FACILITIES PLANNING
FOR
AVIATION EDUCATION

by

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ABSTRACT

The importance of properly designed physical facilities as an environment for the delivery of an aviation and education program cannot be over émphasized. While excellent teaching can and does take place in inadequate physical settings, the delivery process and related human experience both for teachers and students invariably suffers. At the same time, the decision making process involved in producing suitable facilities for any aviation related activity has become exceedingly complex. Growing sophistication of technology and state of the art of aviation systems, changing educational programs, complex administrative structures, and difficulties in the economy and ability for institutions to fund building programs all serve to complicate any well intentioned building development goals.

It is essential that a broad based comprehensive planning and design process be utilized if the product of any building development is to achieve requisite facility objectives. Short term, expedient approaches to replacement of inadequate facilities invariably result in an equally short lived solution to the problem. Even worse, they often complicate longer range development opportunities due to the absence of an overall masterplan, and usually create a poor architectural image. The planning process must incorporate a successful integration of client/users and planning/design professionals as well. Input and expertise from all parties involved must come together in a continuing interaction and dialogue. The key words in any facility development endeavor are comprehensive planning and professional interaction.

This process has been applied to the long range facility needs of the Institute of Aviation at the University of Illinois in Urbana-Champaign. A review of the methods and techniques utilized in this project can be beneficial in developing insights for application to other similar programs.

INTRODUCTION

The challenge of flight with its lure of adventure has been a recurring theme throughout civilized history. The experience of flight is still a dream for many. Aviation as we know it today is more than just flying, however. It is a vast system, with vehicles used as tools in transportation, business, public services, sport, and national defense. Its product touches each of us almost every day of our lives.

Aviation is an important element of our educational system. Aviation education materials can be found at almost all grade levels. In the elementary programs aviation can be used in teaching traditional subjects bringing relevency to the learning process. At the secondary or high school level its uses are directed toward career awareness and development, and the enlightenment of an informed society. At the college or university level programs in aviation are directed at career development and research.

With the rapid advancements in technology, our interdependence on aerospace/-aviation products and the opening of the new frontier of space, aerospace/aviation education is an important addition to the total education of our citizens.

Facilities, the physical man-made environment which society has produced to serve its diverse needs, are vital to any educational mission. As the level of specialization increases, the importance of the architecture designed specifically for the mission and program involved increases dramatically. As humans are extremely adaptable it is possible to get by with discomfort, inconvenience, inefficiency and generally unattractive surroundings. However, both the quality of the performance and the sense of enjoyment and satisfaction of the individuals involved is immeasurably enhanced if the physical setting is of a high architectural level. It is clear the rationale exists for appropriate facilities to serve the mission of aviation education. The challenge is to seek the best method for achieving the proper physical product.

FACILITIES PLANNING--THE PROCESS

As modern society has grown in complexity, both from the standpoint of technological expansion and human potentials, the planning and design professions have also expanded their capabilities. Traditional professional expertise for delivery of physical facilities to meet functional and human needs has broadened to include the entire range of environmental problem solving considerations. In a day and age where physical, economic, and human resources are both in high demand and short supply, it is essential that the process of creating physical facilities be pursued with the utmost care and precision. This is not a simple task.

In recent years, numerous terms have evolved to better describe the notion of a broad based planning and design expertise. Comprehensive planning, master planning, total systems planning, and facility programming all refer to the general concept of comprehensive problem solving for physical development. Obviously, the exact nature of any procedure will depend greatly on the type, scale, and magnitude of the project and its related issues. The general underlying theory is based on an analytical and systemic process for bringing about physical solutions to identified needs.

As such, basic steps would include problem scoping (determining needs, defining goals and objectives, and identifying priorities), project analysis (needs assessment and feasibility), and project synthesis (physical development).

