A GUIDE TO FACILITY PLANNING AND SAFETY IN

TECHNOLOGY EDUCATION

Developed in Cooperation With the

Wisconsin Department of Public Instruction
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and
The Wisconsin Technology Education Association

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FORWARD

Technology Education is a dynamic curriculum requiring innovation and change. As the world changes because of Technology, so must our schools. This *Guide to Facility Planning and Safety* was developed to assist educators in planning for the future.

This guide is intended to be a companion publications to the *State Curriculum Guide* and identifies alternatives, resources and specifications for the teacher to use in preparing a facilities proposal which will communicate their ideas to administrators, boards of education and lay persons in the community, and to architects.

The guide was developed through the efforts of the Wisconsin Department of Public Instruction, the Wisconsin Technology Education Association, the Wisconsin Vocational Industrial Clubs of America (VICA) and many dedicated teachers.

GUIDE TO FACILITY PLANNING IN TECHNOLOGY EDUCATION INTRODUCTION

Criteria for Facility Planning

Introduction

This guide is written for technology education teachers and facility planners. It should also be of use to school administrators, supervisors, members of school boards, architects, and others interested in planning for new or the renovation of existing technology education facilities.

The guide represents ideas, information, suggestions and a development process for use by teachers in the planning of technology education facilities and equipment. The ideas suggested follow the objectives of technology education program as outlined in the *Wisconsin Guide to Curriculum Planning in Technology Education, K-12.* It does not present solutions to specific problems.

New criteria strategies for planning technology education laboratories for today and the future are needed by teachers in the field. Innovations in education are bringing about a great need for change in school facilities. New and changing curriculums, team teaching, modular scheduling, programmed learning, and audio-visual media are all a part of these changes.

Some programs in technology education emphasize group techniques such as mass production activities and team approaches to solving problems. Therefore, contemporary facilities should provide for small group activities as well as large group activities and consider the combining of two or more classes working toward a common goal.

Today, new instructional materials and techniques play an expanding role in the educational environment. Many traditional industrial education shops are not designed to properly utilize such techniques as closed-circuit television and multi-media teaching approaches. These techniques need to be included to aid the teacher in effectively presenting some of the curriculum content and improving the teaching-learning process.

A major responsibility of a teacher is to arrange the learning environment in such a manner as to facilitate learning and to promote optimum educational results. Thus, every technology education teacher should continually strive toward the most efficient arrangement of tools and equipment in the laboratory. While some teachers may never be called upon to design a new technology education facility or to refurbish an older one, each must face the problem of providing the best possible physical arrangement of the lab setting.

The most important element, the student, must not be excluded in the facility planning. It is the student who will be using the facility to better prepare for the world of work. If the student's needs and concerns are not recognized, the basic purpose for which the facility is planned will be defeated. A lab should motivate the student to learn and become aware of what this environment has to offer. It should be a laboratory for learning with action oriented experiences that enable students to understand the relationship of school work to the world in which they live.

Sooner or later many technology education teachers may be faced with the problem of planning or reorganizing a technology education laboratory. This may range all the way from working with the architect in deciding the size, shape and general lab layout for an entirely new laboratory to the rearrangement of a room which has seen many years of service as a school shop. It may also include refurbishing a room which was designed for an entirely different purpose.

In many instances, the industrial education shops were was designed with traditional and sometimes outdated techniques. Technology education has often been allocated insufficient space for an effective and meaningful program. Facilities should be designed according to the program to be implemented within the allocated space. Technology education laboratories are a costly venture in any school system and require careful consideration and planning. A facility should give the most for the financial investment as well as fit the curriculum program and the needs of the students. The cost factor seems to restrict planning because it is felt that more space means more equipment. This need not be the case. The utilization of space and how it will function to reach the objectives of the curriculum should be given more consideration than the cost factor.

Labs should be planned for the future so they do not become prematurely obsolete. Improvements in the technology education program is needed if challenging curriculums, which will permit students to understand the world of work and its career opportunities, are to be effectively and efficiently implemented.

Elementary level technology education facilities should be planned to give students a better awareness of their world which is heavily influenced by industry and technology. At the junior high or middle school level, the technology education facility needs to provide for a wide range of exploratory experiences which become more in-depth and occupation oriented at the senior high level. This should be a continuing articulated program, not two or three separate programs. They should compliment each other and form an appropriate sequence for the student to follow. Program levels should be open entry, open exit to eliminate tracking of students.

The comprehension approach will assist students as we teach to their individual differences. The facility must be designed and equipped to allow the student not only to comprehend, but to analyze, synthesize, evaluate and apply the knowledge. The facilities should permit an easy transition for the student to progress through the curriculum sequence. Since educational events will be varied and often integrated, the facility must be capable of effectively permitting and supporting the necessary activities of the expanding curriculum. The uniqueness of a facility will be in its ability to be modified as new requirements are identified.

It is possible that the laboratory will have to be multi-purpose in nature as it transforms from one type of environment to another. The program may have several teachers or consultants in the laboratory to supervise the educational experiences necessary to implement certain aspects of a curriculum. A need may arise for the laboratories to be used during the day by students and the community during the evening hours. These extra hours may not be for specific, formal learning but merely open to the community for leisure time activities or to upgrade skills on an individual basis. The facility needs to be a versatile, multi-learning activity laboratory and not a simulated industrial facility. It must be able to respond to whatever setting the program curriculum content demands. The students may be working on individual problems, research, working as a team on a problem, or participating in the process of mass production from product orientation to product distribution. The technology education area for the program of the future must be one where change is not only possible but practical. This approach must provide for change taking place with minimum effort and expense. In order to accomplish this, continual change must be planned into the facility.

With the expansion of knowledge and the broadening outlook for the purposes of technology education, the curriculum content cannot hope to be effectively covered unless changes can be incorporated into new or existing facilities. The rapid growth of technology in automation is another force which is shaping the direction of change. The increasing number of job titles with new skill requirements and a need for new competencies and knowledge is bringing a need for new learning environments and new uses of present environments. Students must be educated to be ready and able to cope with new occupations.

Laboratories in a technology education department cannot be thought of only as individual areas of concentration but as one large area available to meet the student's needs and demands. The areas may be merely divided by work modules or by portable or powered foldable walls to divide processing areas from production or construction areas. A student may carry on independent study in a flexible environment which permits freedom to move from process to process, material to material or wherever is needed to complete their study. Independent areas may be established as departments within an industry and become integrated into a complete production problem by merely opening up the available space. Areas also need to be flexible enough to permit in-depth experiences where the curriculum is designed for upper levels of the total technology education program.

Real changes in the program can come with better utilization of present space equipping and laboratories. These elements of change will enable the student to better understand and experience the world of work. The space concept implies that versatility and flexibility are the important features to be considered in the planning process. The main point is that space should be subject to changing conditions and lend itself to a rearrangement of machines, tools, services and work stations. Space should be economically adapted to curriculum changes and capable of serving many functions. Space is not merely an end in itself but must be looked on as a means to a larger end with the intention of promoting the well being and increasing the productivity of its occupants. The facility should function and operate according to program content and activities. It must be functional and utilized to its maximum in order to provide maximum efficiency of the educational environment.

Time and effort spent in carefully planning technology education facilities will bring rewards of more effective teaching and learning experiences for students. Program, facility and teaching strategies go together. Facilities to the technology education program are like the chemistry laboratory to the science program or the gymnasium to the physical education program. Without the proper facility the program is likely to be limited and restructured. Limitations in space for technology education facilities cannot be afforded if it is expected to maintain a complete technology education program which will meet the objectives of the technology education program.

Rationale

We live in one of the most fascinating eras of time to be seen and recorded by modern day man. We are constantly bombarded by technological innovations, and will continue to do so at an astonishing rate into the future. We must prepare our youth to understand, expand and control this technological change so that they may prosper and grow as generations have done so before them. Technology education plays an integral role in the development of our young people as they prepare for life. In doing so we must consider the needs for teaching them about technology with regards to providing relevant curriculum and appropriate to facility design.

New criteria for planning technology education laboratories of today and the future are needed by teachers, administrators, architects and engineers in the field. Too often poor planning results in an outdated and improperly designed facility renovation, addition or new structure. As mentioned previously, innovations in technology education are bringing about a great need for change and flexibility in school facilities.

The technology education profession has evolved through many dramatic changes over the years of its existence. The manual training program movement began in the latter part of the 19th century. The manual arts program also came into being in America around 1893. Much of the emphasis during this era was influenced by the Arts and Crafts and apprenticeship movement in England.

Industrial arts was next in program evolution spanning from pre-World War I through World War II. The content base for teaching industrial arts was skill orientated. Out of this skill orientated curriculum grew the concept of unit shops. Also at this time Industrial arts broadened its horizons and become Industrial Education due to it being considered part of "general education." During the late 1960's and early 1970's dozens of new curriculum approaches to the study of industry and technology were designed as technology changed. Industry was considered the content base. We saw a combination of exploration type programs being developed. In the early 80's facilities began changing to accept these new curriculum approaches that dealt with "clusters" such as communications, transportation, manufacturing and construction rather than individual subjects such as graphic arts, woodworking and small engines. Open spaces dealing with the cluster concept began to replace specific unit facilities.

The beginnings of the study of technology evolved from a meeting of educators called the Jackson's Mill Project. Introduced was the concept of studying not only industry, but also technology in which "technology" is considered the content base. Since then technology education has built upon this concept and continued to evolve and grow to reflect current trends.

As one can clearly see, the necessary changes made to reflect contemporary technology in curriculum has also warranted changes in our teaching methodologies/strategies and delivery systems which in turn impact changes in facility design and utilization.

In many instances the space used for technology education reflects an earlier and outdated eras curriculum. New instructional materials and techniques play an expanding role in the educational environment. Many traditional "shops" are not designed to properly utilize such techniques as interactive video, satellite communications and the station approach to teaching technology education. In some instances the technology facility could be "shared" with other curriculum areas such as science, math and physics reflecting an interdisciplinary approach. Also important is the intra-departmental sharing of facilities. Technology facilities must be designed to reflect contemporary curriculums and allow for future changes so that they do not become prematurely obsolete. Flexibility is extremely important to allow the physical shape/design/layout to accept the changes demanded by contemporary curriculums. The uniqueness of the facility will be in its ability to be modified as new requirements are identified and implemented.

Some instructors may never be called upon to design a new facility or redesign an old one. However, each must face the problem of providing the best possible physical arrangement of the setting that is conducive to efficient learning. Every technology education teacher should strive toward the most efficient arrangement of tools and equipment in the facility.

The evaluation, modification of existing facilities or the building of a new structure requires careful planning by a "team" of dedicated professionals, students and community people involved in all aspects of the facility. Only through the cooperation and effort of the team can success be realized. Limitations in space for technology education cannot be afforded if it is expected to maintain a contemporary technology education program which will meet the needs as dictated by modern society.

The Planning Process

Introduction

Educational facilities should, of course, be designed and constructed to house educational programs. This includes all aspects of all programs including curriculum, instruction, students, staff, equipment, materials and supplies. As a result, decisions about these factors must be made before a facility can be adequately planned for either remodeling or new construction.

Because so many factors need to be considered leading to decisions about a facility, it is essential that a **long range facility improvement plan** be developed which parallels the **long range program plan.** Without such plans, time lines are difficult to maintain and important factors can easily be overlooked.

Usually a new, expanded or remodeled facility is the result of an influx of additional students or a redesigned program. Lately, however, technology education has not been experiencing an influx of additional students, so growth is usually the result of a conventional program being redesigned. But growth isn't the only factor that leads to a redesigned facility; improved effectiveness is often the main justification.

When programs have recently been redesigned, there is usually a long range plan in place. In such an instance, facility considerations have probably been scheduled into the process. It is unusual to see a facility being upgraded unless the program has been updated, the building is undergoing extensive remodeling in several program areas or a new building is being construction.

It is ideal to have a program evolve from a carefully developed plan. When this is the case, facility requirements unfold nicely with the plan. As was mentioned in the last paragraph, however, there are instances when the planning process needs to be accelerated because a building program is soon to be underway. When this is the case, the same programmatic factors need to be considered, only now the facility will be designed on the basis of careful study and good judgment rather than careful study, good judgment and experience. Flexibility is always an appropriate consideration. It is especially appropriate when the planning process must be accelerated.

There are five core areas to consider within the technology education laboratory.

- A production area is needed for the students to be able to build prototypes and production products. The production area can be divided into these areas: fabricating, assembling and production.

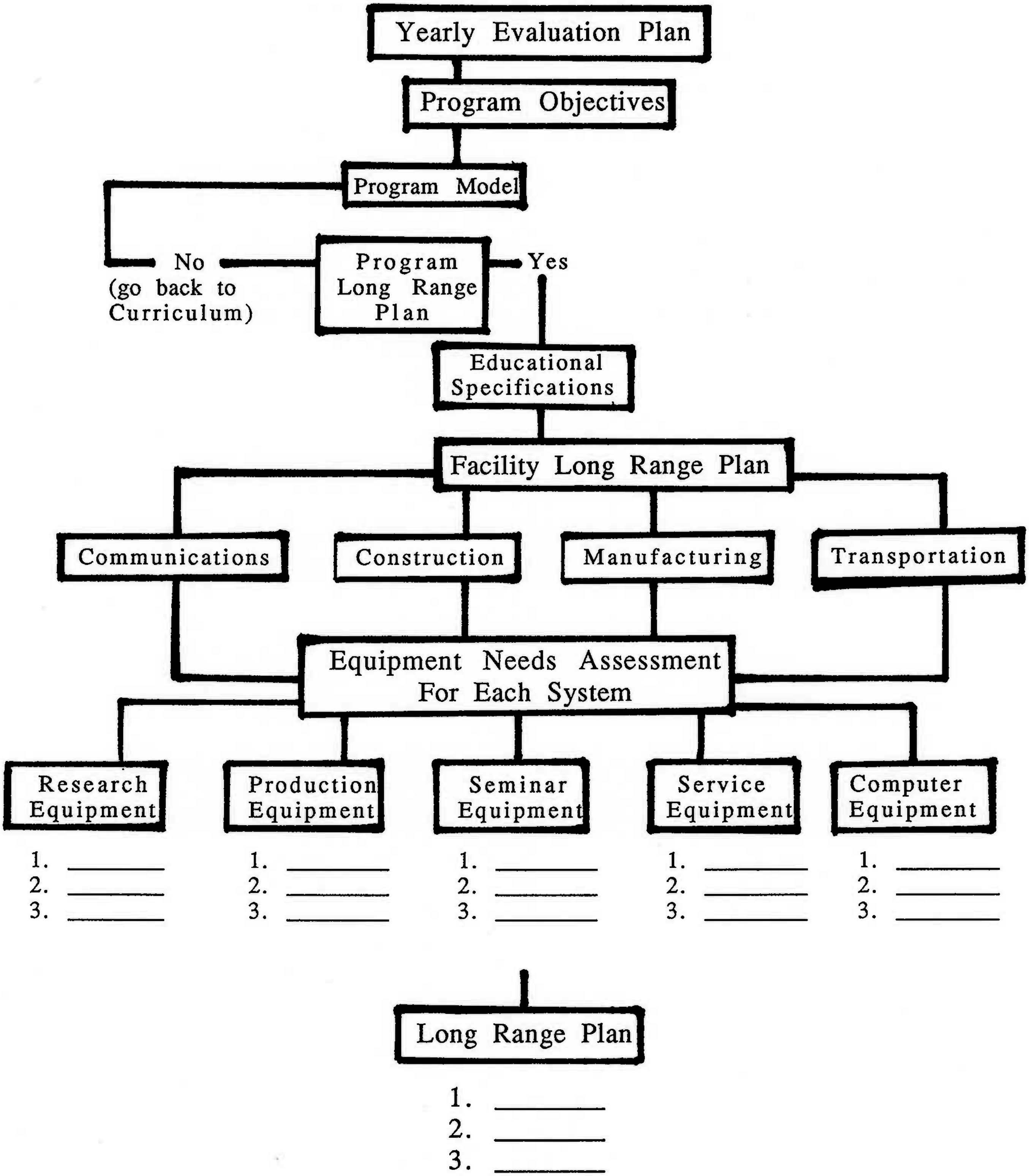
- A servicing area is most often associated with transportation system and encompasses electrical, solar and power types of exploration.

- Space needs to be provided for research this is often incorporated with the seminar or discussion.

- Specialized equipment involving computers and numerical controlled machines requires a designated space sometimes referred to as a "clean area." This will protect this equipment from dust and other production debris.

- The last space within a lab is the storage area. Be flexible on your storage room design as equipment and materials will change.

Model For Implementing a Technology Education Laboratory



The Long Range Plan For Facilities

A long range plan will serve several important purposes. First of all, the plan will serve the function the name suggests - it provides direction. To be a useful tool in providing direction, a good plan should include a goal statement, a set of measurable yearly objectives, a listing of activities that will help to attain the objectives, and a time line or schedule of events. The plan should also include a list of people who will need to have input into the plan. Referred to as a planning committee.

The goal should be broad, far reaching, challenging and elusive. That is, the goal should provide direction, be idealistic, but truly attainable. Objectives, on the other hand, should be more specific than the goal, be attainable and be measurable. They should be developed for each year of the plan. Activities should be sequential and if completed, enable the objectives to be attained.

In addition to providing direction, the facility long range plan is a communication link back to program plans as it communicates information to school decision makers. It provides information about what direction the program is taking, the pace at which it is progressing and what it will cost.

Cost is always a factor. However, if expenditures can be planned, they can be budgeted appropriately. Before submitting a budget, get administrator and school board approval of the plan. After the idea is approved, get approval of the budget one year at a time, but have a five year estimate for the total project. Plan to report progress from the previous year each time an annual budget is presented.

Following is a sample long range plan It is only a sample, however, with a few modifications, it could serve as a model for any district to follow.

SAMPLE

TECHNOLOGY EDUCATION

Local Long Range Plan for Program and Facilities

School District of ____________________________

Goal:

To implement an instructional program that will provide for technological understanding, exploration and skill development.

Objective 1.1 Program Objective

By August 15, 1994, the technology education staff will have developed, for implementation, courses at levels I, II and III* as evidenced by written curriculum program model and organized instruction.

Objective 2.1

By August 15, 1995, the technology education staff will have completed, for implementation, revisions of courses at levels I, II & III and development of courses at level IV as evidenced by written curriculum and organized instruction.

Objective 3.1

By August 15, 1996, the technology education staff will have completed, for implementation, revisions of courses at levels I, II, III & IV and development of courses at level V as evidenced by written curriculum and organized instruction.

Objective 4.1

By November 15, 1997, the technology education staff will have implemented the entire technology education program with courses at levels I, II, III, IV and V as evidenced by written curriculum, organized instruction and an evaluation report complied by a qualified third party evaluator.

* Course levels will vary in different models, however, in this sample levels one and two represent the middle school while levels three through five are high school level courses.

May 1993 to August 15, 1994

Objective 1.1

By August 15, 1994, the technology education staff will have completed, for implementation, courses at levels I, II & III as evidenced by written curriculum and organized instruction.

ACTIVITIES

1.1.1 By June, 1993, develop level III courses in communication, construction, manufacturing and transportation technology, complete with descriptions, objectives, a content outline, suggested learning activities and an evaluation strategy.

1.1.2 By July, 1993, collect learning activities from sources such as state education agencies, universities and local school districts.

1.1.3 By July, 1993, collect commercially produced materials such as texts and references.

1.1.4 During August, 1993, develop detailed content outlines for level III courses.

1.1.5 By September, 1993, select student learning activities for level III courses.

1.1.5 Learning activities are the basis for determining the kind, size and number of pieces of equipment. The equipment and teaching plan will determine the laboratory arrangement.

1.1.6 During August, 1993, revise courses at levels I and II.

1.1.7 During September, 1993, meet with counselors to explain new and revised course offerings.

Facility Plan

1.1.8 During October, 1993, orient the technology education staff to proposed changes and ask their assistance with the identification of materials, equipment and supplies.

1.1.8 Invite the entire technology education staff to participate with selection of equipment. Often, even a person reluctant to change will be willing to assist with equipment.

1.1.9 During October, 1993, develop and implement a plan of parent and community awareness and involvement.

1.1.10 During November, 1993, develop and implement a plan to attract to the program, students who are typically not served by technology education.

