by the injured employee/student or the employee who observed or discovered the accident.		
2. In the case of employee occupational injury or disease, a proper State Accident Insurance form should be completed by the affected employee for all occupational injuries or illness involving loss of time and/or medical care beyond that of first aid.		
3. In case of student injury a proper accident report should be filed in the district office. These reports should be used in correcting conditions and planning instructional activities.		
4. Proper accident reporting provides a management tool for instructing future accident inservice training.		
5. Accident reports are clear and concise with sufficient information to allow evaluation of unsafe conditions and recommendations for improvements.		
6. Accident records are tabulated on a regular basis. Accident records show:		
a. Accident frequency rate by grade level.		
b. Accident cause and nature of injury for total number of accidents.		
c. Accident frequency rate by area or building.		
d. Cause of injury compared to nature of injury.		

SAFETY INSPECTION PRACTICES

Each local district shall conduct and document regularly scheduled safety inspections of all property under its jurisdiction. 581-22-282

	Compliance YES	Compliance NO
1. Each school district conducts and documents regularly scheduled safety inspections of all property under its jurisdiction.		
2. Official Industrial Education facility and equipment inspections are conducted regularly.		
3. Inspections are planned well in advance to permit systematic and thorough evaluation.		
4. The district safety officer and the person in charge of Industrial Education safety are both present when official facility and equipment inspections are conducted.		
5. An approved shop safety inspection check list is used to inspect each individual shop facility and shall include, but is not limited to, the following items:		
a. Fire prevention - Extinguishing equipment available, exits marked and clear, panic hardware, alarms tested and functioning, stairways clear and properly lighted, fire drills conducted as required, electrical wiring in good condition, emergency lighting functioning, flammable liquids properly stored, new employees properly oriented, fire notification system functioning properly.		
b. Chemicals - Properly stored, identified, safe handling procedures reviewed with employees, appropriate protective equipment available.		
c. Hoisting equipment - Check condition of all electric, hydraulic or mechanical equipment including jacks, cables, safety hooks and support devices.		
d. Machinery and parts thereof - The point of operation, guards for shafts, couplings, gears, pulleys, drums, cables, belts, sprockets, rope and chains when used to transmit power, etc., are operating properly.		
e. Storage of materials - Stack materials so there is no danger of them falling during storage or removal.		
f. Flammable liquids, gases, sprays - Check for proper storage according to fire codes, proper grounding, cylinder tie down, handling devices, fire protection, including fire suppression blankets.		

Item	Compliance YES	Compliance NO
g. Pressure vessels, boilers and pipes - All equipment containing gas or liquids under pressure are operating properly and have pressure relief devices.		
h. Pumps, compressors, blowers and fans - Check moving parts for appropriate guarding and condition of wires and connectors.		
i. Shaftways, pits and floor openings - Check for safe marking or all types of openings into which persons may fall or trip; check for use of guardrails, etc.		
j. Warning devices - Alarms, vapor detectors, smoke detectors, emergency radio systems, emergency telephones, safety limit switches are operating properly.		
k. Vehicles - All trucks, cars, motorized carts, lift trucks, buses, vans, boats, etc., are in good operating condition. (Check with the Department of Education regarding school bus inspections.)		
l. Office area inspection - Floors, desks, power cords, file and storage areas, etc., are in safe condition.		
m. Miscellaneous - Be alert to other potentially hazardous objects or conditions that do not fall into above categories.		
6. There are records which show that the Industrial Education facilities are evaluated regularly by a school administrator, a student safety committee and the instructor, to establish and maintain a high standard of safety.		
7. An advisory committee composed of citizens of the community, SAIF and representatives of industry are invited to evaluate the safety program in the Industrial Education facilities and to make suggestions to improve safety practices.		
8. Unsafe conditions are reported as follows: Unsafe conditions, detected as a result of periodic inspection, which cannot be corrected at time of detection, shall be documented on an "Unsafe Condition Report", complete with budget estimate of correction costs. These reports will be prepared by the District Safety Officer or representative, with copies furnished to the Building Monitor concerned and the district administrator's office.		
9. The Unsafe Condition Reports are furnished to the district superintendent for review and corrective action.		

NOTE: For a more comprehensive and detailed safety check list for inspection of a specific Industrial Education shop, please contact the Industrial Education Specialists at the State Department of Education.

SAFETY DEVICES

All schools shall provide necessary safety devices and instruction for their use for students and adults. 581-22-288

		Compliance	
		YES	NO
1.	A safety instruction and enforcement policy is written and given to each student and signed by parents.		
2.	Illumination meets requirements for the work being done.		
3.	The proper uses of color and lighting and its effect on learning have been considered in the finishes of the walls, windows and ceilings.		
4.	Electrical lines and power supplies, volatile materials and storage areas are properly identified through application of the safety color coding recommended by the American Standards Association.		
5.	Fire extinguishers are proper type for this particular laboratory.		
6.	Fire extinguishers are adequately supplied, properly located and inspected regularly.		
7.	The number of exits are adequate and properly identified.		
8.	Ventilation is adequate for normal and laboratory uses.		
9.	Additional ventilation is available in painting areas, spray rooms, areas of extreme heat, and areas where caustic explosive or poisonous gases occur as a result of work in process.		
10.	The laboratory is cleaned and swept at the close of each period.		
11.	The tool and supply storage areas are designed to allow for safe removal and return of items.		
12.	Student lockers and storage areas are inspected regularly for cleanliness and prevention of fire hazards.		
13.	Non-skid floor surfaces are provided in the working area of each machine.		
14.	Traffic surfaces, location of stairways, aisles and floors, safety lanes around machines contribute to the safe movement of traffic within the laboratory.		
15.	All gears, belts and chains are protected by permanent enclosure guards.		
16.	All guards are in good working order.		
17.	All guards are used.		
18.	All switches are easily accessable to the operators.		

Safety Devices
Page 2

	Compliance YES	Compliance NO
19. All machines are in safe working condition.		
20. All machines can be locked off when the instructor is out of the room.		
21. All electrical outlets are grounded.		
22. All portable electrical hand tools are grounded through the electrical outlet.		
23. The main power source is easily accessable and can be shut off quickly.		
24. All electrical outlets are identified by voltage.		
25. Furniture and machines are adapted to the age level of the student.		
26. All blades and cutting tools are kept sharp.		
27. Benches, vises, glue table and other furniture are in good repair and operable.		
28. Machines, work stations, tool panels, are arranged to provide a safe working area.		
29. Goggles are worn at all times in the laboratory where eye hazards exist.		
30. Respirators are provided for dusty or toxic atmosphere conditions.		
31. Proper kinds of safe wearing apparel are worn properly for the job being done (protective device for hair and feet, aprons).		
32. First aid is administered only by the school nurse or the holder of a current first aid card.		
33. A well stocked first aid cabinet is available in the laboratory.		
34. General laboratory safety is taught as a part of the curriculum.		
35. Safe operation of all equipment is taught.		
36. A written and performance test designed to measure a student's knowledge of safety working practices in the shop is administered to each student.		