As the scale of any facility project expands, the importance of a comprehensive masterplanning phase also increases. Such a process can involve a wide variety of tasks important to critical pre-facility design decisions. These include site selection, environmental impact assessment, functional planning, etc. The site selection process itself has become a major area of professional endeavor in the last few years.[1]

At the more specific level of building design, a similar growth in importance of pre-design analysis has emerged. It is widely referred to as facility programming, and has become a specialized area of expertise.[2] It is basically a process for handling information in order for an architect to make proper design decisions. Facility programming emphasizes identification and analysis of user needs in relation to physical, economic, and social factors affecting the project. The product is a program document which can vary in levels of complexity and detail. The most general is referred to as a master program while the most specific is called a component program. It identifies precise design requirements for a component of a facility.[3] Whatever the scale of application, facility programming is essential to the design decision making process. The success of such a process is dependent on an interactive information sharing activity between the design professional and those by whom the facility will be utilized (the client user).

Applications in Aviation.

Airplanes, those elements around which the entire aviation industry revolves, represent the ultimate in both beauty and efficiency of design. The rapid development of the aviation industry has resulted from the maximum output of human endeavor and resourcefulness. Inherent in this achievement, whether it be in the aircraft technology itself, the evolution of an on-board and ground-based control system, or on the management of a vast world-wide airline traffic system, has been the reliance on a comprehensive systems planning approach to problem solving.

> "Aviation plans being developed today must consider all elements on a total system basis...professionals, in attempting to find the best solution must consider all system interfaces, and, in particular, the suitability of his solution to the other elements of the total system environment."[4]

Further, the importance of such a process for aviation training, research, and educational resources is not a new idea. It should be a natural outgrowth of systems planning approach to overall aviation needs. It is somewhat paradoxical, therefore, that aviation education programs in many instances are content to operate within a physical environment that is obsolete, generally unplanned professionally, and usually without any future plan or program for improvement.

If there is any industry which could be well served by a systematic and comprehensive planning approach to facilities needs it is aviation education. The dimension and variety of educational demands are particularly diverse.

Academic opportunities range from business and management subjects to human factors and advanced instrument technology studies. Teaching methods range from hands-on maintenance and flight programs to human psychology instruction. Facility needs range from sophisticated laboratories to general hangar spaces. The implications for specialized supportive facilities design are apparent and underscore the need for utilization of the most advanced state of the art in facilities planning methods. Unfortunately, what is too often found is a willingness to construct new structures (with the objectives of expediency and economy), originally designed for and probably best suited for storing corn.

APPLICATION--UIUC INSTITUTE OF AVIATION FACILITIES

The consideration of future facility needs for the Institute of Aviation at the University of Illinois in Urbana-Champaign has incorporated a comprehensive facilities planning approach in a rather unique way. Review of the process and techniques utilized in this process can serve as an important example for others. By examining a given case study it is possible to obtain new insights on approaches to similar type projects. Hopefully, the sharing of knowledge gained from each such experience can aid in the cumulative expertise and capability for application to other aviation education developments in the future.

Background

Willard Airport at which the Institute of Aviation is located is a state owned facility, operated by the University of Illinois. Located 5 miles south of the cities, it serves the Champaign-Urbana area for commercial, private, and corporate aviation, in addition to the Institute of Aviation with its academic and research programs. The Institute of Aviation, which has the additional mission of management and operation of the entire airport, is located in its entirety at Willard Airport. (See Fig. 1.)

Aviation education at the University of Illinois had its beginnings in the early 1940's when the University made the decision to construct and operate an