1.1.11 By October, 1993, identify materials, equipment and supplies for courses at levels I, II and III.

1.1.12 By October, 1993 prepare a budget.

1.1.13 During October, 1993, prepare and present a three year implementation plan to appropriate administrators.

1.1.14 By December, 1993, identify laboratories and develop an equipment arrangement plan for each lab at each school where level III courses will be offered.

1.1.15 By December, 1993, develop an equipment arrangement plan for each lab at each school where level III courses will be offered.

1.1.16 During the Spring & Summer, 1993, conduct curriculum/staff development workshops to evaluate and modify level I & II course work and to start detailed development of level IV offerings.

1.1.17 During July, 1994 purchase materials, equipment and supplies for levels I, II and III courses.

1.1.18 During August, 1994 prepare laboratories for operation.

1.1.12 The budget will include staff development, materials, travel, consultants and the like. This is where equipment installation and minor remodeling will be budgeted.

1.1.14 In this example, level three experiences are considered beginning courses at the high school level. Most likely these courses will have to be taught in existing laboratories until the new program can be more fully developed. Therefore, the labs will need to be reorganized to accommodate the new courses while at the same time, still serving the existing course offerings. This reorganization will be temporary, so it is important not to spend a lot of money remodeling.

1.1.17 Purchase equipment for the new program. Consider the fact that this equipment will be used in the remodeled laboratories.

1.1.18 Install new equipment. Be careful not to make the installation permanent. This is a good time to experiment with different arrangements.

1.1.19 Starting in August, 1993, teach courses at levels I, II & III.

1.1.20 During early October, 1993, attend area university sponsored technology education conferences.

1.1.21 During late October, 1994, attend the annual state association technology education conference.

April 1994 to August 15, 1995

Objective 2.1

By August 15, 1995, the technology education staff will have completed, for implementation, revisions of courses at levels I, II and III and development of courses at level IV as evidenced by written curriculum and organized instruction.

ACTIVITIES:

2.1.1 By April, 1994, involve additional technology education staff members in the program development process.

2.1.2 By June, 1994, develop level IV courses, complete with descriptions, objectives, a content outline, suggested learning activities and an evaluation strategy.

2.1.3 By July, 1994, collect new learning activities from sources such as departments of education, universities and local school districts. For upper level courses it may be necessary to look to specific schools and teachers for appropriate activities and materials.

2.1.4 By July, 1994, collect any new commercially produced materials such as texts.

2.1.5 During August, 1994, develop detailed content outlines for level IV courses

2.1.6 By September, 1994, select student learning activities for level IV courses.

2.1.6 Level four courses are those offered at the middle high school range. Again, the activities will serve as the basis for equipment selection.

2.1.7 During August, 1994, evaluate and revise courses at levels I, II & III.

2.1.8 During September, 1994, meet with counselors to explain new and revised course offerings.

2.1.9 During October, 1994, orient the technology education staff to proposed changes and ask their assistance with the identification of materials, equipment and supplies.

2.1.10 During October, 1994, continue implementing the plan of parent and community awareness and involvement.

2.1.11 By October, 1994 identify materials, equipment and supplies for courses at levels I, II, III and IV.

2.2.11 Even though some level three course equipment was already selected, additional equipment might need to be added because of what was learned from the first year of experience with the new program. Also, budget restraints may have caused acquisition to occur over a period of several years.

2.1.12 By October, 1994, prepare a budget.

2.1.13 During October, 1994, prepare and present a three year revised implementation plan to appropriate administrators. Drop the completed year and add a new year to maintain an up-to-date three year plan.

2.1.14 By December, 1994, identify laboratories and develop an equipment arrangement plan for each lab at each school where level IV courses will be offered. This may be the time to start thinking about the facilities needed to deliver courses at levels III, IV and V.

2.1.15 By December, 1994, develop an equipment arrangement plan for each lab at each school where level IV courses will be offered.

2.1.16 During the Spring and Summer, 1994, conduct curriculum/staff development workshops to evaluate and modify level III course work and to start detailed development of level V offerings. Course work at levels I, II & III will also be reviewed, but by now they should need only minor adjustments.

2.1.14 Just as for level three, level four courses will need to be implemented in existing laboratories until the program is fully implemented and new laboratories can be either constructed or remodeled. This is clearly the time to start serious consideration of new facilities. Apply the experience gained during the phase-in years.

2.1.15 Existing equipment will need to be rearranged and new equipment added. As with level three implementation, use this phase-in period as an opportunity to experiment with different arrangements.

2.1.17 During July, 1994, purchase materials, equipment and supplies for level IV courses.

2.1.18 During August, 1995, prepare laboratories for operation.

2.1.18 Rearrange existing equipment and install items just purchased for the new program. As before, don't install the equipment permanently. It will have to be moved when the new facility is completed.

2.1.19 Starting in August, 1995, teach courses at levels I, II, III and IV.

2.1.20 During early October, 1995, attend appropriate university conferences.

2.1.21 During late October, 1995, attend appropriate state association conferences.

April 1995 to August 15, 1996

Objective 3.1

By August 15, 1996, the technology education staff will have completed for implementation, revisions of courses at levels I, II, III & IV and development of courses at level V as evidenced by written curriculum and organized instruction.

ACTIVITIES:

3.1.1 By April, 1995, involve in the program development process those technology education staff members who were not previously involved.

3.1.2 By June, 1995, develop level V courses, complete with descriptions, objectives, a content outline, suggested learning activities and an evaluation strategy.

3.1.3 By July, 1995, collect new learning activities from sources such as state departments of education, universities and local school districts. For upper level courses it may be necessary to look to specific schools and teachers for appropriate activities and materials.

3.1.4 By July, 1995, collect any new commercially produced materials such as texts and references.

3.1.5 During August, 1995, develop detailed content outlines for level V courses.

3.1.6 By September, 1995, select student learning activities for level V courses.

3.1.7 During August, 1995, evaluate and revise courses at levels I, II, III and IV.

3.1.8 During September, 1995, meet with counselors to explain new and revised course offerings.

3.1.9 During October, 1995, orient the technology education staff to proposed changes and ask their assistance with the identification of materials, equipment and supplies.

3.1.10 During October, 1995, continue implementing the plan of parent and community awareness and involvement.

3.1.11 By October, 1995, identify materials, equipment and supplies for courses at all levels of the entire program.

3.1.11 This is the time to look back at the implementation of the earlier levels. Consider adding any equipment that might have been overlooked during the phase-in of the program. Also, consider equipment that will be needed for level five experiences. Level five experiences are advanced level offerings.

3.1.12 By October, 1995, prepare a budget.

3.1.13 During October, 1995, prepare and present a three year revised implementation plan to appropriate administrators. Drop the completed year and add a new year to maintain an up-to-date three year plan.

3.1.14 By December, 1995, identify laboratories and develop an equipment arrangement plan for each lab at each school where level V courses will be offered. This is the time to start planning the facilities that will be needed to deliver courses at all levels of the program.

3.1.15 By December, 1995, develop an equipment arrangement plan for each lab at each school where level V courses will be offered.

3.1.16 During the Spring and Summer, 1996, conduct curriculum/staff development workshops to evaluate and modify level IV courses. Course work at levels will also be reviewed, but by now they should need only minor adjustments.

3.1.12 Be realistic. This could be the most costly year of the process in terms of equipment acquisition. During this year, some additional equipment will be added for earlier levels of instruction along with equipment for upper level experiences. Level five equipment could be more sophisticated, thus more costly. Buy what you need, but don't over-buy. Also, it might be necessary to project the expenditures over several budget years. Look for outside sources of funding whenever possible. Finally, this is the year of serious facility planning. Look at "Factors to Consider."

3.1.14 Following are some "Factors to Consider" when planning for either remodeling or new construction. They are not presented in any particular order.

3.1.17 During July, 1996, purchase materials, equipment and supplies for level V courses.

3.1.18 During August, 1996, prepare laboratories for operation.

3.1.18 Although planning might already be underway for a new or remodeled facility, it might still be necessary to continue using the old facility until remodeling can take place.

3.1.19 Starting in August, 1996, teach courses at levels I, II, III, IV & V.

3.1.20 During early October, 1996, attend appropriate university sponsored conferences.

3.1.21 During late October, 1996, attend appropriate state association conferences.

DESIGN FACTORS TO CONSIDER

Introduction

In the planning process, emphasis was placed on curriculum and program model development and activity generation. These are essential elements that need to be considered in planning a new or remodeled facility. If this suggested process is followed, then these factors have already been taken into account. If, on the other hand, the program development recommended process is not followed because a facility is an immediate need, then serious consideration should be given to existing and projected curriculum and methods of instruction.

Design Factors To Consider

Populations Served

A high quality technology education program should serve all students regardless of their interests, sex, level of ability or learning style. As a result, the facility must accommodate these differences.

Aesthetics

Traditionally, school shops have been dark, drab and noisy with little regard for appearance, comfort or location. New facilities are being designed as learning laboratories that are inviting, efficient, comfortable, bright and located such that they are an integral part of the school.

Flexibility

Just like technology, society and other aspects of life, technology curriculum and methods of instruction are subject to constant change. Therefore, laboratories must be designed with change and flexibility in mind. Even if we are very sure of our curriculum at a given time, we can also be sure that it will change with time.

OCCUPATIONAL SAFETY AND HEALTH ACT AS APPLIED TO TECHNOLOGY EDUCATION FACILITIES

Safety in the Laboratory

Most technology education teachers will admit that although the unsafe acts of students cause most school shop accidents, and effective accident prevention program must begin with safe machines, tools, procedures, and environments. However, nearly all are caused by identifiable unsafe acts or conditions and are, therefore, avoidable. Major causes of accidents in the technology education shops include:

1. Unfavorable environmental conditions, such as exhaust, lighting, etc.
2. Lack of (or improper) fire protection equipment.
3. Lack of sufficient space.
4. Inadequate electrical systems.
5. Insufficient or poor materials storage.
6. Poor housecleaning in shops.
7. Insufficient equipment maintenance.
8. Lack of good safety instruction.
9. Enforcement of safety rules.
10. Unwise equipment selection.

Each of these causes can be prevented or offset by a good safety program, good laboratory planning and an equipment maintenance program.

Technology education teachers planning a new laboratory or remodeling an old facility must constantly be aware of safety and health needs when undertaking the task of securing necessary equipment and specifying other conditions in the facility. They are not only concerned with machine and tool safety, but also exhaust systems, ventilation, fire protection, electrical systems, personal safety equipment, and good laboratory organization. Every technology education teacher has the responsibility to make a determined effort to minimize the seriousness and affects of accidents that could occur in his laboratory.

Although the Occupational Safety and Health Act of 1970 (OSHA) was passed to assure safe and healthful working conditions for every man and woman, its implication for education institutions cannot be disregarded. Already, several states have established state plans regarding OSHA and its implementation.

Safety in industry is a matter of good training and education in safe working practices. Technology education can provide the environment and experiences to teach students safer working habits as they study about industry in the laboratory.

The goal of the Wisconsin Occupational Safety and Health Plan is to produce a recognized reduction in the reported industrial injuries and illness occurring annually in Wisconsin. It is intended to work towards the provision of safe and healthful work environments through the combined use of voluntary compliance, educational activities and meaningful sanctions applied where required. It is the intent of the State of Wisconsin to adopt and enforce the Federal standards.

It is recommended that each school system have available a copy of the State Plan and the Federal Register on Occupational Safety and Health Standards. In some cases further investigation will be necessary to find specific standards such as those found in the State and National Electrical Codes and the National Fire Protection Codes as well as Building Codes. Other standards organizations referred to are found in each sub-section of the Federal Register.

Sub-Sections of the Federal Register

There are many sections of the Federal Register that will have a direct effect on technology education facilities. It would be impossible to include all items in this guide. However, there are priority items in the Federal Register to which attention can be brought. They are as follows:

1. Walking - Working Surfaces (Subpart D).
   - 1910.22 - General requirements.
   - 1910.23 - Guarding floor and wall openings
   - 1910.25 - Portable wood ladders.
   - 1910.26 - Portable metal ladders
   - 1910.30 - Other working surfaces.
2. Means of Egress (Subpart E).
3. Environmental Control (Subpart G).
   - 1910.93 - Air contaminants.
   - 1910.94 - Ventilation
   - 1910.95 - Occupational noise exposure.
4. Hazardous Materials (Subpart H).
   - 1910.101 - Compressed gases.
   - 1910.102 - Acetylene.
   - 1910.104 - Oxygen.
   - 1910.106 - Flammable and combustible liquids.
   - 1910.107 - Spray finishing.
5. Personal Protective Equipment (Subpart I).
6. General Environmental Controls (Subpart J).
   - 1910.141 - Sanitation.
   - 1910.144 - Safety color code.

1910.145 - Specifications for accident prevention signs and tags.

7. Medical and First Aid (Subpart K).
8. Fire Protection (Subpart L).
9. Compressed Gas and Compressed Air Equipment (Subpart M).
10. Materials Handling and Storage (Subpart N).
    1910.176 - Handling materials - general.
    1910.177 - Indoor general storage.
11. Machinery and Machine Guarding (Subpart O).
12. Hand and Portable Powered Tools (Subpart P).
13. Welding, Cutting and Brazing (Subpart Q).
14. Electrical (Subpart S).

The following are some excerpts from the Federal Register on rules and regulations directly related technology education facilities.

1910.36 **General Requirements.**

(8) Every building or structure, section or area thereof, of such size, occupancy and arrangement that the reasonable safety of numbers of occupants may be endangered by the blocking of any single means of egress due to fire or smoke, shall have at least two means of egress remote from each other, so arranged as to minimize any possibility that both may be blocked by any one fire or other emergency conditions (11, p22130).

1910.95 **Occupational Noise Exposure**

Loss of hearing occurs as result of the cumulative effect of exposure to sound above a maximum intensity and over a maximum duration in a given period of time. For the purpose of this standard, the basic permissible intensity is 90 decibels, when measured on the "A" scale of a standard sound level meter set at "slow" response, for a duration of 8 hours out of a day. If the variations in noise level involve maximum at intervals of one second or less, it is to be considered continuous. Table I indicates the duration of exposure to higher sound intensities which will result in no more damage to hearing than produced by 8 hours at 90 decibels. Employees must not be exposed to steady sound levels about 115 decibels, regardless of the duration (11, p22157).

Table 1

Permissible Noise Exposures

Duration Per Day Hours	Sound Level in Decibels, Slow Response
8	90
6	92
4	95
3	97
2	100
1 1/2	102
1	105
1/2	110
1/4 or less	115

1910.94 **Ventilating**

Hoods connected to exhaust systems shall be used, and such hoods shall be designed, located, and placed so that the dust or dirt particles shall fall or be projected into the hoods in the direction of the air flow. Exhaust ventilating systems for removing contaminated air from a space, comprises two or more of the follow elements: (a) enclosure or hood, (b) duct work, (c) dust collector, (d) exhauster, and (e) discharge stack (11, p22144).

1910.101 **Compressed Gases**

All compressed gas cylinders shall be stored and transported in an upright position and lashed or chained so they cannot topple over. Caps shall be kept on all cylinders when not in use. All compressed gas cylinders should be shut-off at the cylinder valve and not at the regular (11,p22163).

1910.106 **Flammable and Combustible Liquids**

Flammable or combustible liquids shall be stored in tanks or closed containers. Fire resistance storage cabinets must be used and marked in conspicuous lettering. "Flammable - Keep Fire Away." A maximum capacity of not more than 60 gallons of flammable or 120 gallons of combustible liquids may be stored in a storage cabinet. The quantity of liquid that may be located outside of an inside storage room or storage cabinet in a building shall not exceed 25 gallons of Class IA (includes those having flash points below 73 degrees Fahrenheit and having a boiling point below 100 degrees Fahrenheit). At least one portable fire extinguisher, of proper type, shall be located outside of, not more than 10 feet from, the door opening into any room used for storage (11,p22169).

1910.107 **Spray Finishing**

All spraying areas shall be provided with mechanical ventilation adequate to remove flammable vapors, mists, or powders to a safe location and to confine and control combustible residues so that life or property is not endangered. Spray booths shall be construction according to correct specifications (11,p22187).

1910.132 **Personal Protective Equipment - General Requirements**

Protective equipment, including personal protective equipment for eyes, face, head, and extremities, protective shields and barriers, shall be provided, used and maintained in a sanitary and reliable condition wherever it is necessary by reason of hazards of processes or environment, chemical hazards, radiological hazards, or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation or physical contact (11,p22231).

1910.141 **Sanitation**
Housekeeping - all places of employment, passageways, storerooms, and service rooms shall be kept clean and orderly and in a sanitary condition (11,p22234).

1910.144 **Safety Color Code**
Red - identification of fire protection equipment.
Orange - designating dangerous parts of machines
Yellow - designating caution areas
Green - designating safety and first aid equipment
Blue - designating caution against use, moving, starting of equipment.
Purple - designating radiation
Black, white or combinations thereof - designating traffic and housekeeping markings (11,p22238).

1910.145 **Accident Prevention Signs and Tags**
Danger signs - used only where an immediate hazard exists. Color - red, black and white.
Caution signs - warn against potential hazards or caution against unsafe practices. Color - yellow and black.
Safety instruction signs - needed for general instructions and suggestions relative to safety measures. "Do Not Start," danger and caution tags should be used as temporary means of warning (11,p22239).

1910.151 **Medical Services and First Aid**
The employer shall ensure the ready availability of medical personnel for advice and consultation on matters of health. In the absence of an infirmary, clinic, or hospital in near proximity to the work place which is used for the treatment of all injured employees, a person or persons shall be adequately trained to render first aid. First aid supplies approved by the consulting physician shall be readily available (11,p22242).

1910.157 **Portable Fire Extinguishers**

A fire extinguisher, rated not less than 2A, shall be provided, for each 3,000 square feet of ordinary hazard occupancy, or major fraction thereof. Travel distance from any point of the protected area to the nearest fire extinguisher shall not exceed 75 feet. Portable fire extinguishers shall be inspected periodically and maintained in accordance with maintenance and use of Portable Fire Extinguishers shall be mounted properly in easy to get location and properly marked (11,P22243).

1910.212 **General Requirements for all Machines**

One or more methods of machine guarding shall be provided to protect the operator and other employees in the machine areas from hazards such as those created by point of operation, in-going nip points, rotating parts, flying chips and sparks. Guards shall be affixed to the machine where possible and secured elsewhere if for any reason attachment to the machine is not possible. Point of operation is the area on a machine where work is actually performed upon the material being processed. This area shall be guarded. Anchoring fixed machinery. Machines designed for a fixed location shall be securely anchored to prevent walking or moving (11,p22273).

1910.213 **Woodworking Machinery Requirements**

All belts, pulleys, gears, shafts, and moving parts shall be guarded in accordance with specific requirements of Section 1910.219.

Combs (feather boards) or suitable jigs shall be provided at the work-place for use when a standard guard cannot be used, as in dadoing, grooving, jointing, molding, and rabbeting.

A mechanical or electrical power control shall be provided for each machine to make it possible for the operator to cut off power from each machine without leaving his position at the point of operation.

On applications where injury to the operator might result if motors were to restart after power failures, provisions shall be made to prevent machines from automatically restoring upon restoration of power.

Power controls and operating controls shall be located within easy reach of the operator while he is at his regular work location making it unnecessary for him to reach over the cutter to make adjustments.

<u>Hand-fed ripsaws</u>

1) each circular hand-fed ripsaw shall be guarded by a hood which shall completely enclose that portion of the saw above the table and that portion of the saw above the material being cut. The hood and mounting shall be arranged so that the hood will automatically adjust itself to the thickness of and remain in contact with the material being cut but it shall not offer any considerable resistance to insertion of material to saw or to passage of the material being sawed. The hood shall be made of adequate strength to resist blows and strains incidental to reasonable operation, adjusting and handling, and shall be so designed as to protect the operator from flying splinters and broken saw teeth. It shall be made of material that is soft enough so that it will be unlikely to cause tooth breakage. The material should not shatter when broken, should be non-explosive and should be no more flammable than wood. The hood shall be so mounted as to insure that its operation will be positive, reliable, and in true alignment with the saw; and the mounting shall

be adequate in strength to resist any reasonable side thrust or other force tending to through it out of line.