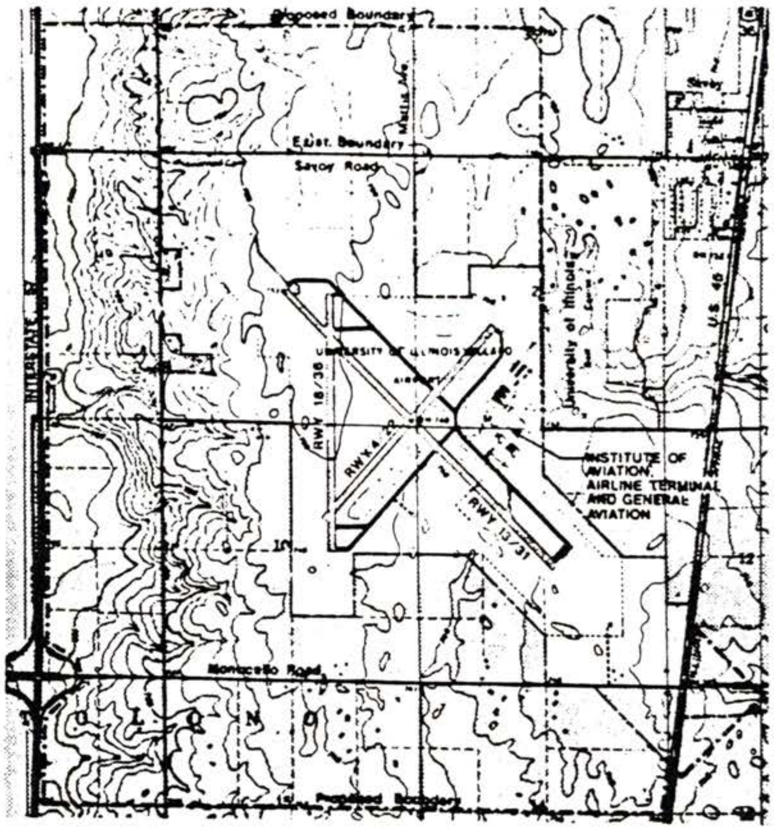

FIG. 1
WILLARD AIRPORT

airport. In 1941 a program sponsored by the University of Illinois, the Illinois Aeronautics Commission, the legislature and local businesses was undertaken to create a University airport at Urbana/Champaign. Funding was subsequently received from the Legislature in 1943 and upon completion in 1945 was officially dedicated with formal ceremonies in front of the main hangar.

In the years following the 1945 dedication, over 35 buildings were constructed including surplus Quonset buildings for classrooms and labs, T-hangar, business-executive hanger, fire station, terminal building and research facilities, all of which are in use today.[5]

Aviation programs at the University stemmed from a recommendation in 1945 to the Board of Trustees from an Advisory Board on Aeronautics to "facilitate a comprehensive program of aviation education." It was through these recommendations that in May 1946 the flight training program was initiated. Two years later the aircraft maintenance curriculum was approved with the first class graduating in 1950. Today the University of Illinois Institute of Aviation is responsible for the academic programs of flight, maintenance, and research, and other commercial operations of Willard Airport for the University.

In 1974, a comprehensive master plan for the airport was completed, but never was officially adopted.[6] Physical change continues to take place however, and some form of long range plan is essential if the change is to be orderly and effective. Expansion of facilities for the Institute in the past has been hampered by the lack of an accepted plan for the airport as a whole.

The Institute's academic and research program operates out of facilities which are totally obsolete and inadequate to the mission of the program. The present (1983) academic setting for aviation programs at the Institute is a post-World War II temporary Quonset hut environment. They have been adapted and modified over the years, and are basically structurally sound. However, they are extremely inefficient and are poorly equipped for use as a modern aviation education program operation. Figure 2 illustrates existing conditions.

FIG. 2
EXISTING FACILITIES

During the years of major University physical expansion, the Institute of Aviation was low on the priority list for new facilities. In recent years Institute needs have become critical, but serious curtailment of building construction funds has occurred. Thus, badly needed new construction has not taken place. Planning for new facilities has been pursued, however, in spite of the gloomy climate for achieving results. The Institute administration has long realized the need for pursuing long-range program goals, and in 1975 a planning study was initiated. It included both an academic development study as well as facility development needs.

Academic Planning

An academic plan was completed in 1976.[7] It outlines the educational objectives for the Institute both for the short-range and long-range. The two-year program currently in place is projected for upgrading to a four-year program in the future. Over the long-range the Institute includes plans for a graduate program in aviation studies.

One unique and useful aspect of the Institute planning process has been the establishment of a planning advisory committee. This committee has been made up of representatives from the various fields within the aviation industry nation wide. The group has been utilized periodically over the years for input and reaction to concepts and ideas for Institute improvement in both programmatic and facility areas.

Physical Planning

In 1975, a facility planning committee was established. The need for representation by design professionals was recognized and provided by the faculty of the University of Illinois School of Architecture. This involvement has continued intermittently over the years up to the present time. As no immediate construction was contemplated and no funds were available for professional services, this participation by Architecture faculty and subsequently, graduate students has served as a successful alternative.