2). Each hand-fed circular ripsaw shall be furnished with a spreader to prevent material from squeezing the saw or being thrown back on the operator. The spreader shall be made of hard tempered steel, or its equivalent, and shall be thinner than the saw kerf. It shall be of sufficient width to provide adequate stiffness or rigidity to resist any reasonable side thrust or blow tending to bend or throw it out of position. The spreader shall be attached so that it will remain in true alignment with the saw, even when either the saw or table is tilted, and should be placed so that there is not more than 1/2 inch space between the spreader and the back of the saw when the largest saw is mounted in the machine.

3). Each hand-fed circular ripsaw shall be provided with non-kick back fingers or dogs so located as to oppose the thrust or tendency of the saw to pick up the material or to throw it back toward the operator. They shall be designed to provide adequate holding power for all the thickness of material being cut (11,p2274).

<u>Jointers</u>

Each hand-fed planer or jointer with horizontal head shall be equipped with a cylindrical cutting head, the knife projection of which shall not exceed one-eighth inch beyond the cylindrical body of the head.

The opening in the table shall be kept as small as possible. The clearance between the edge of the rear table and the cutter head shall be not more than one-eighth inch. The table throat opening shall be not more than 2 1/2 inches when tables are set or aligned with each other for zero cut.

Each hand-fed jointer with a horizontal cutting head shall have an automatic guard which will over all the section of the head on the working side of the fence or gage. The guard shall effectively keep the operator's hand from coming in contact with the revolving knives. The guard shall automatically adjust itself to cover the unused portion of the head and shall remain in contact with the material at all times.

Each wood jointer with vertical head shall have either an exhaust hood or other guard so arranged as to enclose completely the revolving head, except for a slot of such width as may be necessary and convenient for the application of the material to be jointed (11,p22275).

Lathes

Lathes used for turning long pieces of wood stock held only between the two centers shall be equipped with long curved guards extending over the tops of the lathes in order to prevent the work pieces from being thrown out of the machine if they should become loose (11,p22276).

Sanding Machines

Each disc sanding machine shall have the exhaust hood, or other guard if no exhaust system is required, so arranged as to enclose the revolving disc, except for that portion of the disc above the table, if a table is used, which may be necessary for the application of the material to be finished.

Belt sanding machines shall be provided with guards at each nip point where the sanding belt runs on a pulley. These guards shall effectively prevent the hands or fingers of the operator from coming in contact with the nip points. The unused run of the sanding belt shall be guarded against accidental contact (11,p22276).

Miscellaneous

All knives and cutting heads of woodworking machines shall be kept sharp, properly adjusted, and firmly secured. Where two or more knives are used in one head they shall be properly balanced.

Push sticks or push blocks shall be proved at the work place in the several sizes and types suitable for work (11,p22276).

1910.215 Abrasive Wheel Machinery

Abrasive wheels shall be used only on machines provided with safety guards fitting specifications. The safety guard shall cover the spindle end, nut and flange projections. The safety guard shall be mounted so as to maintain proper alignment with the wheel, and the strength of the fastenings shall exceed the strength of the guard.

On off-hand grinding machines, work rests shall be used to support the work. They shall be of rigid construction and designed to be adjustable to compensate for wheel wear. Work rests shall be kept adjusted closely to the wheel with a maximum opening of one-eighth inch to prevent the work from being jammed between the wheel and rest, which may cause wheel breakage. The work rest shall be securely clamped after each adjustment. The adjustment shall not be made with the wheel in motion (11,p22278).

1910.242 **Hand and Portable Powered Tools**
Each employer shall be responsible for the safe condition of tools and equipment used by employees, including tools and equipment which may be furnished by employees.

Compressed air shall not be used for cleaning purposes except where reduced to less than 30 psi and then only with effective chip guarding and personal protective equipment (11,22295).

1910.309 **National Electrical Code**
Articles and sections of the National Electrical Code, NFPA 70-1971; ANSI-Ci-1971 (Rev. of 1968) shall apply to all electrical installations and utilization of equipment (11,p22342).

Guide for Implementing Eye Protection Programs in Wisconsin Schools

The eye safety law stipulates in Section 146.015(4) of the Wisconsin statutes that: "The state superintendent of public instruction shall prepare and circulate to each public and private educational institution in this state , instructions and recommendations for implementing the eye safety provisions of this section." In addition, Section 101.01(2)(e) stipulates that "frequenter means every person, other than an employee, who may go in or be in a place of employment of public building under circumstances which render the person other than a trespasser. Such term includes a pupil or student when enrolled in or receiving instruction at an education institution." Expanding the term "frequenter" permits state safety inspectors from the Department of Industry, Labor and Human Relations (DILHR) to include students as well as school employees and visitors in safety inspection coverage.

It is the responsibility of each educational institution's administration to ensure compliance with this law and with DILHR codes regarding eye protection. It is highly recommended that all school districts shall have a policy on eye safety. Regular orientation meetings should be held at least annually with the entire staff to fully explain the program and assign responsibilities for its implementation. The administrator should emphasize that compliance with and enforcement of the statutes are requirements of the instructional process.

An administrator or school safety coordinator[1] should conduct an inspection at least monthly to determine compliance with the law. Infractions should be immediately corrected. Repeated violations should be corrected by administrative action.

[1] "The responsibility for developing a total safety program should be delegated to a competent professional staff person who will be directly responsible to the superintendent or designee. The role of this person should include a combination of administrative and coordinator responsibilities concerned with the overall safety aspects of the school system, the title--School Safety Coordinator. (*Emergency Care Policies and Procedures for Wisconsin Schools*, Page 6, Paragraph 2. Published by the Division of Health, Wisconsin Department of Social Services.)

All staff members have the responsibility of ensuring that those persons in affected areas (whether visitors, students, faculty, or others) wear proper eye protection devices.

School safety coordinators should fully analyze the eye hazards involved in activities for which they are responsible and make faculty members aware of their responsibility for explaining to students the need for the type of eye protection specified.

For other eye hazard exposures not covered in this guideline, the hazard must be analyzed by the school safety coordinator in conjunction with the administrator to determine the appropriate eye protection required by the American National Standards Institute, Inc.

General Information

All eye-protection equipment must meet the current standards of the American National Standards Institute (ANSI), Practice for Occupational and Education Eye and Face Protection, Code Z87.1 - 1989, and subsequent revisions thereof. Prior to delivery and in bid specifications, suppliers must certify that devices for order meet the above mentioned standards.

1. Advantages of Industrial Safety Spectacles Over Standard Eye wear

   A. Safety lenses have greater strength than standard eye wear to help resist breaking.

   B. Safety lenses must be fitted into safety frames, and lenses must be trademarked and frames stamped Z87.1.

   C. Industrial safety spectacle frames are made of special materials for greater strength and fire resistance.

   D. Industrial safety spectacles equipped with side shields afford added protection.

2. Personal Eye wear

   A. Those desiring to wear their own prescription industrial safety spectacles may do so providing they meet the ANSI Z87.1 - 1989 standards and subsequent revisions thereof.

   B. Those wearing non-approved personal eye wear must wear chemical goggles meeting the ANSI Z87.1 - 1989 standards and subsequent revisions thereof.

   C. Federal Food & Drug Administration (FDA) "impact resistant" or dress eye wear lenses **do not meet** ANSI Z87.1 - 1989 standards.

3. Contact Lenses

   It is estimated that close to two million individuals in the U.S. are fitted with contact lenses each year, and approximately 20 million Americans already wear them. Many of these individuals are employed in industry. Contact lenses provide no eye protection at all. Soft contact lenses may absorb chemicals, especially vapors, resulting in an eye injury.

The National Society to Prevent Blindness (NSPB) has issued a position statement providing guidelines on the wearing of contact lenses in industrial environments:

> "Contact lenses sometimes provide a superior means of visual rehabilitation for employees who have had a cataract removed from one or both eyes, who are highly nearsighted, or who have irregular astigmatism from corneal scars or keratoconus. Except for situations in which there exist significant risks of ocular injury, individuals may be allowed to wear contact lenses in the workplace. Generally speaking, contact lens wearers who have experienced long term success with contacts can judge for themselves whether or not they will be able to wear contact lenses in their occupational work environment. However, contact lens wearers must conform to the prerogatives and directions of management regarding contact lens use. When the work environment entails exposures to chemicals, vapors, splashes, radiant or intense heat, molten metals or a highly particulate atmosphere, contact lenses should be restricted accordingly. Contact lens use considerations should be made on a case by case basis in conjunction with the guidelines of the Occupational Safety and Health Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH)."

Contact lenses, of themselves, do not provide protection in the industrial sense. For occupational use, contact lenses should be worn only in conjunction with appropriate industrial eye protection. Certain federal or state regulations may also limit their use.

4. Photochromic Lenses

For many general activities the ANSI Z87.1 - 1989 standards do allows the use of lenses whose depth of tint changes when exposed to varying amounts of daylight. They must be marked distinctly and permanently with the symbol "v" (variable) as well as with the manufacturer's monogram. Such lenses shall not be used when special protection from ultraviolet or infrared radiation is required. They also shall not be used when specially and/or specifically tinted lenses are required for such tasks as: welding, glass-blowing, and checking metal melt.

5. Maintaining Eye Protection Devices

Safety eye wear lenses must be kept clean. Continuous vision through dirty lenses can cause eye fatigue and contribute to accidents. Lenses should be cleaned as needed.

Pitted or scratched lenses reduce vision and seriously reduce protection. They must be replaced immediately.

Slack, worn-out, sweat soaked, knotted, or twisted headbands cannot hold an eye protector in its proper position. Replace headbands before they become inadequate.

Store eye-protection equipment in suitable cases or containers when not in use.

An eye-protection device is a personal item and should be used exclusively by the person to whom it is issued. They should be cleaned and disinfected regularly. If circumstances require reissuing or sharing, the protectors must first be cleaned and disinfected.

Cleaning Procedure: Thoroughly clean all surfaces with soap or a suitable detergent and warm water. Carefully rise off all traces of soap or detergent. Completely immerse the protector for 10 minutes in a solution of modified phenol, hypoclorite, or quaternary ammonium compound in a strength specified by the manufacturer and at a room temperature of 68° F. Remove the protector from the solution and suspend it in a clean place for air drying at room temperature or with heated air. Do not rinse; rinsing will remove the residual effect.

Ultraviolet disinfecting equipment may be used instead of the immersion described above, provided that such equipment can offer disinfection equal to the immersion.

When protectors need extensive cleaning, disassemble them to the extent possible without tools (prior to washing and disinfecting). Replace any defective parts with new ones.

Once the equipment is cleaned, disinfected, and thoroughly dry, place in a clean, dust proof container.

6. Using Cover Goggles

All cover goggles must be of the approved ANSI chemical type to provide maximum eye protection for all types of exposure.

Modifications for Special Needs Students

In the past, many special needs learners have been denied their basic right to a public education because of architectural barriers, non adaptive facilities, equipment, and tools. However, federal legislation has done a great deal to provide equal access to educational programs for every learner. For example, according to Section 503 of the *Rehabilitation Act of 1983*, each federally funded program or activity in which a handicapped individual can enroll and profit must be made accessible to the student (Sarkees & Scott, 1985). In addition, The Carl D. Perkins Act of 1990 has emphasized the importance of providing supplemental services for special needs learners, which include the adaptation of facilities, equipment, curriculum and instruction.

Modifying Facilities

A barrier-free planned for safety, efficiency, and convenience is of vital importance to individuals with special needs--especially those who are in wheelchairs, on crutches, or have artificial limbs. According to Sarkees & Scott (1985), three major areas in which architectural barriers may be present at most vocational education facilities are:

- Getting to and entering the building--getting to the ground from public or private transportation; parking; negotiating parking lot pavement, curbs, walkways, ramps, and stairways; and entering exterior doors;

- moving about inside a building--moving through corridors and hallways; moving from floor to floor; identifying and entering classrooms, laboratories, and auxiliary areas; moving through aisles and traffic lanes inside classrooms and laboratories, and

- using school fixtures, applieance, and study/work station area equipment--using rest rooms, drinking fountains, vending machines, tools, machines, and woprk station apparatus.

In an effort to eliminate these barriers, vocational educators, planners, and administrators should contact the State Architectural Barriers Board or State Department of Education regarding the guidelines and standards that have been developed for compliance with federal mandates. The federal government has adopted the American National Standards Institute (ANSI) accessibility standards as its mandatory guidelines for removal of architectural barriers.

Modifying Equipment and Tools

Based upon the needs of each special learner, it may become necessry to modify exisiting equipment and tools to accommodate the special needs student. The degree of modification will depend upon the type and extent of each student's impairment. It should be remembered, however, that equipment should be modified only to the extent necessary to assist the student. Whenever possible, as the student generates competence in a learning task, the modified equipment should be replaced with regular equipment. the following are some general suggestions in which equipment and tools can be modified for special classifications of special needs students.

Modifications for Orthopedically-Impaired Students

- Work tables can be cut out so wheelchair bound students can pull close to the work surface.
- Modify the height of workbenches, storage cabinets, table tops, etc. to make them accessible to wheelchair bound students.
- A lap board can be fitted on the arms of the wheel chair to provide a work area.
- Rearrange storage areas for toos and supplies to make them accessible and as near to the work station as possible.
- Position bench-mounted power tools on the neds of benches.
- Semistationary equipment should be put on variable height bases.
- Modify machine controls so they can be operated with prostheses, such as an arm hook.

- Replace cabinet knobs with levers or handles.
- Convert knob-type ON-OFF switches to toggle switches, levers or slide0adjustment mechanisms.
- Provide an aid that increases mechanical advantage in manipulating controls.
- Convert machines and equipment that have hand controls to the foot pedal type for student who have upper extremity disabilities.
- Select machines that do not require two-hand operation, such as a radial arm saw instead of a table saw.
- Place small parts or instruments on a foam pad to aid students in picking them up.
- Select tools that require only one hand to perate, such as split screwdrivers, which hold screws and bolts for starting.
- Provide holding devices such as vacuum vises, stationary vises, clamps, jigs, and fixtures that permit one-hand operation.
- Provide tools that supply more mechanical advantage to loosen or tighten screws or bolts, such as a lever-type socket set or an offset screwdriver.
- For students who have weak hands, increase the size of tool handles by replacing them with larger idameter handles or by enlarging them with tubbing or tape wrappings.
- Provide templates to aid drafting students who have trouble manipulating standard drafting instruments.

<u>Modifications for Hearing-Impaired Students</u>

- Install a red light next to the on/off switch so the student can tell when the machine is in operation.
- Install amplification devices on auditory warning signals so they can be heard by those with partial hearing.
- Use visual timers in place of those that emit sound.

<u>Modifications for Visually-Impaired Students</u>

- Purchase commercially available measuring tools with raised or engraved markings that can be read by touch.
- Purchase measuring devices that provide auditory signals.
- Enlarge markings on tools, tool holders, or machine controls.
- Provide jobs, guides, and templates to aid students in positioning and guiding tools.
- Identify controls by changing their size, shape, or texture.

Modifications for Mentally-Impaired Students

- Color code important parts of machines or equipment.
- Devise jigs, fixtures, templates, and guides to simplify work task operations.

Safety Checklist

The following checklist is designed merely as an aid to discovering areas in the technology education laboratories where safety hazards may exist. It does not attempt to cover everything included in the Occupational Safety and Health Act. The person using this checklist should be familiar with the rules and regulations found in the Federal Register. It is recommended that a safety consultant be made available for any questions you may have in regard to interpretation of the regulations.

SAFETY CHECKLIST FOR TECHNOLOGY EDUCATION

ITEM	APPEARS OKAY	NEEDS ACTION	N/A	COMMENTS
A. Walking-Working Surfaces.				
1. a. floors clean				
b. aisles clear				
c. floors dry				
d. operator non-skid				
e. aisles marked				
f. stairways clear				
2. Guarding floor and wall openings.				
a. stairway railings				
b. floor holes covered				
c. floor wells guarded				
d. floors fire proof in hot metals area				
3. Ladders				
a. properly braced				
b. no loose or broken steps				
c. safety feet provided				
d. proper material				
B. Means of Egress and Exit				
1. Way of exit access clear				
2. Exit clear				
3. Beyond exit clear				
4. Exits properly marked				
5. More than one exit				
6. Doors swing outward				
C. Environmental Control				
1. Dust collector				
a. adequate cfm				
b. all machines connected, where applicable				
c. floor sweep available				
d. ducts correct size				
e. on/off switch in lab				
f. clean out trap provided				
g. hopper sufficient				
2. Fume control				
a. ducts over hot metals				
b. adequate cfm				
c. size adequate				
d. welding booths ducted				
e. adequate size for (d)				
f. adequate cfm for (d)				
g. darkroom ducted				
h. spray booth ducted				
i. finishing room ducted				
j. diazo machine ducted				

ITEM	APPEARS OKAY	NEEDS ACTION	N/A	COMMENTS
3. Noise level				
a. safe noise level				
b. baffling provided in extremely noisy areas				
D. Hazardous Materials				
1. Acetylene/Oxygen				
a. containers marked				
b. cylinders tied down				
c. cylinders stored upright				
d. caps on unused cylinders				
e. valves closed (not in use)				
f. safe distance from welding bench				
g. on/off wrenches in position				
h. all fittings tight				
2. Flammable and combustible liquids				
a. kept in locked storage				
b. metal storage cabinets				
c. proper ventilation				
d. 25 gal. limit outside storage cabinet				
e. fire extinguisher within 10 ft. of storage room				
f. properly marked				
g. metal containers used for storage of liquids				
E. Personal Protective Equipment				
1. Safety glasses available				
2. Face shields provided in hot metals area and on lathes				
3. Welding goggles provided				
4. Face masks for spraying				
5. Hard hats provided where applicable				
6. Rubber protective equipment in electrical area				
7. Hot metal clothing				
8. Fire blanket provided				
9. Hearing protection provided				
F. Sanitation				
1. Waste disposal available				
2. Rest rooms nearby				
3. Drinking fountain nearby				
4. Wash sinks available				
5. Cleaning sink available				
G. Safety Color Code and Markings				
1. Color codes used				
2. Accident prevention signs				
a. danger signs				
b. caution signs				
c. safety instructions signs				

ITEM	APPEARS OKAY	NEEDS ACTION	N/A	COMMENTS
3. Accident prevention tags				
a. out-of-order tags				
b. do not start tags				
c. danger tags				
d. caution tags				
H. First Aid				
1. First aid cabinet supplied				
2. First aid cabinet marked				
I. Fire Protection				
1. Fire extinguishers				
a. properly marked				
b. hanging properly				
c. easy access				
d. inspected and marked				
e. proper types				
f. located within 75 feet of anywhere in shop				
J. Compressed Air				
1. Valves off when not in use				
2. Air pressure gauges at all locations where used				
3. Air outlets not in use properly capped				
4. Moisture drains in lines				
K. Machinery				
1. Guards				
a. affixed to all machines				
b. working properly				
c. belts and pulleys guarded				
d. adjusted properly				
2. Fixed machinery anchored				
3. Blades kept sharp				
4. Push sticks available				
5. Grinder table adjusted 1/8" from wheel				
6. Color coded				
7. Operator zone marked				
8. Machines maintained				
L. Hand and Portable Powered Tools				
1. Properly maintained				
2. Portable powered tools properly guarded...				
3. Portable powered tools properly grounded				
M. Electrical				
1. Magnetic switches on all machines				
2. All machines properly wired				
3. Proper conduit used for all wiring from bus-duct				
4. Panic buttons accessible				
5. Proper grounding on all electrical wiring				
6. Adequate amperage for operating needs....				

ITEM	APPEARS OKAY	NEEDS ACTION	N/A	COMMENTS
7. Main switch box in lab..				
8. All machine switches reached by operator..				
N. Miscellaneous Comments..				

INITIATING FACILITY CHANGE

Introduction

The stimulation that results in changes to a technology education facility can originate from a great variety of sources. They may be outside of the system or within the system. Whatever the source, each of them should be treated as complementary to the ideas of the classroom teacher of technology education.

Many times influence within the system as well as influence outside of the system are disguised and are difficult to recognize. One of the purposes of this chapter is to identify many of the forces which should be evaluated by those who are considering facility modification so the forces can be recognized for their influence and used to advantage when the need or desire for change occurs.

The forces which are discussed in the following text include:

Internal Forces

-Administrative Decisions
-Populations
-Curricula and Programs
-Methods, Delivery Systems, and Strategies
-Philosophical Changes
-Colleagues

External Forces

-Society and its Evolution
-Professional Trends
-Advisory Groups
-Legislation
-Associations and Organizations

Once a decision to pursue a facility change has been made, following a planned sequence is more likely to assure success than would a random procedure. The second purpose of this chapter is to provide a suggested sequential process for implementing the changes. Some steps to include in a planning sequence are:

Suggest Sequence for Planning

-Obtain approval
-Budget sufficient time
-Develop a time-line
-Select participants
-Evaluate facilities
-Collect information
-Develop specifications
-Prepare plans

Internal Forces Influencing Change

Administrative Decisions: Administrators--including boards, district administrators, principals, and department chairpersons--by the nature of their position may have a different perspective than the classroom teacher. When changes are not forthcoming they may intercede and issue edicts directing change. Such direction may be positive or negative. Directions may be in the form of safety requirements, changes to the environment, or curriculum changes, any or all of which can require facility changes.

Populations: District population and school enrollment, usually related, can have negative or positive influences on facilities. An Increasing enrollment and facility expansion logically complement each other as need for pupil space becomes apparent, whereas a reduction in numbers is considered to be detrimental to any facility plans. However, smaller enrollments may become the impetus for consolidating facilities. Consolidating or reorganizing of existing facilities may cause interest to be generated in technology education. Population size is not the only factor to consider. Population make-up is equally as important. In contemporary technology education program facilities must be accommodating for students of both sexes, students who have physical and learning disabilities and students of many ages and sizes.

Curriculum: The major influence causing changes in facilities is the curriculum itself. Content added to existing curricula and content replacing existing curricula may necessitate adding to or remodeling classroom space. Content including communications, construction, manufacturing, and transportation may be more advantageously presented in classrooms different from the traditional industrial education classrooms. Such curriculum evolution promotes facility changes. Consequently, when curriculum changes occur, facility changes may follow.

Methods of Teaching, Delivery Systems, and Strategies: Teachers directed activities in a classroom with multiples of equipment was for many years the primary delivery system in industrial education classrooms. Contemporary technology education programs use individualized instruction with tapes, interactive video, computer-assisted instruction, and other electrical-electronic systems. Such a delivery system necessitates an environmentally-controlled area which reduces fumes, dust, and great variations in temperature to protect complex, expensive and delicate equipment.

Group learning and individualized learning may require different methods and strategies as well as different delivery systems, all of which may require variations from the large single-room classroom typical of traditional industrial education facilities.

Philosophical Changes: Many times the content remains the same but the teacher's emphasis changes. For example, wood may remain as the major medium in a technology education program but technical application may replace skill development as the major objective. Testing and experimenting stations may become integral to the curriculum. Such changes in belief, priorities, or philosophy may be followed by a recognition of the need for facility renovation to provide learning cells or station. A change in belief or philosophy of this nature may be followed by development of such learning stations needing minor or even major physical changes in the facility.

Colleagues: Other teachers are frequently ignored as a source of ideas and influence for facility change, but colleagues in other academic disciplines, as well as technology education, may provide ideas from which potential facility changes can evolve. Suggestions of team teaching or other interdisciplinary activities may imply variations in classroom arrangement or actual physical changes in the facility. All human resources should be used to advantage when they are available.

External Forces Influencing Change

Society and Its Evolution: Much has been written about how our society has evolved from an industrial society to an information society. The impact of new technologies has been greater felt more in technology education than in most other disciplines and has necessitated re-evaluation of some traditional industrial education activities. Many new activities have been added in existing programs which require new and different philosophies, equipment and facilities.

School district citizens have become more and more cost conscious as their taxes increase to fund more costly activities in education as well as other tax supported institutions.

Professional Trends: Wisconsin technology educators can look within the boundaries of the state and find trends of change. Dynamic teachers of technology have shown leadership by implementing exciting new philosophical approaches to technology education by upgrading facilities and programs. The Wisconsin teacher-education institutions, anticipating future needs, have supplemented existing courses and added new technology content to programs and curricula. The guides to curriculum planning issued by the Wisconsin Department of Public Instruction have been accepted as models for other states' planners.

Although Wisconsin is a focal point for educational evolution, it is not entirely unique. Other state and national efforts have also added influence and direction for educators considering change. It is apparent that local, state and national efforts have all aided in developing a climate for change and have exerted influence on many technology educators to bring about facility modifications in their localities.

Advisory Groups: Alert members of advisory groups frequently are among the first to recognize that public school programs are not providing adequate technological understanding, occupational awareness, exploration or readiness. They provide input in the form of basic education concepts as well as basic technology concepts expected of potential employees. Advisory committees are one of education's connecting links to society and the world of work; they exist to provide guidance and direction; their suggestions should be given strong consideration.

Legislation: Both state and national legislation have become primary sources of initial funding for technology education programs. Although in some cases the result may be the "tail wagging the dog" when programs are designed to meet the parameters of the legislation, the importance of legislation as an influence cannot be minimized. Many good programs owe their successful implementation to legislation which has provided a source of funding, direction and influence.

Associations and Organizations: The International Technology Education Association, Wisconsin Technology Education Association, State Technology Education Advisory Committee, local technology education associations, and other associations publish special resources, newsletters, and articles in journals which document procedures and processes for facility modifications. Such resources should be consulted by those who are contemplating changes to facilities.

A Sequence of Facility Related Factors to Consider in a Long Range Improvement Plan

The following is a list of facility related factors that should be considered when planning a new facility or a remodeling project. The items are listed in a sequence that follows a logical order of events that would be contained in most long range plans for improving technology education. These factors also correspond with the planning sequence that is suggested in *A Guide to Curriculum Planning in Technology Education,* published by the Department of Public Instruction.

<u>Obtain Approvals</u>: An advantage of having a long range plan is that it serves as a communication tool. It helps planners communicate with decision makers. Get approval, in concept, for the entire long range plan. Then get approval one year at a time for budget items, including ongoing facility and program planning and design.

<u>Budget Sufficient Time</u>: Since planning curricula, instruction and the facility takes time and a lot of hard work if the job is to be done correctly, sufficient time must be provided to assure that the necessary work can be completed. Summer workshops provide a good time to get staff together for planning purposes, however, some time will be needed during the school year if, for example, visits are to be made to other schools while they are in operation.

<u>Develop Schedule</u>: Even though a long range plan is being used for development of the total program, it is important to develop a sub-plan for designing the facility. Develop a time-line or schedule of events that will fit within the scope for the overall program plan. Be sure to consider how an evolving curriculum will be accommodated before the new or remodeled facility is completed.

<u>Select Participants</u>: Select members of the planning team. Get a good representation of technology teachers, teachers of other related subjects, advocates of special student populations, administrators, school board members and advisory persons from the community.

Evaluate Facility: Evaluate the existing facility to determine the extent to which it is consistent with the new program. Consider possibilities of minor remodeling, major remodeling and new construction. Examine other facilities from which additional ideas may be adopted.

Collect Information: Visit other schools, request information from your state and national technology education associations, departments of public instruction, colleges and universities with recognized quality technology education programs and check the library for recent journals.

Develop Specifications: Develop a set of specifications that will help with the transition from the program design to the facility plan. This will be a series of statements describing the needs that have to be accommodated by the facility. Consider curriculum organization, methods of instruction, types of activities, number student populations to be served and the nature of the equipment that will need to be accommodated.

Prepare Plans: Develop a set to sketches. Make a concept drawing. That is, sketch a floor plan of the facility. Use "bubble" drawings to represent space. This drawing will help to communicate ideas from the specifications to decision makers and later, the architect. Don't get too settled on an idea. Leave room in your thinking for suggestions and new ideas.

Space Needs

Once the instruction program is defined and the scope and sequence of courses established, space needs should be established as a vital part of the education specifications. School and technology education enrollment, class size, number of class sections, the balance between required and elective courses, availability to boys and girls, amount and nature of equipment and student/teacher activities to be implemented must be weighted in determining space. Although each school is different and, therefore, it is necessary to estimate space according to the local conditions, there is a minimum size for laboratories of given types.

Some guidelines suggest that "a figure of 25 percent of the school membership be used to determine the number of students which will elect technology education courses." Obviously, however, this depends on the school's program policies and consequently the 25% figure can range from 25% to 100%. To calculate the space required, the estimated enrollment then needs to be multiplied by the square foot per student allocations for each technology area as recommended in Table 2. For example: For a junior high school manufacturing laboratory, using a middle-of-the-road 100 square feet per student standard, and an estimate of 20 students/class, yields a general area requirement of 2,000 square feet.

Planners need to keep in mind that there are three basic space requirements which should be considered. They are (1) station allowances - space for basic equipment, teaching system, work area for students around equipment, and...safety clearance; (2) station circulation burden--general circulation allowance within that area of the laboratory containing stations, such as aisle space and traffic patterns; (3) general circulation--space allowance for general support facilities, such as clean up and future expansion. This last space category usually amounts to about 25% of the total of (1) and (2). The space allocations recommended in Tables III-1 and III-2 are minimums for technology education programs. Professional judgement suggests they work best with class sizes of 15-24.

MINIMUM FACILITY RECOMMENDATIONS
INTRODUCTORY TECHNOLOGY EDUCATORS
GRADES 6, 7, AND 8

Technology Instrucational Arrangement	**Existing Facility** (*) Recommended minimum safe area. (square feet per student approximately 80% of new facility).	**New Facility** (*) Recommended design standard for a class of 24 students. Minumum Area and Utilization.
General Data Applies to all laboratories unless listed differently.	The maximum number of students per class period isequal to the existing floor area divided by the safet square feet per student recommended below. Not to exceed 24 students total.	Office ....100 sq. ft Supply storage ....5% of area Material storage ....5% of area Student storage...........10% of area Resource center ....5% of area Class discussion..........15% of area
Communication Technology Lab for Introductory Technology I, single area of instruction.	53 square feet per student	1600 square feet inclusive Dust-free atmosphere Dark Room...........20% of area Machine ....5% of area
Energy Technology Laboratory for Technology I, single area of instruction	53 square feet per student	1600 square feet inclusive Fume exhaust system Bench..................20% of area Machine ....15% of area
Production Technology Lab for Introductory Technology I, single area of instruction	106 square feet per student	3200 square feet inclusive Dust collection system Bench..................15% of area Machine ....15% of area Processing ....20% of area
Manufacturing Technology Lab for Technology II, single area of instruction	106 square feet per student	3200 square feet inclusive Dust collection system Bench..................15% of area Machine ....15% of area Processing ....20% of area
Construction Technology Lab for Introductory Technology II, single area of instruction	106 square feet per student	3200 square feet inclusive Dust collection system Bench..................15% of area Machine ....10% of area Processing ....25% of area
Introductory Technology I Laboratory (All three Technology areas taught in the same facility)	133 square feet per student	4000 square feet inclusive Dust-free communications area Dark room............5% of area Bench..................15% of area Machine ....15% of area Processing ....15% of area
Introductory Technology II Laboratory (Manuf. and Const. Tech. Taught in same facility)	133 square feet per student	4000 square feet inclusive Dust Collection system Bench..................15% of area Machine ....10% of area Processing ....25% of area
Introductory Technology I & II Comprehensive Laboratory	166 square feet per student	5000 square feet inclusive-- Multi-activity facility--Combine values in Intro. Ind. Technology I & II

• Facility is used here to identify a single laboratory or education space for a course

MINIMUM FACILITY RECOMMENDATIONS
TECHNOLOGY EDUCATION--GRADES 9-12

Technology Course	**Existing Facility** (*) Recommended minimum safe area. (square feet per student approximately 80% of new facility)	**New Facility** (*) Recommended design standard for a class of 24 students. Minumum Area and Utilization.
General Data Applies to all courses unless listed differently.	The maximum number of students per class period isequal to the existing floor area divided by the safe square feet per student recommended below. Not to exceed 24 students total.	Office ....100 sq. ft Supply storage ....5% of area Material storage...........5% of area Student storage...........10% of area Resource center ....5% of area Class discussion..........15% of area
Engineering Graphics Construction Graphics Computer Applications Electricity/Electronic Systems Principles of Technology Applied Technology Biotechnology	66 square feet per student	2000 square feet inclusive (Single activity facility) Dust-free atmosphere
Communications Systems Energy Systems Communication Graphics Power/Transportation Systems	100 square feet per student	3000 square feet inclusive (Single activity facility) Dust-free atmosphere Fume exhaust system Work surface.........15% of area Machine space ......15% of area Dark room-Grf. Comm................10% of area Dark room-Photo....20% of area
Production Systems Manufacturing Systems Construction Systems	133 square feet per student	4000 square feet inclusive (Single activity facility) Dust and fume collection system Material storage for stock up to 18 feet long..........8% of area Student storage.....12% of area Planning area ....5% of area Bench..................15% of area Machine ....15% of area Processing ....15% of area
Technology Systems (All three technology areas taught in the same facility) Comprehensive Laboratory	166 square feet per student	5000 square feet inclusive (Multi-activity facility) Each technology area in the facility to meet or exceed the recommendations listed above.
Any two courses taught in the same facility	Add the square feet per student for each area and multiply the total by .75.	Add the square feet for each area and multiply the total by .75. Each course area in the facility to meet or exceed the recommendations above.
Research and Development	Space requirements must match that of the Technology area being taught	

(*) Facility is used here to identify a single laboratory or education space for a course

Auxiliary Spaces: in order for Technology Education facilities to work effectively, suitable auxiliary spaces are absolutely necessary. Those include storage areas for tools, materials and projects, finishing rooms, darkrooms, office space, classrooms and many others as facilities become more specialized. These spaces should be planned separately but in relationship to the main laboratory. Specifications for each auxiliary area should be very explicit and include all necessary accessories, such as lighting, electrical, ventilation, exhausting, built-in features, shelving and built-in cabinets.

- An instructional area (class size) and resource center should be planned within or near the technology education department. It should be adjacent to the main lab areas for easy access and partitioned preferably with glass walls for proper supervision. Proper layout can make the instructional area accessible to several main work areas.

  In smaller schools where fewer sections are scheduled, the classroom may be designed as a multi-purpose room. It may serve as a planning center, resource center, technical library and may be used for small group discussions as well as a classroom. Normally, this area may have a lower ceiling height providing a mezzanine for potential storage overhead.

- Storage areas should be adjacent to, but separated from, the main work area. They must be designed to form an integral part of the laboratory's operation. Large storage areas should be provided for such materials as lumber, metal and plastics. Doorways into storage areas must be positioned correctly so the materials may be moved in and out easily. This positioning is also related to the location of vertical or horizontal racks to be used inside the room. The number of racks will be determined by the quantities of materials needed during the year. These rooms should also be located near where deliveries are made and close to the first processing operations to eliminate, as much as possible, material handling. When designing a new facility there are many items of storage which may be built-in and the cost absorbed in the building contract. For example, a darkroom sink or fixed storage racks should be included in the cost of construction and not taken from the equipment budget. Consideration should be given to sharing storage space between labs

- A finishing room, free of dust, should be provided adjacent to the manufacturing laboratory. It is recommended that visibility be provided for instructor supervision of the area. It is extremely important to check local fire regulations and building codes regarding requirements for a finishing room. These codes usually require explosion-proof electrical fixtures and exhaust fans ducted to the outer atmosphere. A filtering system should be provided. Fire resistant finishing cabinets must be used for storage for all flammable liquids. In some cases, only a limited amount of flammable or combustible liquids may be stored in the finishing room. A fire extinguisher must be located within ten feet of the door leading into where these liquids are stored. If a spray booth is provided it must meet the regulations and be properly filtered and connected to an exhaust system. For safety reasons, the fume exhaust on the spray booth should have an automatic cut-off when the air flow drops below an unsafe level. Also, it is recommended that an automatic sprinkler system be installed in the finish room. It is also a good idea to provide drying shelves or racks.

- The office area should provide a space for the instructor to plan and organize the instructional program. It should also be semi-private for counseling of students. It is preferred that the office(s) be located near the laboratory for easy access to needed materials. Offices should be equipped with a desk, chair, planning table, file cabinets, bookshelves, a telephone, and a computer.

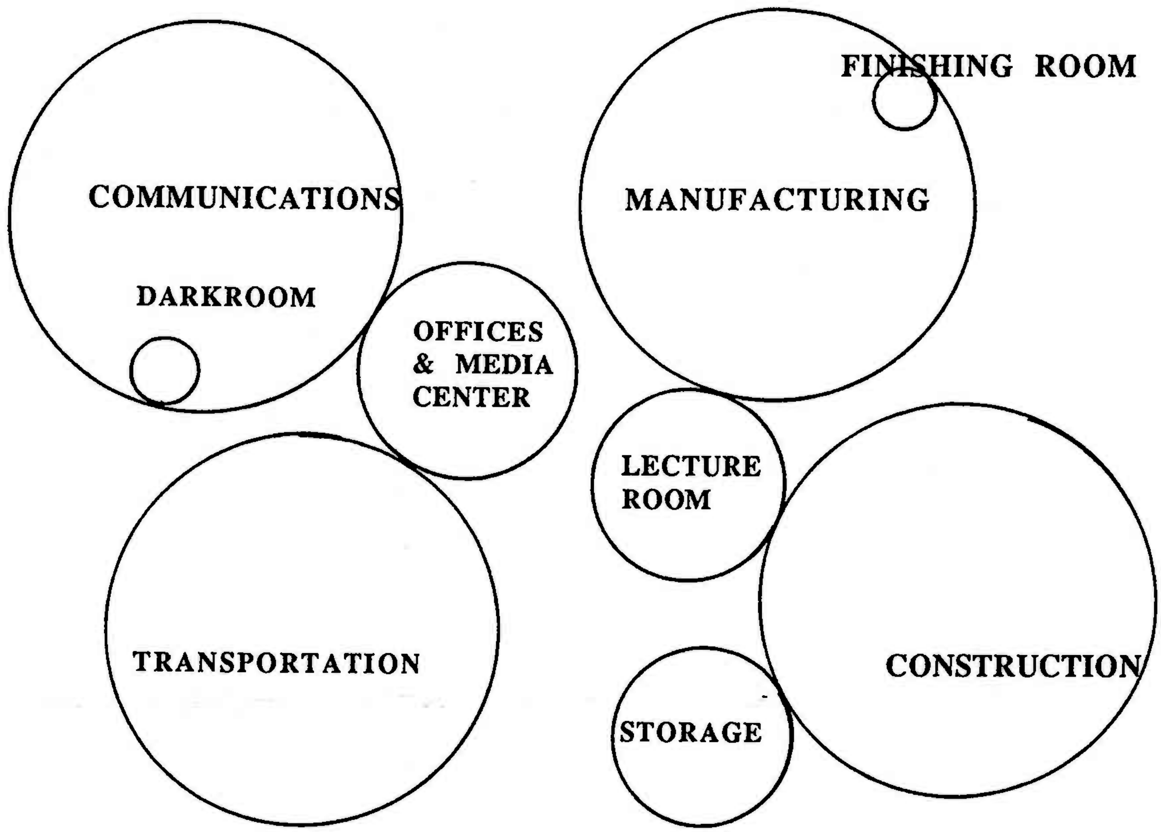
Space Relationship: The shape of the spaces and their relationships to each other, and to other areas of the school, are equally important. The shape may vary from square or rectangular to other geometric shapes, but more important are maximum efficiency in traffic patterns, safety, clustering of areas, flexibility and good supervision. Any shape which does not permit complete visibility for the instructor from any position in the laboratory should be avoided.

Along with the recommended floor layout, the planning committee should submit a relationship chart that shows the relationships of sizes of spaces using bubble diagrams or space relations diagrams to the architect. Figure III-6 shows such a chart. These diagrams should illustrate the relationship of the technology education department to other areas of the school, relationships of each laboratory to all others and the relationship of auxiliary areas within each laboratory. The architect will have the responsibility of interpreting the specifications and providing preliminary layouts showing the relationships in more detail. Teachers can assist in placement of equipment following the approval of the preliminary layout of the laboratories.

The technology education department is an integral part of the total school program and should be designed this way. It is normal to position the laboratories on the perimeter of the building because of materials deliveries, the need for large overhead doors and sound control but they should not be designed as an appendage to the main school building. As an integral part of the educational program, they should be easily accessible to other areas of the school so interdepartmental activities may be implemented.

Individual laboratories within the technology education complex should be placed in positions for the best physical arrangement and most effective intra-departmental activities. Layout should be such that it is not necessary to pass through one laboratory to get to another.