An initial problem needs assessment phase was conducted by the Institute facilities planning committee. This included a period of investigation of other aviation and education programs and related facilities. It was during this time that the idea of utilizing a class of graduate students in Architecture to pursue a complete facility planning and design study emerged.

In architectural education a proven instructional method is the design studio, and the Institute of Aviation project provided an ideal vehicle for an educational experience due to its complexity and reality. At the same time, this academic planning exercise served the Institute administration well. It provided an initial exposure by the staff to the process of physical planning without all the constraints and limitations inherent in a real study. It provided a vehicle by which the staff could better understand its facility problems and needs as they related to present and future mission goals. It provided a means for visualization of a number of facility design concepts and alternatives. Perhaps most importantly it reinforced the importance of and need for a comprehensive planning approach to Institute facility needs.

As an initial step in the study, an overall planning methodology was developed by Professor Bruce Hutchings of the Architecture faculty. It served as a procedural guide during the six month period for conduct of the study and also served as a framework for a follow-up evaluation.[8] A diagram of this process showing sequence of steps involved, contextual definitions, and related planning techniques of each step is illustrated in Figure 3.

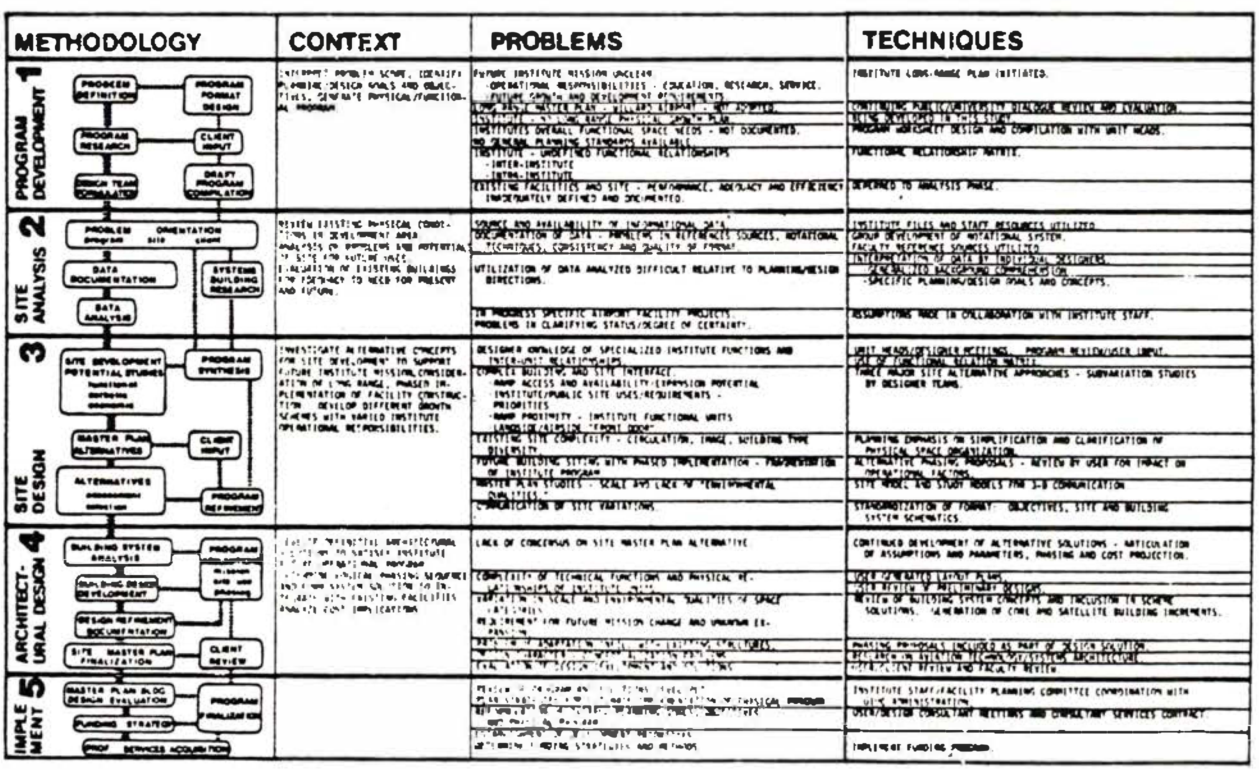

FIG. 3
PLANNING METHODOLOGY

Four key procedural activities in the process are identified with subactivities within each. The major product of phase 1 was a building program. For this study a format was created for use by Institute staff in identifying operational activities and associated space requirements. Compiled forms were then used by the architects as a reference for building design requirements. A functional relationship using a matrix for illustration was also prepared to aid in programming. These aids are illustrated in Figure 4.