Figure III-6
Space Relationship Chart



Interaction With the Architect: Instructors and school system administrators are encouraged to take active role in the development of new facility plans. This means that the teacher should be afforded the opportunity to interact with the architect who will design the new facility. This is important because architects are usually not expert in the requirements of the technological curriculum nor are instructors expert in school architecture. What is needed is the systematic blending of the two expertise areas. This can only come through face-to-face discussion. Mere paper, or even cursory oral communications, will just not achieve the desired ends.

Equipment Layout: Once the architect has completed preliminary plans showing position and size of spaces to be included, placement of equipment may begin. This is especially important to the architect so he/she can visualize where the mechanical services are going to be needed throughout the facility.

Equipment must be properly positioned to allow a normal sequence of operations with a minimum student movement. Movable equipment will aid in proper positioning and encourage special activities such as production lines. Semi-permanent positioning of the equipment will enable proper positioning of electrical bus links, exhaust systems, airlines and lighting. Generally since materials move from storage to machines for sizing, to bench fabrication or processing, to finishing, this order should be followed for proper layout of materials and processing facilities whenever feasible. Machines must always be positioned to permit safe operation, material handling, maintenance and sufficient aisle space between machines so traffic flow does not interfere with machine operations. Similarly, the direction of lighting should be considered to reduce shadows on working surfaces. The use of scale model equipment or templates can be very helpful in determining the optimum arrangement of the laboratory equipment.

It is essential that equipment lists and equipment layouts become a part of the specifications so the architect has some idea of proposed mechanical requirements and design layout features to be desired in the preliminary layouts. While it is not necessary to list hand tools and pieces of equipment which will be stored in cabinets, it is necessary to list all those items which require floor space or special mechanical support like electrical dust collection.

The equipment list should be separated by rooms and by fixed or movable categories. Information needed for each piece of equipment is the floor space required and utilities required. It is not as detailed as the information needed for developing purchase requisitions, but it must be sufficient to provide the architect enough information for effective layout and to provide for adequate and safe operating space. It will also provide the architect with information regarding flexibility and location of utilities necessary for the laboratory.

<u>Construction</u>: During the construction period the technology education instructor should maintain contact with the architect and contractor on the progress of the building or remodeling. Minor adjustments to the plan may be needed. Often there emerge electrical, plumbing or other questions that need clarification that only an instructor familiar with the program can provide.

<u>Acquisition of Equipment and Materials</u>: Immediately following approval of expenditures, work must begin on the actual acquisitions of equipment and materials. This typically is the responsibility of the technology education teachers or supervisors who will be working in each of the laboratories. If the equipment list formulated during the development of education specifications was done well, this step should be relatively easy. It is also recommended to take a priority ranking on each equipment item for

each laboratory. This becomes quite useful if equipment and material budgets are reduced for any reason.

Installation of Equipment: This part of the process takes considerable organization on the part of the technology education faculty in order to be ready to receive and position all equipment upon delivery. Again, lead time is critical if the equipment is to be inventoried, installed and checked out before the school year begins. It is recommended that the school system assign a team of plumbers, carpenters, electricians and painters to the facility setting up the laboratory. In this way the set up will be facilitated and administrative workload will also be reduced. Every effort should be made to coordinate equipment delivery dates.

One technology education teacher should be responsible for checking all equipment orders as they are received so they can be cross-referenced with the purchase orders. After equipment deliveries have been checked, a receiving report should be sent to the school business manager. The items can be inventoried and the boxes marked as to which laboratory area they are to be moved into for installation or storage. Placing each item on inventory cards saves time later because all the necessary information is available. See Figure III for a recommended inventory card to use during this stage.

Using the equipment layout generated in the educational specification step will provide for easier placement of equipment as it arrives in the laboratory. All equipment needing utility connections should be placed in position immediately to enable maintenance personnel and/or contractors to make proper hookups. Once utilities are connected, the teacher should thoroughly check out the operation of equipment and note any discrepancies so they can be reported to suppliers for adjustment.

Some suppliers of technology equipment provide installation service. The technology education teachers should be aware of this service, if provided, and contact the supplier when equipment is needed for installation. It is also important that any guaranty or warranty cards received with the equipment be filled out and returned to the supplier or manufacturer as soon as possible. For easy reference, the customer copy of the guaranty or warranty should be filed with the inventory cards.

Figure III
Sample Equipment Record Card[1]

EQUIPMENT INVENTORY CARD

Name of Equipment: ______________________________

Description: ______________________________

____

Serial No.: ____________________ Location: ____________________

Inventory					
Date	By	Date	By	Date	By

Purchase Order No.: ____________________ P.O. Date: ____________________

Purchase Rec'd. Date: ____________________ Cost: ____________________

Supplier: ______________________________

Maintenance	
Date	Description

Purchasing Considerations

Decisions have been made to modify facilities, staff and administration have come to an agreement on what should be taught and the philosophical statement is in place. The budget is in order so that some buying decisions can now be made. Now comes a time that many teachers and administrators fear most. That is:

- How do I get the most curriculum and equipment for the money to be spent?
- Will my equipment meet the needs of staff and students for several years to come?
- How do we avoid paying too much and still get good service from the supplier?

It is at this point that the teacher must verify that they know precisely what the EDUCATIONAL GOAL is that they want to reach. That should include motivational factors of equipment for the student they hope to reach.

That is do you prefer to teach "concept" or "comprehensive" courses? Are you attempting to motivate the student to seek additional information or is the student looking for in-depth knowledge in a more narrow area. Or are you attempting to do both? Chances are, if the equipment fits this challenge, special consideration must be made for equipment.

Now the teacher must determine the number of student hours expected for hands on. Can the equipment and curriculum be customized to provide for shorter or longer periods of study? What does the supplier say the length of time is required to complete each experiment or phase of the program? What is the recommended grade level or age group at this time period?

It is also important that the instructor determine if the reading level is at the comprehension level of its student body. In technical education this is sometimes difficult to determine with standard reading comprehension tests. Technical terms must be introduced that are multi syllable and are not able to be presented in another manner.

Finally, the instructor has to look at the product according to budget restraints. It does little good to specify equipment that cannot be purchased.

This is the point when hardware and student packages should be selected. Many times this entire procedure is reversed and the result is equipment and curriculum that appear to be "high-tech," but are really "new-tech" with little or no training value to students.

Specifications: Most suppliers should be able to provide purchasers with in depth specifications. You must remember that "specmanship" does not always provide the superior product. Some suppliers attempting to eliminate competition will have specifications written that no one else can meet. Sometimes, unfortunately, neither can they. It is the instructor's responsibility to verify claims of suppliers.

Generally those that have been responsible in the past and have worked successfully with other schools are the ones you should consider. Also, try not to be the first to buy a particular piece of equipment. Has it been supplied to others? What are their feelings about the equipment? Have they been satisfied? Does it meet the suppliers specifications and claims? How has the service been from the manufacturer or their representative? Does the equipment purchase price include all necessary software to teach on the equipment, e.g. student work books, lab or activity manuals instructor guide?

When you feel comfortable and have looked to see what else is available, ask the supplier for complete literature and specifications. You may want to modify these specifications so that they do not necessarily eliminate other providers of equipment. However, when specifications become too general, you may not get the product that best meets your needs.

Ask a lot of questions. Any good supplier will have answers or be able to get them for you. Does it meet the needs of handicapped students? Is it priced in line with similar equipment from other suppliers? Is there an educational discount? Be careful here, some major equipment manufacturers will boast of educational discounts and over 90% of their equipment is being sold to education facilities. Realistically who is getting a discount?

Other questions to ask may relate to how many students can work on the equipment at one time. Is this in line with your opinion? Are there ways of getting a lot of students to work on the equipment simultaneously? Such as one CNC Lathe may provide students with software for which an entire class may be writing programs.
Obviously this enhances the value. Another question may be, is the training realistic? Sometimes manufacturers are not using current approved, generally accepted methods of operation. An example of this might be in the area of Computer Numeric Control (CNC) suppliers requiring students to write elaborate programs to do minimal jobs. Or using languages that minimize the programming that the student would never see in an industrial setting. Why would the student benefit from either of these settings? The answer is, they don't, yet both are common today.

Can you use the same piece of equipment for various programs? Probably. When you look at your curriculum try to determine if you can see which pieces of equipment fit multiple areas of the program. An example may be a robot that could be used in manufacturing processes as well as an example of Man to Machine in communications and electrical control of mechanical devices in transportation/power and energy.

Another area often overlooked by administrators as well as teachers is whether or not the teacher will be trained on the equipment. If so, will they be taught how to teach with it? Some manufacturers run regular workshops. If this is the case, will the teacher be released to learn to properly operate the equipment? With technology changing, teachers must be provided with realistic release time to be cognizant of the applications of this technology. Just as important, are you, as well as the teacher, willing to spend time learning new technology? Do not expect the equipment to be your class. Good equipment enhances good teachers. The responsibility is a shared one.

How about safety? Does the equipment appear to be safe if operated under normal classroom conditions. Bear in mind that no manufacturer can make equipment safe under unsafe operating conditions. You should be able, however, to rely on the manufacturer to provide full instructions on safe operation.

Most important, remember that this is your program. The school system eventually will depend on the decisions that are made at this time. Be as sure as you can that the student will truly benefit from the learning experience. This must be in line with your philosophical statement. You probably won't go wrong if you remember the needs of the student and rely on good suppliers. The intention of reliable suppliers is to earn your trust and continue to trust them. Chances are they probably have visited more classrooms, been to more advisory committee meetings, attended more school board meeting than you have. Trust their judgement when it is critical to do so. When in doubt "ask about."

Equipment Specification

The actual selection of equipment is as important as planning the facility. When selecting the equipment develop a characteristic list which can be used to justify cost of the project and breakdown the project costs.

Equipment Characteristic List

Lab ❑ Communication ❑ Construction ❑ Applied Technology Center

❑ Manufacturing ❑ Transportation

Type of equipment ______________________________

Quantity ________ Unit Cost ________ Multiple Unit Discount (if any) ________

Mechanical System needed:

Electrical	________
Gas	________
Comp Air	________
Ventilation	________
Bolted down	________
Moveable/pourable	________
Dust collection	________
Water	________
Drain	________
Special lighting	________
Heat or AC	________
Special storage	________
Security	________

Other Special Considerations

____

____

____

____

CURRICULUM RELATIONSHIP TO FACILITIES

Curriculum - While this guide is not intended to assist districts as they develop their technology program and subsequent course offerings, it is very critical that the curriculum help focus the facility planning process. For more information on curriculum, refer to state guide *A Guide to Curriculum Planing in Technology Education.*

Introduction

Everyone must be willing and able to live with change each day. When changes occur, people must make decisions according to the effect of these changes on their particular situation. This decision making entails a careful look at alternatives which are available. When a school district's enrollment and/or curriculum changes, a decision must be made to find a better way to either use existing facilities or to build new facilities. The same applies to a business enterprise. When a company decides to market a new product or service, they must consider the cost verses result of the present or new facilities. In each case they have alternatives and must select the one which will give them the best return on their investment.

Curriculum Delivery

When a technology education committee decides it is time for a change in the curriculum, it too has alternatives. Some alternatives might be a center approach, multi-centers, technical centers, remodeling, to use existing space within the building, to use existing space in other buildings, to use modular structures and mobile units, build new.

In some cases the alternative may be to change the instructional technique so as to provide a better learning opportunity for students, without doing anything to the facility. With this alternative we must rely heavily on our facility evaluation process to see if the present facility will efficiently and effectively provide all which is necessary to accomplish the new and changing objectives of the program. A goal should be to maximize the utilization of your present facilities. There are many facilities where only minor reorganization will accomplish the necessary changes to provide an environment in which the new program can be implemented. The only real change becomes one of instructional methods. For instance, instead of individual projects the technique becomes one of establishing a student enterprise to plan, develop and market a product in order to gain an understanding of the concepts of technology.

However, with some program changes more space must be found to accommodate the increase in course offerings and to provide a broader foundation for the technology program.

If a new facility seems feasible, then the school district must decide if it will be a concentrated center where all areas will be together or smaller centers located at different sites with each center specializing in different aspects of technology education. If present facilities are to be used, will it mean adding needed space, or modernizing existing space, or providing space for a telecommunication center to receive programs via satellites.

It is important that the school system look into all options available. There is no one answer to a facility problem. We live in a diversified world with rural, urban, suburban, industrial, agricultural, recreational and a variety of other considerations. One type of facility will not satisfy all the desires and expectations of the community. However, we want to be certain that all alternatives are given consideration.

Facility Options

Center Approach: A wide variety of technology education offerings are concentrated under one roof. This may be at each secondary school or centralized to serve several schools. This system is easiest from an administrative standpoint because it is concentrated. Where it is serving several schools it may be administered by its own staff. There may be conflict with the staffs of the schools being served.

The center approach can provide a laboratory sharing concept to be implemented between certain course offerings. In the one case it would eliminate the repetition of building at each school, although it does provide a transportation problem. The center approach may provide exposure to a multitude of educational experiences and opportunities to integrated course content. The center approach most often used is where the entire curriculum is offered at each school because of administration and transportation problems associated with the separate center approach.

Multi-Centers: This method would take considerable coordination and cooperation with each school taking part in administering certain aspects of a technology education program. Each school in the system (or they may be from different systems) would offer a different area of concentration within the technology education curriculum.

The multi-center approach provides for greater, in depth study of each concentration but has the problem of transporting students from school to school. It eliminates completely the opportunity to integration of the areas. Some students may never see the possibilities offered in other areas of the technology education program.

Technical Centers: A third alternative is to establish technical satellites located in the community where a student may obtain first hand experiences in areas of manufacturing, construction, transportation and communications. This plan would take considerable coordination with the cooperation enterprises but is an important option for some school districts. Basic technology education space would still be required in each high school, but the in-depth content would be handled by the technical centers. These centers may be located within an industrial park where cooperative education possibilities are closely associated with the educational program. Several schools could use the satellites to eliminate repetition.

Remodeling: A fourth alternative to be considered is space within existing educational facilities. This is the remodeling of the present technology education labs to meet new objectives, course offerings, and student needs. This would not include additional space but merely the reorganization of what is already available to make maximum utilization of the space.

Existing Space Within the Education Building: A fifth alternative is to look at existing educational space which could be converted to use for technology education. Many times a school has built a new gymnasium, auditorium, or cafeteria which may make old space available for other functions. These open areas may be adaptable for technology educational purposes. Even areas under football stadiums might well be considered for utilization as technology education facilities.

Existing Space in Other Buildings: Alternative six may be to look for existing space in empty buildings located close to the school so as to minimize problems of transportation. Such space might be found in an old office building, supermarket, warehouse, or industrial plant. Buildings with open spaces and good sound structure could, with minor modernization, be an ideal facility for technology education.

Modular Structures and Mobile Units: A seventh alternative would be to consider either moveable modular structures or mobile units. Each module becomes a self-contained area of the program with capability of integration between areas.

One might consider the advantages of mobile units which move around the school district or between districts. Some school districts do not have a large enough student enrollment to justify the building of a complete technology education facility. Mobile units may be the answer. Consideration may be given to mobile units which are equipped with technology education equipment which will supplement a small existing facility in the school. These mobile units may be stationed at different schools in a district for a period of time to provide students with experiences they may not get elsewhere. These mobile units could be equipped with electronic equipment, visual communication, or material processing equipment which the district could not justify placing in all schools because of expense, utilization and space. Trucks could be equipped with special programs and move from school to school or town to town.

Build New: Alternative eight would be to build a complete new facility to house the technology education program. This alternative includes building additions or separate buildings. If the school district has an old, undated structure which cannot be adapted to the new programs, then building may be the only alternative.

In view of curriculum, enrollment, finance and trends toward more career preparation, a facility planning committee must be aware of the options available to them and balance the options against the educational needs of students now and in future years. Alternatives need to be carefully scrutinized by school districts. Whatever the decision, the student and the curriculum must be considered above all other factors when planning the type of facility needed for the technology education department.

Today the best new facilities are provided with modular utility systems that enhance flexibility by easing rearrangement of the laboratory when needed. Also important to flexibility is the use of portable equipment and tool storage. Roll-around cabinets, carefully tailored storage systems and tables are often used to tailor instruction in varying areas of the facility.

Types of Technology Education Facilities: When looking at the profession's activity across the nation, it seems clear there is a trend toward cluster courses in technology education. These are typically implemented in three distinct kinds of laboratories. They are: the comprehensive laboratory, the cluster laboratory and the technological specialization laboratory.

Comprehensive Laboratories: The comprehensive laboratory is a single facility designed and equipped to permit instruction in each of technology's three key clusters. The size of the facility may vary depending on the number of instructors and students to be accommodated. Such a facility is specifically designed to permit broad, exploratory work in each major technology: manufacturing, communication, transportation and construction. Each of these cluster areas may be further subdivided if space is available. The type of facility is desirable at both the junior and senior high school level. This is the facility type recommended for schools with only one laboratory.

System Laboratories: The system laboratory is designed for instruction in a single technological system. Within this system, various sub-specialty areas (e.g. audio/video rooms, dark rooms, etc.) are implemented so that activities may be carried in reasonable depth. This design is recommended for large junior/middle schools and senior high schools with multiple laboratories. System laboratories need to comprehensively cover the technology's major areas, e.g., a transportation facility would need to provide for power and energy, hydraulics, pneumatics and alternative energy. Typically, schools would set up four such system laboratories in order to cover the range of technology. This arrangement also permits offering exploratory experiences by rotating students through one cluster laboratory after another during the school year.

Technological Specialization (Unit) Laboratories: The technology specialization laboratory is designed for in-depth instruction in one area of a technology. Examples of technology specialization laboratories include computer aided design, construction, graphic communications and principles of technology laboratories. This kind of laboratory is effective with respect to the overall objectives of technology education. These facility are most appropriate to providing in-depth experiences related to vocational programs at the upper grade levels in high school. It is recommended only for senior high schools with large enrollments that justify laboratories.

Technology Center: The introduction of a Technical Center Concept at each level of education provides a broader interdisciplinary approach to learner outcome education. Consideration must be given to the nature of learning styles each student possesses. The technology center provides a basis of facilitating teachers who could provide the technical advice and resources necessary to integrate technology and academic education across context. Consideration of this approach to education would provide a centrally located applied learning center which would complement the classroom teacher with information through application of theory taught by academic subject teachers. The intent of the technology center is to have students learn how various disciplines work together, provide challenging activities of learning which are not the independent math, science or technology education courses, and establish a sound educational platform of understanding of business and industry.

Informing Key Constituents
(Public Relations)

Introduction

Often the informing of key constituents (public relations) is considered something that is of secondary importance--but never by successful teachers and administrators. There are several excellent guides to effective public relations, among them *Promoting Vocational Education: A Public Relations Handbook for Vocational Educators.* The reader is encouraged to review this guide for additional detail.

A comprehensive public relations program begins with a systematic plan. Technology education instructors are encouraged to employ the following steps (adapted from *Promoting Vocational Education,* p. 13) in developing their public relations program:

1. Identify your internal and external publics. Think in terms of the individuals and groups in your community and institution such as those listed in Figure IV first column.

2. Collect data on your publics. Find out what your publics know and think about your programs, and what they want and need to know. Do your homework carefully--there is no point in spending time and energy to launch a public relations campaign without first knowing what change you should try to bring about.

3. Identify the problem areas. As you assess the view of your publics, certain problems and issues will begin to emerge.

4. Establish short-term and long-term objectives. Be realistic about what can be accomplished.

5. Determine your public relations details, organization and strategy. Select the communication techniques and media for accomplishing each objective. You will have to consider your budget in making plans, but don't feel that the job is hopeless if your budget is small or nonexistent; ask for volunteer help and keep an eye out for shortcuts and low-cost techniques. Some items to consider in a plan include:

   - school or program or VICA newsletter;
   - annual or more frequent open houses;
   - slide shows;
   - presentation to civic groups;
   - displays and exhibitions;
   - contacts with local technical groups;
   - local, state and national competitions such as the annual Wisconsin Technology Education Association awards program;
   - technology festival or fair;
   - news and media releases;
   - a program advisory council;
   - interface to the PTA;
   - student organization activity;
   - newspaper articles;
   - state advisory committee business/industry awards.