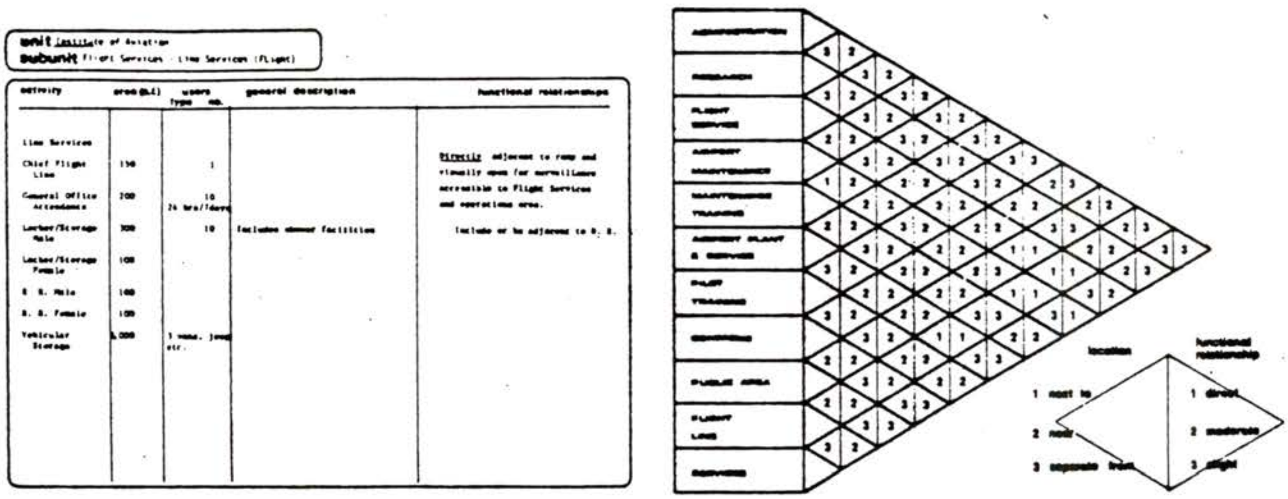

FIG. 4
PROGRAM FORMAT & MATRIX

Site analysis has become an inherent part of any medium to large scale building projects and rather sophisticated assessment theory and analysis techniques have been developed.[9] Applications of such techniques are invaluable in dealing with unique environmental conditions and their impact on building design.[10] In the Institute of Aviation study numerous environmental issues and problems were identified. One of the most serious of these involved conflicts in site circulation (See Figure 5).

During the masterplanning phase a number of innovative concepts were explored, as very few limitations were present to the designers. In any development project where numerous activities and separate buildings are present the masterplanning phase is critical to the overall decision making which must follow. While a masterplan can and should be subject to change, general

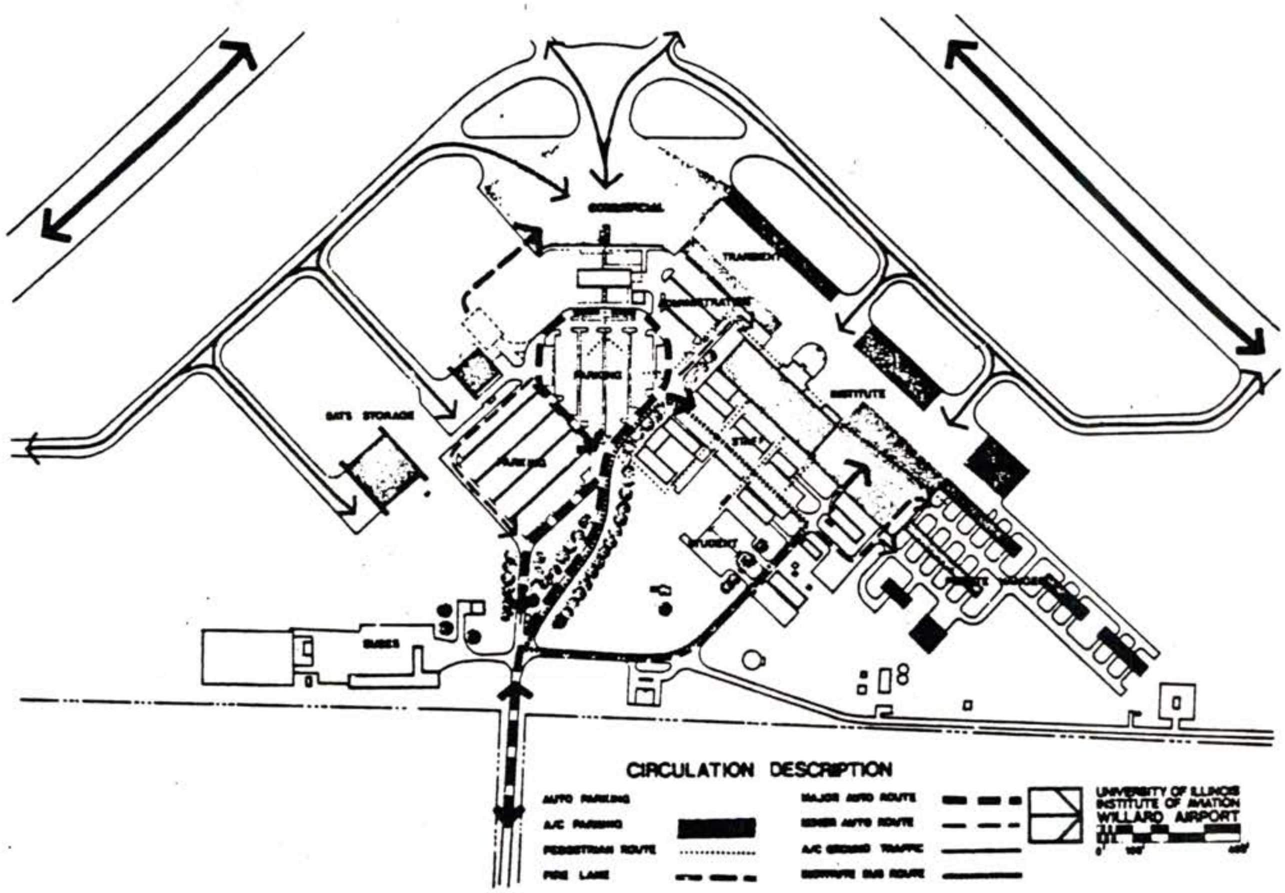

FIG. 5
CIRCULATION ANALYSIS

committments to and decisions on overall site systems organization have to be made. A physical masterplan provides a vehicle for this decision making process. Once developed such a plan can then serve as framework for orderly and efficient land use, circulation, and specific facility planning developments to follow over an extended period of time.

In the <u>architectural design</u> phase a variety of concepts were explored ranging from adaptation of an infill of new construction between existing Quonset structures, to a completely new facility based on an expandable building system concept. This latter idea accommodates a phased construction program as well as establishing an architectural expression in keeping with the current aviation technology. (See Figure 6.) All design studies were accompanied by a construction cost analysis to further complete the level of design knowledge.