6. Map out your program. Schedule your activities in chart or calendar form. Time activities so you reach your publics frequently.

7. Implement your program. This is the most time consuming and difficult part of the process! Monitor your expenses in time and money as you go along, and reallocate your resources as necessary.

8. Evaluate your program. At least once a year, study the effectiveness of your efforts. Figure III-18's matrix provides a framework useful for such an assessment. Use your findings to make adjustments in future planning.

Figure IV

Public Relations Analysis Matrix[1]

Target Groups	Objective	Achievement Review						
		EVALUATION						COMMENTS
		Difficulty			Achievement			
List each specific target group important to your program's public relations	List specific objectives for each target group. Specify date and outcome measures.	Difficult	Average	Easy	Completely	Partially	No Progress	Update objectives and activities here
Internal Administrative Staff Advisory Committees Federal/State Agencies Guidance Personnel Other Teachers School Board Members Students Student Organizations Support Staff **External** Business & Trade Associations Civic Groups General Public Employers Legislators Labor Organizations Mass Media Parents Other:________________ ________________								

INSTRUCTIONS:

Enter the objectives and dates for each specific target group. Also rate the difficulty of each objective/group combination. Then, at the end of the year, rate the extent to which you have achieves each objective. At that time also develop a new plan for the following year. (Adapted from Promoting Vocational Education.... p. 17).

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1 Adapted from Promoting Vocational Education, 1978, p. 17.

Financial Alternatives

Financial Variables: The overall objective in financing the construction of facilities to to get the largest amount of useable space possible per dollar spent. Therefore, all spaces should be carefully analyzed to determine the actual utilization by students and teachers when programs become operational. Rarely used, uneconomical, non-instructional areas should be minimized. Since the cost of facilities is important, careful planning is needed to receive the maximum amount of usable space. The cost of all phases of building construction should be estimated as carefully as possible before seeking funds.

Across the nation the school-age population is stabilizing or, in some districts, declining. This may suggest a lack of school building needs, but this is not entirely true. Previous demands for new construction in growing areas forced many school districts to overlook maintenance and modernization of old buildings. These school districts now face the problem of replacement or renovation. Many schools built in the nineteen-fifties or before, did not anticipate the changes in education and are obsolete.

If school districts are to meet new demands, the ability to finance new buildings and/or modernization programs will be a critical factor. Some school districts find their capital outlay budgets very minimal. Others have used up their legal capacity to support long-term financing. Still other districts have found voters refusing to support new taxes to pay for new construction.

Construction costs are continually rising. Cost estimates based upon floor space requirements should take into account probable construction costs at the time construction will actually occur.

The U.S. Office of Education has listed several important variables to be considered in cost comparisons for school facilities. These variables are as follows:

1. Nature of the education program to be housed.
2. Proportion of actual instructional space to total area of the building.
3. Number and kinds of educational equipment included in construction costs.
4. Labor wage rates and costs of construction materials.
5. Site preparation and development.
6. Availability of utilities.
7. Geographic location.
8. Design and type of building planned.
9. Construction methods utilized.

10. Building materials.
11. Cost trends.
12. Availability of labor for skills required.
13. Amount of off-site and on-site construction necessary.

The cost of all phases of building construction should be estimated as carefully as possible before seeking funds form outside sources. The U.S. Office of Education recommends the following items be considered:

1. Land acquisitions.
2. Building contracts.
3. Architect fees.
4. Engineering services.
5. Consultant services.
6. Administrative expense.
7. Legal services.
8. Interest during construction.
9. Insurance during construction.
10. Site development.
11. Contingencies.
12. Clerk-of-the-works.
13. Furniture and equipment.

<u>Sources of Funds</u>: The basic source of school funds up until 1945 was from local revenues. Since that time school construction needs increased markedly due to the need to accommodate the increased numbers of students, population shift to urban areas, the need for replacement of antiquated school buildings, the development of new education programs, and school district reorganization. Many school districts found it difficult, or even impossible, to fulfill the facility needs solely upon the local property tax income. State legislatures responded to this situation in a variety of ways, shifting the school construction financing burden partially to sources other than property taxes. No general programs of federal financial support for school construction have been developed. However, the Vocational Act of 1963, and the Amendment of 1990 do provide federal construction funds for occupational programs.

In the state of Wisconsin, the burden of facility construction and remodeling of elementary and secondary schools lies largely with local school districts.

Alternatives may be available for financing school facilities but each state may vary on the legality of using certain methods. School districts should have a financial and legal consultant for this part of the planning project. These alternatives are suggested by the *Educational Facilities Laboratories.*

Pay-As-You-Go-Financing: The pay-as-you-go process means the school district pays cash for all construction and equipment in the new facility. This method may be done through (1) one-time levies approved by the voters at the referendum, or (2) accumulation of money in reserve funds.

The one-time levies have been criticized because they burden the taxpayers at one point in time, while future taxpayers may pay nothing for school construction. Long-term financing is preferred over one-time levies because it spreads the burden more evenly among the taxpayers. However, long-term financing requires large amounts of interest charges which may increase the cost of school construction beyond the limitations of the school district.

Accumulation of funds is similar to a manufacturing company accumulating funds for future expansion or new building projects. Some government planners and economists believe this would be a sound plan for many school districts. However, some states have made this practice illegal. This method does accumulate interest and avoids finance charges, but may not always be economical due to rapidly and consistently increasing construction costs.

State Aid: State aid programs have grown in usage since World War II. These consist mainly of grants-in-aid and state loan programs. The state of Wisconsin does not offer a grant-in-aid program, but does have a state loan program for those districts who can qualify.

The grants-in-aid are gifts from the state to the school district to supplement local funds for school construction. State loan programs are usually granted only to districts who are unable to support additional bonded indebtedness because they have reached their legal debt limit, cannot pass bond issues, or cannot market bonds.

Federal Aid: Presently, the only federal aid available for school construction is the Federal Impact Aid Program (Public Law 815) and vocational-technical schools.

The Impact Aid Program assists school districts where the presence of government installations have increased student enrollment by six percent over a four year period of time. The Vocational Act of 1963 and the Amendments of 1990 do provide for funds to districts where there is a need for occupational education.

Reducing Site Cost: Acquisition and preparation of property may be a large percentage of the total construction costs. Savings can be made in ways such as acquiring land that has been designated as urban renewal.

Because pubic land within a city produces no tax income, most cities do not want to give up taxable land for school construction. Some school districts are looking into the possibility of building schools over or under existing public land. For example, the Dade County School District, Miami, Florida, has proposed building an elementary school under a federally owned elevated expressway. The land will be leased to the school at a nominal sum. This may pose several problems such as, need for long spans, heavier construction, noise and vibration, and additional safety precautions, but it still is an alternative which will reduce site costs.

Shared Facilities: Many times community agencies are building facilities which could be shared. Rather than duplicate and build separate facilities, build one facility and share the space. Physical education facilities share with the city recreation department or community library which serves the schools as well as the community may be possible. Perhaps industrial companies may need training facilities and would be willing to join with the school district in building a shared facility. The schools would use the shops in the day-time and industrial classes during the evening hours.

One of the major problems is finding other agencies that are willing to share facilities. One should check agencies at the city, county, state, and federal level to see what the possibilities might be for sharing a common facility. Potential groups related to industrial education might include vocational and adult education, local arts and crafts clubs, hobby clubs, junior or community colleges, technical education, and industrial training programs.

Once an agency is found which will share a common facility, it will be necessary to establish a cost-sharing formula. One method might be to share total costs of construction and equipment on the basis of pro-rated usage. A second method would be for one agency to finance the cost of construction and simply give the other agency the right to use it. These methods would avoid the cost of duplicating facilities for community taxpayers.

Non-Tax Revenue: School districts many times own valuable land but are unable to finance the cost of construction for many years or the district may have purchased a good piece of land five or ten years in advance of building as a future investment against enrollment increases. This land may be rented or leased during the interim period to provide additional funds. This income to the school district over a period of years may be a feasible way to offset construction costs.

This particular method of financing may pose legal and political problems for the school district. If used, it should be only on the advice of legal counsel and after careful considerations of the local community.

Bond Issues: Because of increased costs of constructing and equipping schools, long-term financing has become the traditional method used to gain sufficient funds for building. General Obligation Bonds are the media most often used for long-term financing. They can cover site acquisition, improvement costs, planning costs, construction of new facilities, additions to existing structures, and major renovations. Several projects may be built under one bond issue, but care must be taken not to group too much or too wide a variation of projects under one issue. Taxpayers may be for certain projects and not for others, thereby voting against the bond issue when grouping is used.

The school district must determine whether it can legally issue bonds in the amount required. This is controlled by debt limit. Limits are usually established by state law. The total indebtedness permissible for a school district will be based on a percentage of the equalized value of real estate owned in the school district.

Rural and suburban areas where property valuations are low have a disadvantage. Low debt limits create a problem in issuing bonds to obtain finances for construction purposes. Cities where highly developed areas have a high valuation may have an advantage of a high debt limit.

Another consideration is whether the school district will be able to market bonds after the non issue referendum has passed. The supply and demand in the money market, the level of bond interest rates, and the districts' bond rating will control the school district's ability to sell bonds.

If the debt limit and bond market is favorable, a bond proposal is drawn up and a bond issue referendum is called to authorize the school district to sell bonds and raise the taxes necessary to pay for them. If the non issue passes, the school district sells the bonds to obtain the cash to pay for the building project. If the bond issue fails the school district must reconsider the proposal and determine other means of financing.

The most difficult part of this method of financing is drawing up a proposal to be presented to the voters. The proposal must be carefully developed to prevent misunderstanding of the true needs of the school district. It must contain complete justification for the financial needs and what completion of the project will bring to the community as well as results if the bond issue does not pass. Good communications with the public can win the bond issue for the school district. Time spent in communicating is extremely important and should not be taken lightly.

Leasing: No state prohibits leasing, but the duration or term of leasing is regulated by some states. Long-term leasing is usually ruled out unless approved by referendum. In some states, the school district is permitted to take 30-year leases without voter approval.

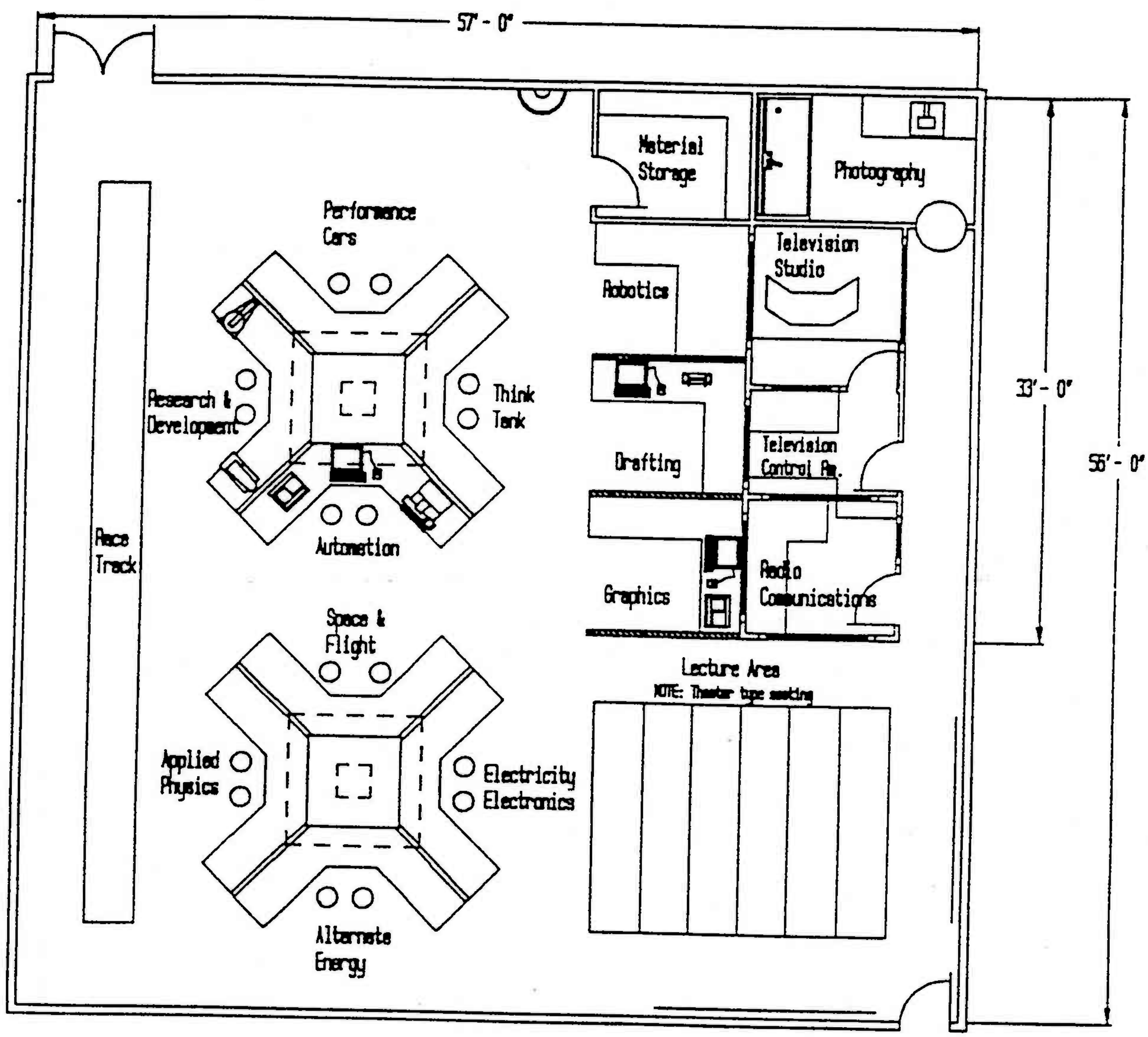
Leasing may be necessary in cases where the school districts have reached debt limits or cannot pass new bond issues. If the need for space is temporary, the most economical solution may be to lease or rent the space. This may occur in a school district where the enrollment projections show temporary increases, which would not justify new facilities. Leasing for long terms may be a disadvantage to the students because the school district may be prevented from making necessary changes in the facility to accommodate the curriculum and instructional techniques.

Some school district lease property with the option to purchase with rentals applying to purchase. This permits the school district to purchase on a time-payment plan without assuming any long-term debt. Leasing is a popular option for school districts where financing is difficult and a real need for additional space is justified.

Conclusions: The effective budgeting of annual and long range needs, together with good project planning for capital improvements is basic to the overall success of the total financial program. It leads to economies in financing the capital debt. It is extremely important that those responsible for educational facility planning and budgeting be aware of the budgeting process and the alternatives available for financing capital improvements.

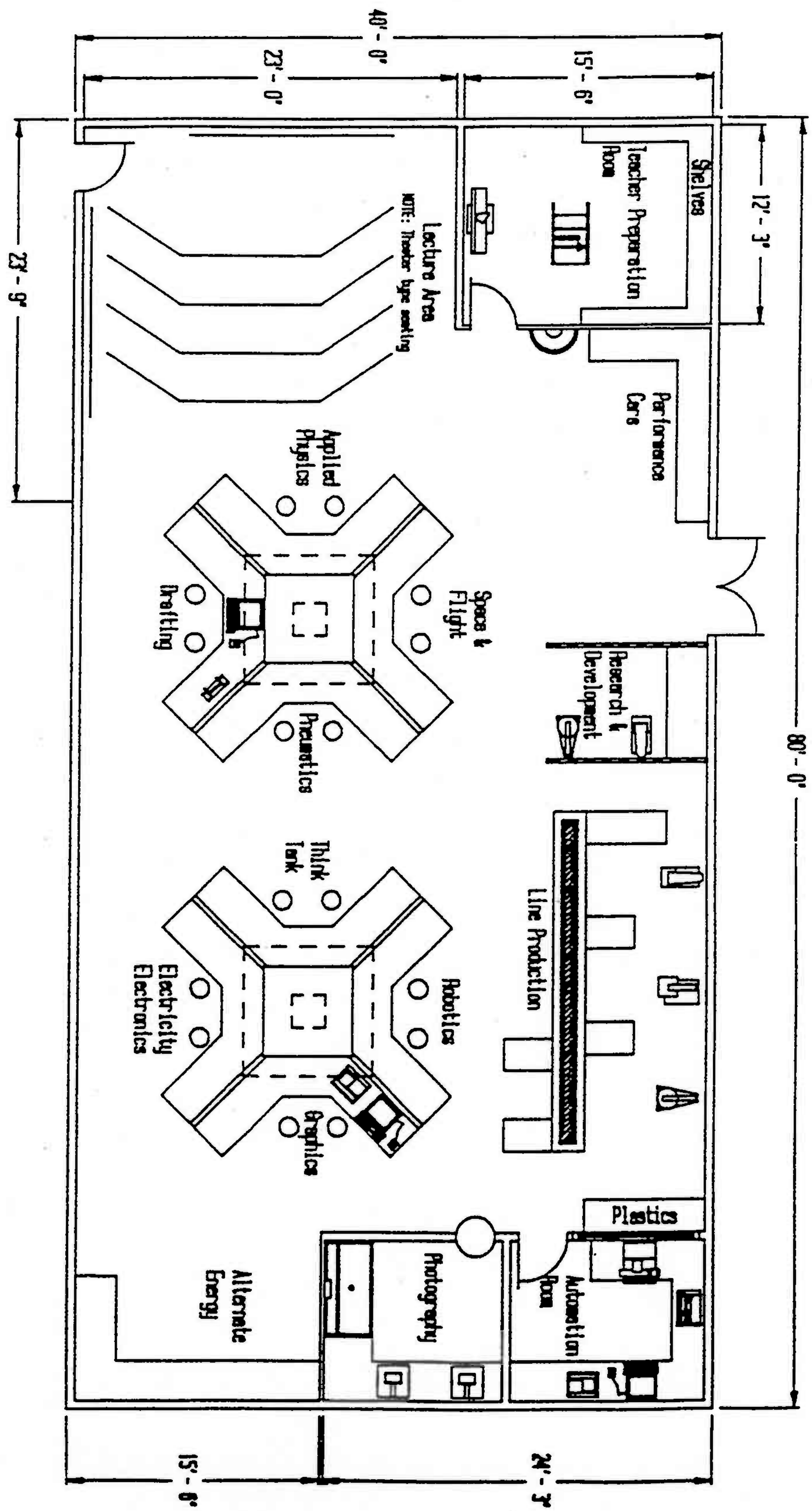
Modular Technology Education Lab

Note: Crosshatched walls 4' - 0' high



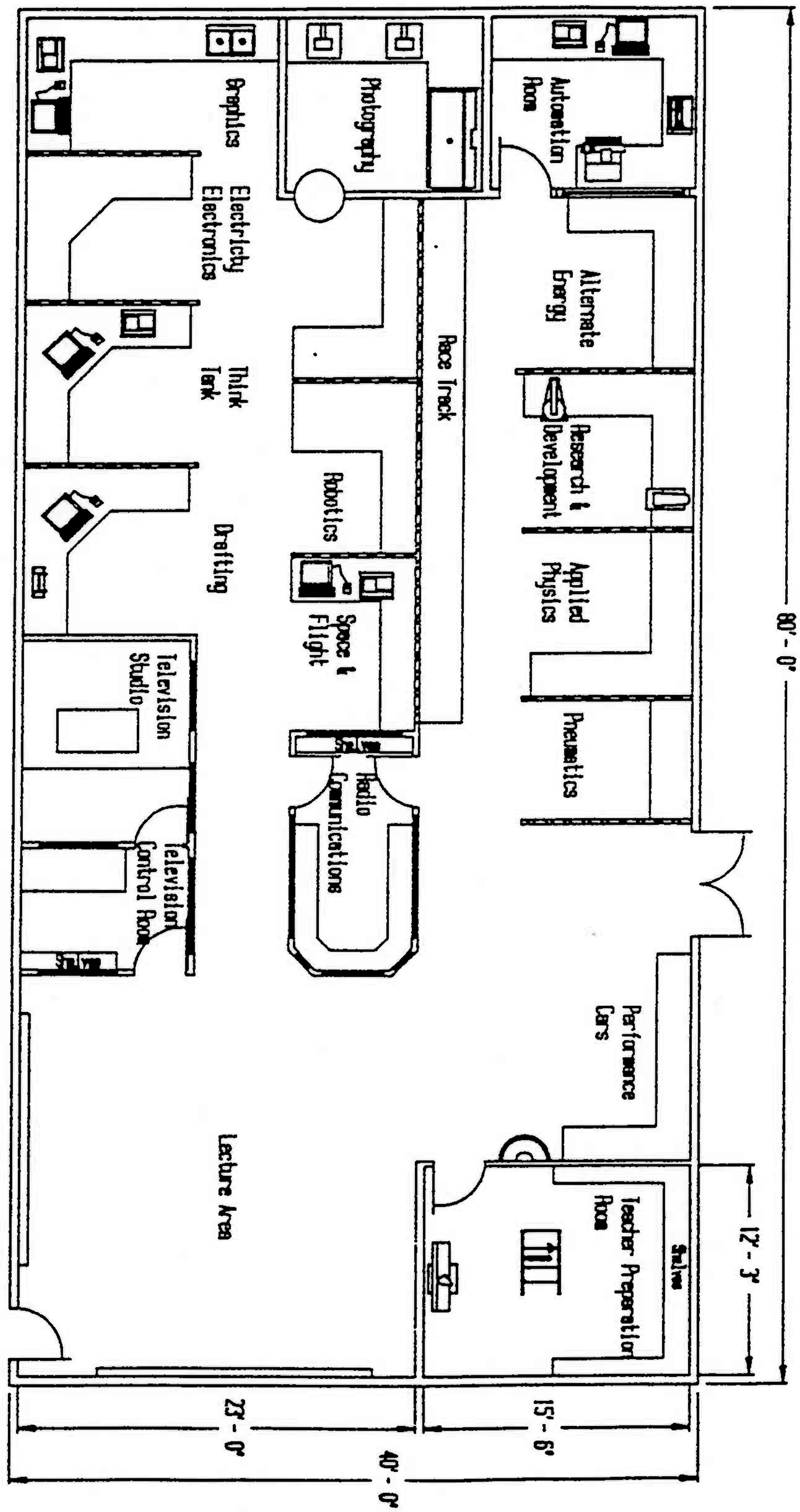
Modular Technology Education Center

Note: Crosshatched walls 4'-0" High



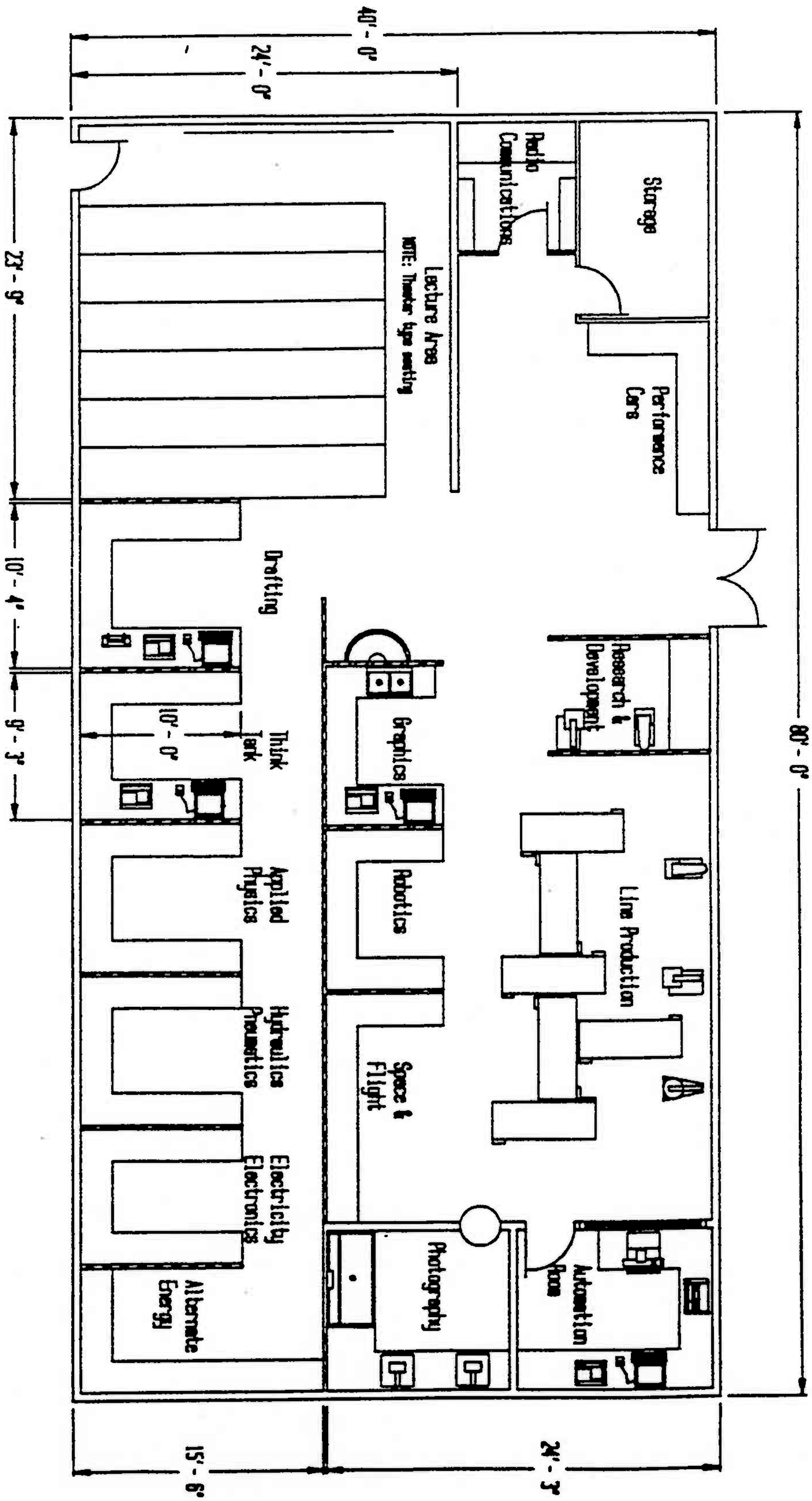
Technology Education Lab

Note: Crosshatched walls 4'-0" High

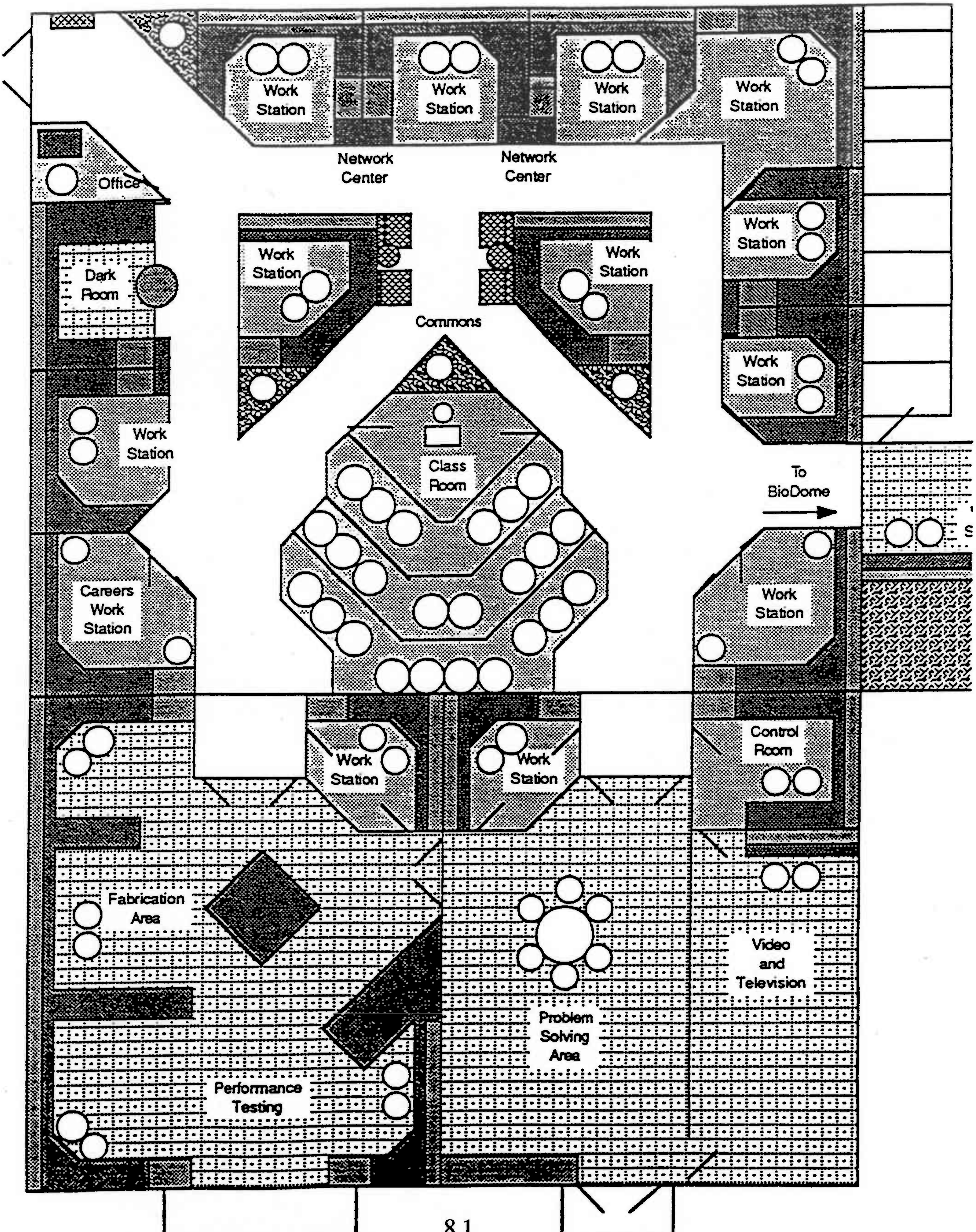


Technology Education Lab

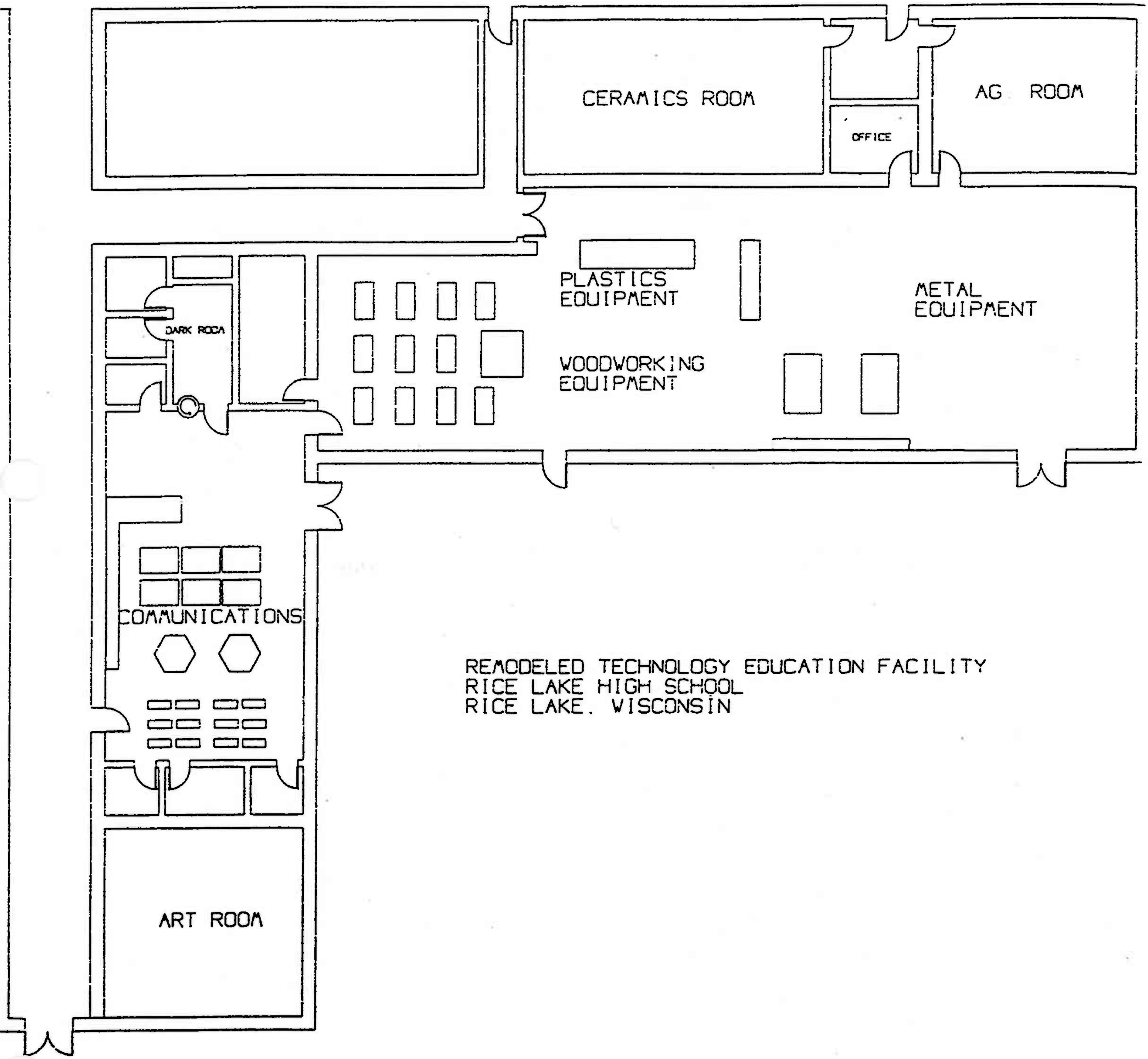
<u>Note</u>: Crosshatched walls 4'-0" High



Technology Education Facility



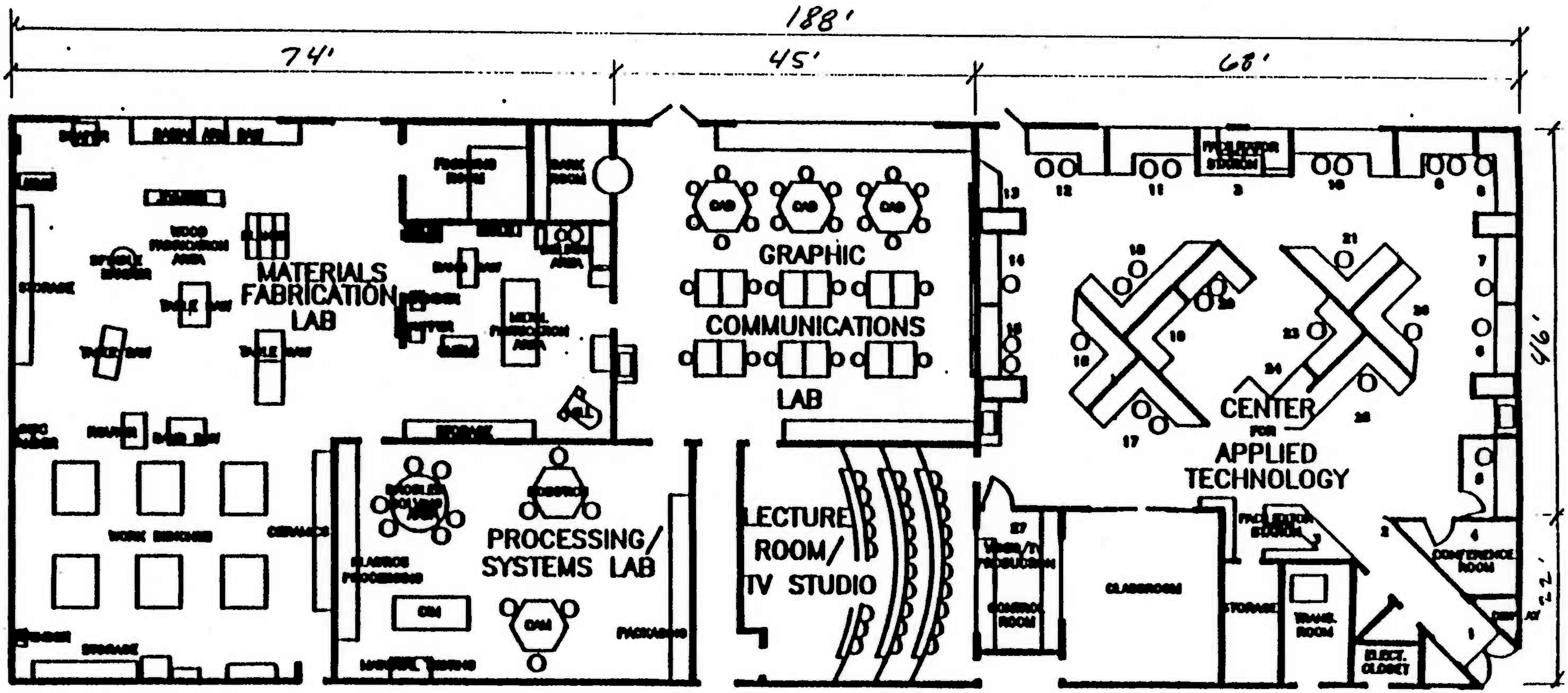
Remodeled Technology Education Facility
Rice Lake High School
Rice Lake, Wisconsin

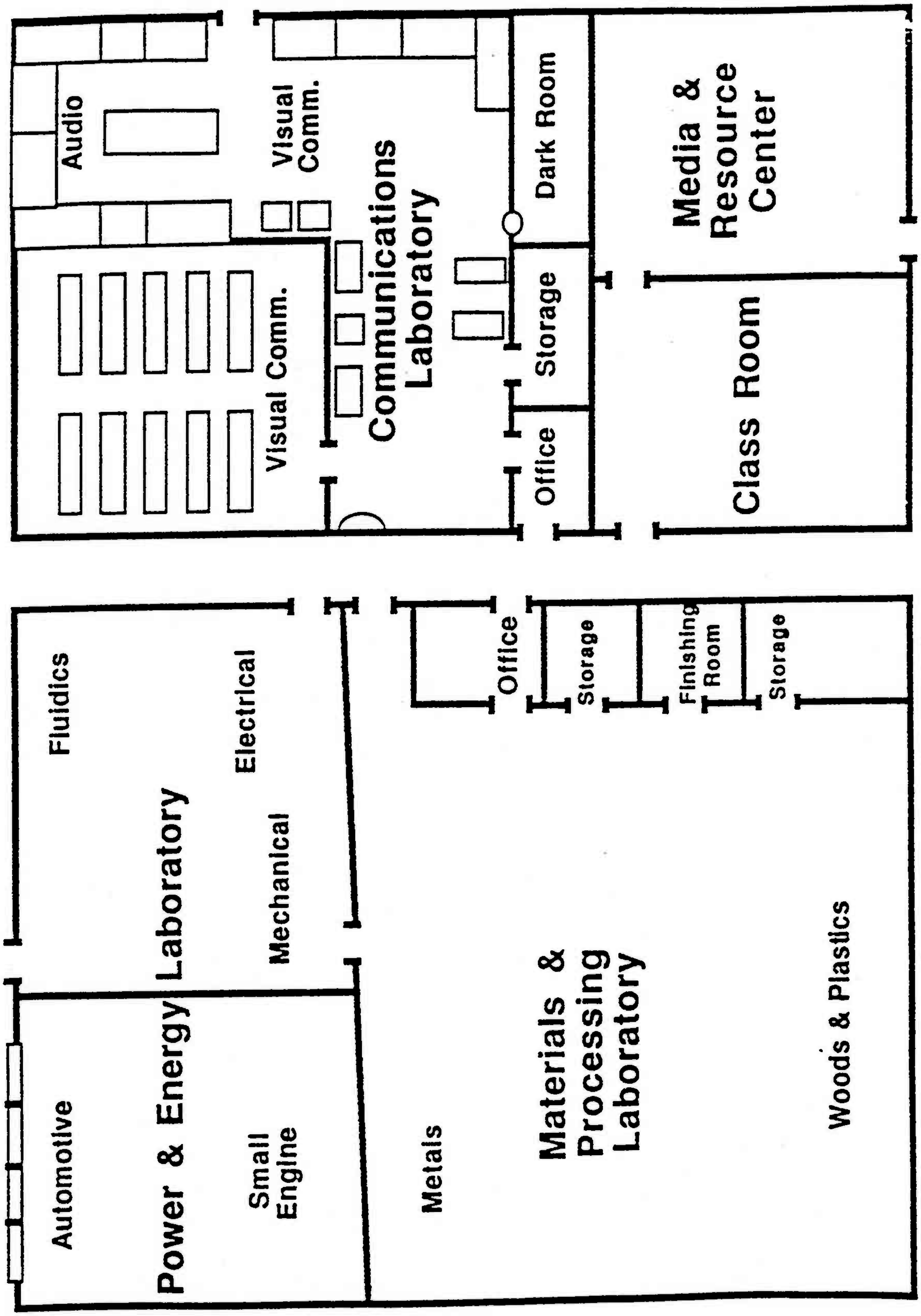


WHEELING ILLINOIS

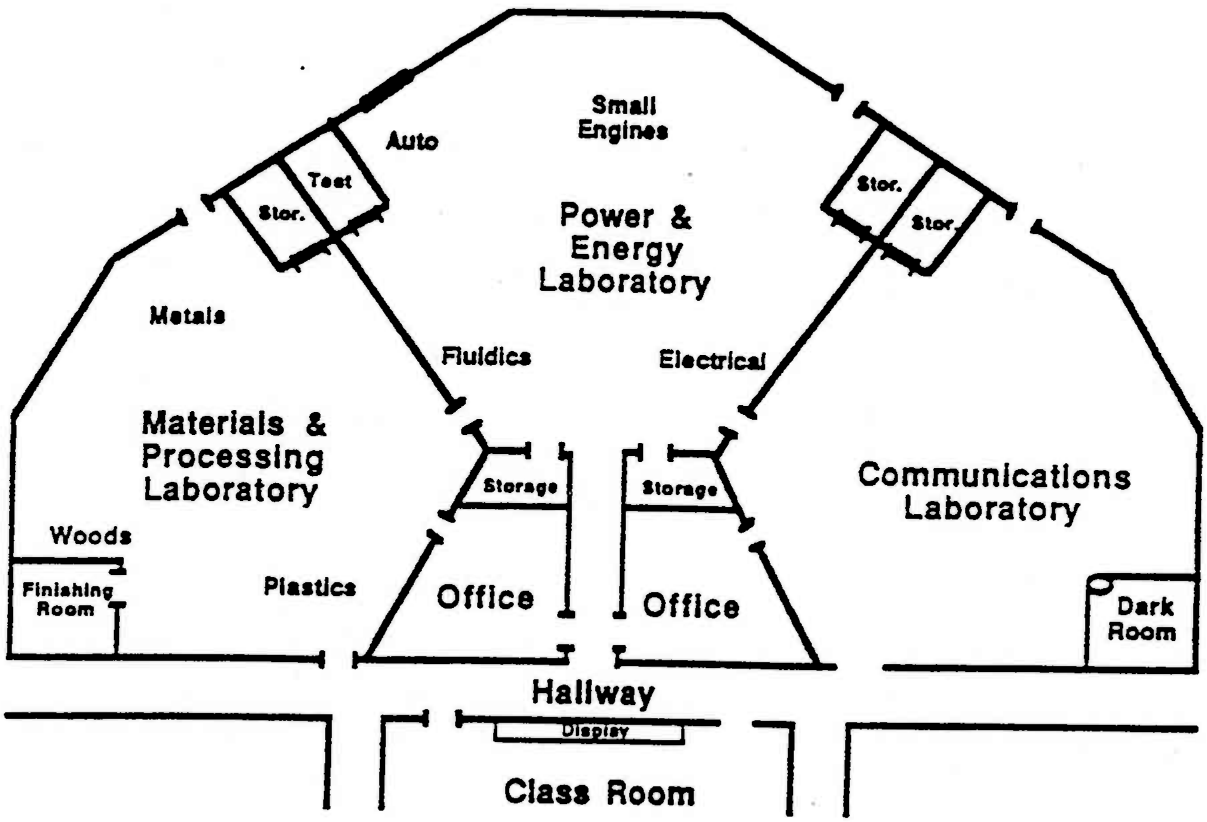
CENTER for APPLIED TECHNOLOGY

NO SCALE ONLY REF.

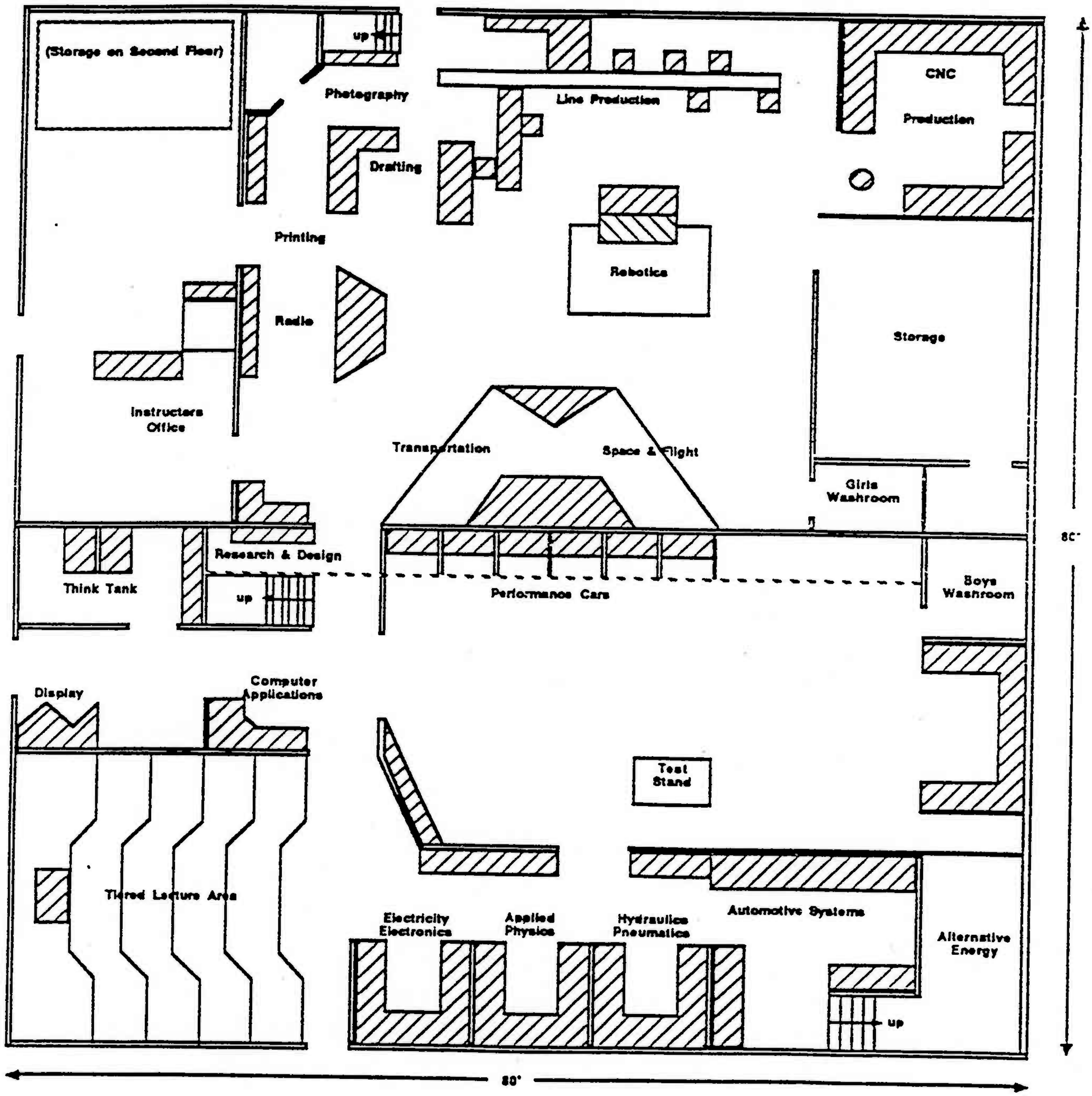



Audio
Visual Comm.
Visual Comm.
Communications Laboratory
Dark Room
Storage
Office
Media & Resource Center
Class Room
Fluidics
Electrical
Power & Energy Laboratory
Mechanical
Automotive
Small Engine
Metals
Materials & Processing Laboratory
Office
Storage
Finishing Room
Storage
Woods & Plastics

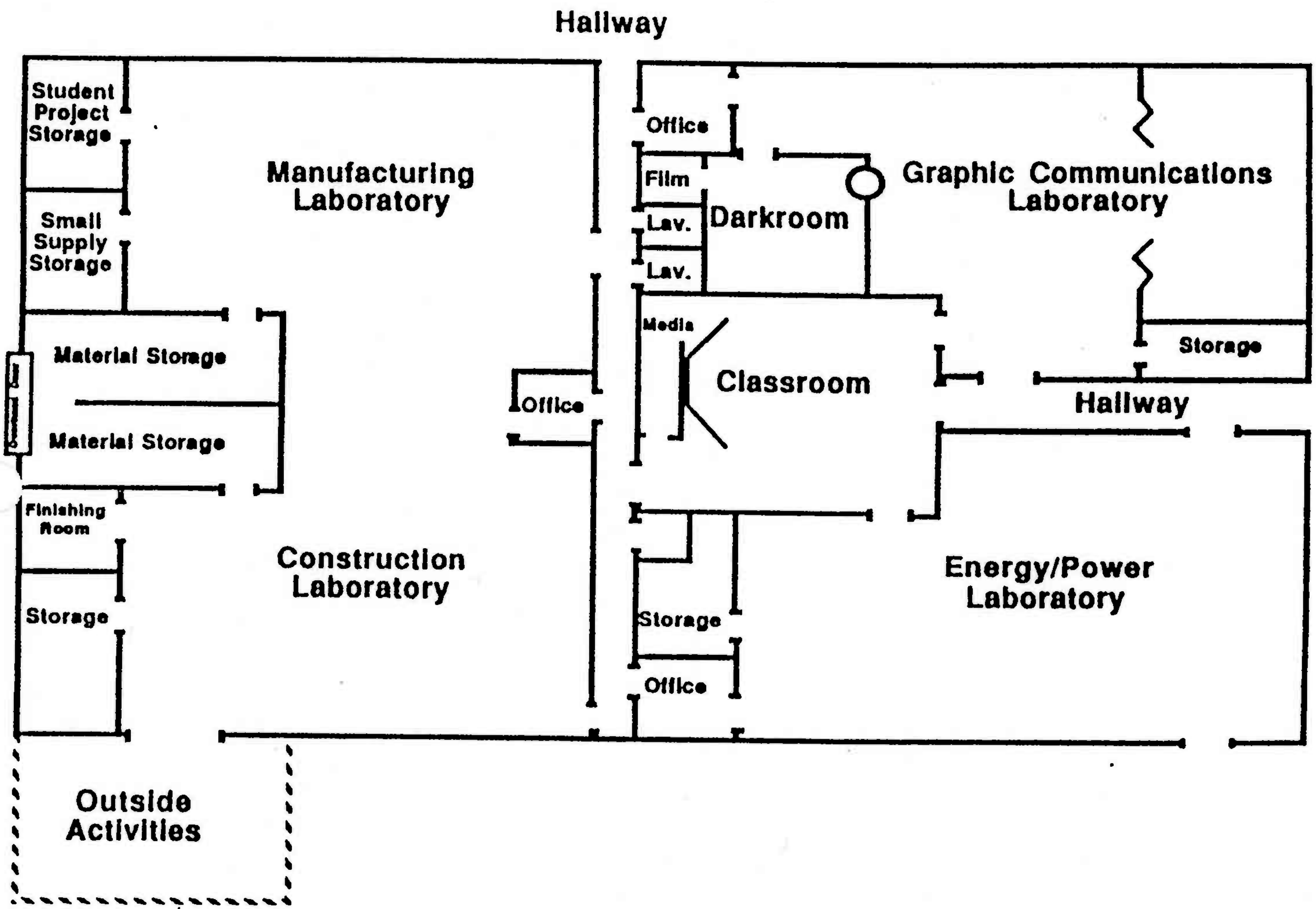
Technology Education Facility--Wedge Shaped



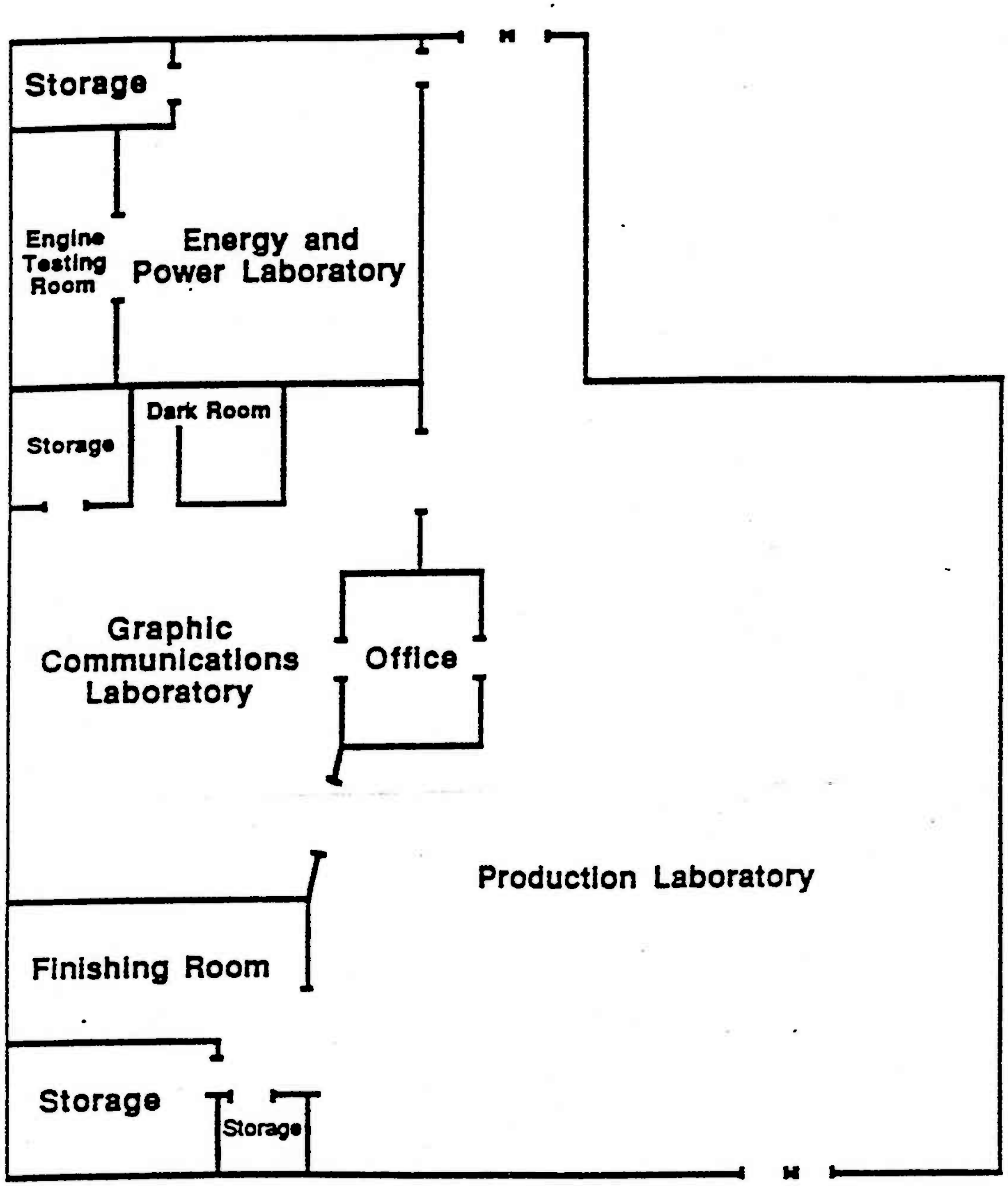
Middle School/High School Technology Education Lab



Sample Small School Technology Education Facility



Technology Education Laboratory



[1]Bender, 1978, p. 52.

APPENDIX A

PARENT/GUARDIAN FORM

School Safety Information

Parent/Guardian and Student

School District ______________________ Campus ______________________

Teacher ______________________ Program ______________________

:

Dear Parent or Guardian:

Your child is enrolled in the educational program identified above and will have the opportunity to participate in supervised class activities that involve the use and operation of varuous tools and equipment.

Appropriate instruction in the safe operation of assigned tools, equipment, and procedures will be given that will include supervised student performance testing on each item. Precautions are taken to prevent accidents but a certain risk is involved due to the nature of the experience and the learning environment.

Proper eye protection is required by state law. We ask your support in discussing with your child the necessity to observe safety policies that have been established. You are invited to visit our school programs to discuss any of the course requirements. Please contact the teacher to arrange for a visit.

Thank you for your assistance.

Teacher

I have read this communication and understand the type of program in which my child is enrolled. I will discuss the safety aspects of the program with my child.

Signature ______________________ ______________________
Parent/Guardian Date

Phone Numbers ______________________ ______________________
Home Phone Work Phone

I agree to observe all safety rules and procedures for the safe operation and conduct in this course. I will wear eye protection in accordance with state law.

Signature ______________________ ______________________
Student Date

APPENDIX B

PERFORMANCE RECORD FORM

Student Safety Performance Record

School ______________________ Teacher ______________________

Program ______________________ Period ________ Year ______________

______________________ has observed safe operating procedure, has passed required
Student's Name

safety exams, and is permitted to operate the items dated according to accepted safety regulations.

Tools, Equipment or Processes	Enter Date Completed		
	Teacher Demonstration	Written Test Passed	Performance Test Passed
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			

The teacher will keep this record until the student exists the program.

APPENDIX C

GENERAL SAFETY RULES

General Safety Rules

The following general safety rules should be reviewed by the students as often as needed to maintain a safe working enviornment. Review is suggested pior to the introduction to major power equipment. This set of basic rules will not be repeated in the guide.

1. Think about what you are doing. Keep your concentration on the task at hand. Stay alert, do not rush.

2. Tools or machines are not to be used until you have passed the appropriate safety tests.

3. Tools or machines will not be operated unless the instructor is present.

4. Behavior that detracts from the learning activity will not be tolerated. No horseplay.

5. Keep the work area clean and orderly.

6. Do not force a tool. Tools work better and safer at the rate and purpose for which they are designed.

7. Wear proper apparel to protect yourself and clothing. Do not wear loose clothing or jewelry. Long hair should be controlled. Sandals or open-toe shoes are not permitted.

8. Wear appropriate eye protection.

9. Secure small or unstable work with clamps or a vise.

10. Do not overreach. Keep proper footing and balance.

11. Maintain tools and equipment. Keep tools sharp, in adjustment, clean, and lubricated. Report and do not use any item that you think is unsafe or not in proper working order.

12. Disconnect equipment from electrical service before adjusting or changing cutters, blades, or bits.

13. Keep hands away from the cutting area. Do not attempt to remove material while the cutter is rotating.

14. Understand the operating characteristics of the tolls and equipment you use. Learn their application and limitations.

15. Guard agains electrical shock by prevent body contact with grounded surfaces. Use electrical tools and cords that are grounded or double insulated and carry the underwriters label.

16. Respect safety zones around all power equipment.

17. Do not operate a machine unless proper guards are in place.

18. Items not used for instruction are not allowed in the work area.

19. Report all injuries to the instructor immediately.

20. Store tools, equipment, and materials to protect the item and the operator.

APPENDIX D

SAFETY SIGNS

OUT

OF

ORDER

DO NOT USE

TECHNOLOGY EDUCATION

VISITORS MUST WEAR E-Y-E PROTECTION

WORK SAFELY

No Horseplay

No Running

OUT

OF

ORDER

DO NOT USE

TECHNOLOGY

EDUCATION

■ ■ ■ ■ ■ ■ ■

Visitors
Please Register
in the Office

NOT ALLOWED

1. SMOKING
2. CHEWING
3. DRINKS
4. CANDY
5. GUM
6. ____________
7. ____________

SAFETY EXAM REQUIRED BEFORE USING TOOLS OR EQUIPMENT

BEWARE

DANGEROUS MATERIALS

DO NOT OPERATE WITHOUT PROTECTIVE CLOTHING

PLACE WASTE IN THIS CONTAINER

DO NOT

REMOVE

G-U-A-R-D

DANGER

FUEL GAS

OPEN FLAMES NOT ALLOWED

ASK FOR INSTRUCTIONS BEFORE OPERATING