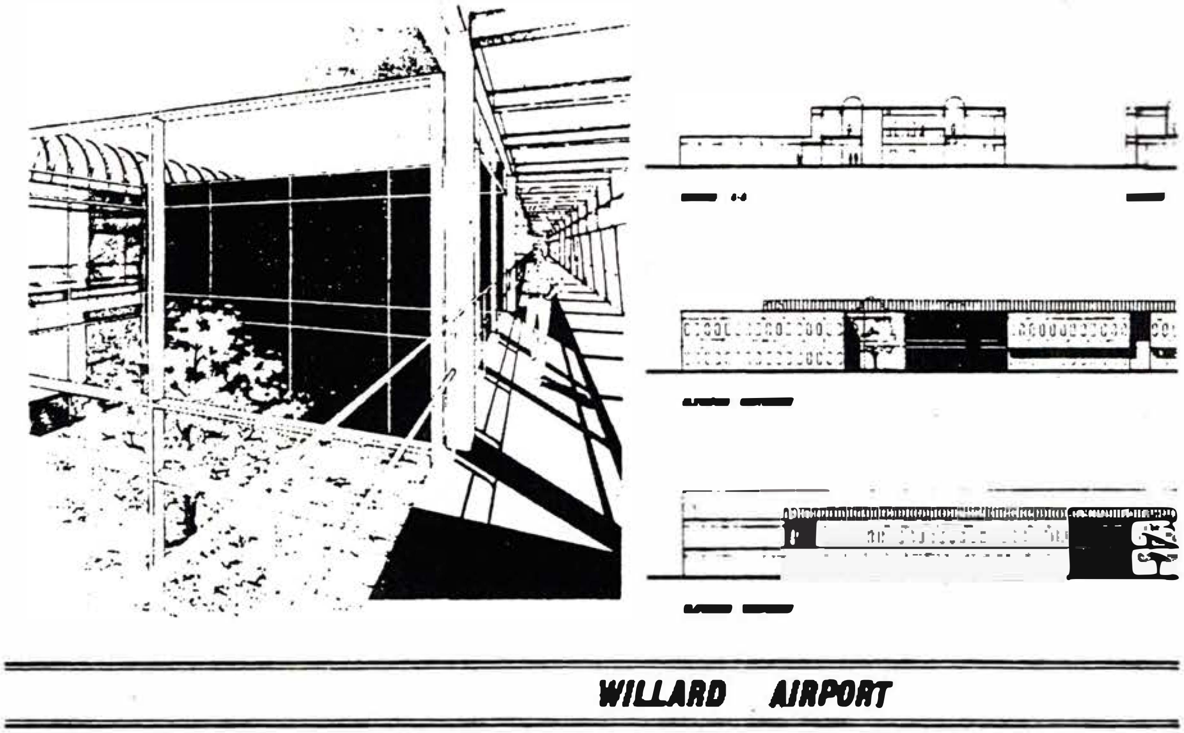

FIG. 6
FACILITY DESIGN

Current Planning

Following completion of the study by the students in 1979 and final presentation of their work to the Institute staff, no further planning activity took place until the summer of 1981. The prospect of University funding for new Institute facilities had not changed or improved during the intervening years. The Aircraft Systems Department of the Institute, under the direction of Dr. David DePue, and with the concurrence of the Institute Director Dr. Henry Taylor, applied for and received a grant from the State of Illinois Board of Education, Division of Adult Vocational and Technical Education. The proposal consisted of three major objectives:

1. To become familiar with other aviation education institutions of an exemplary nature.

2. To determine model facilities and project aviation program needs of the Institute of Aviation.
3. To project Institute facilities needs for the present and into the future.

This study included visitation and documentation of other facilities, use of consultants for planning and program development, and conducting of a facilities planning seminar to review progress of the study.

Professor Bruce Hutchings from the School of Architecture, who had directed the earlier student study, was invited to participate. Based on experience with the earlier study, and related professional experience over the years on institutional planning and design projects both in the United States and overseas, his recommendation was to incorporate the findings into an Institute Facilities Master Plan. In order to assure a proper fit of individual department needs with other existing and possible future facilities for the Institute, a general long-range development strategy needed to be prepared. Further, in order to pursue funding possibilities, promotional material was needed which could illustrate in a visual way an image of a possible future facility.

It was decided that the product of the study should be a three-dimensional concept model suitable for illustration of an overall future facility as well as a physical tool for ongoing planning studies.

General Institute goals relative to facility development were identified early in the process. They were:

1. Create new identity and physical image.
2. Centralize departmental locations.
3. Unify operational activities and combine overlapping functions.
4. Create long-range facility development strategy.

Other physical changes which had occurred subsequent to the student design study also limited the options for future Institute development. These included expansion to and remodeling of the present terminal facility, and establishment of a new fixed base operation. Figure 7 illustrates a firmly fixed general landuse pattern on the site. Figure 8 illustrates the current fragmented arrangement of Institute operations.

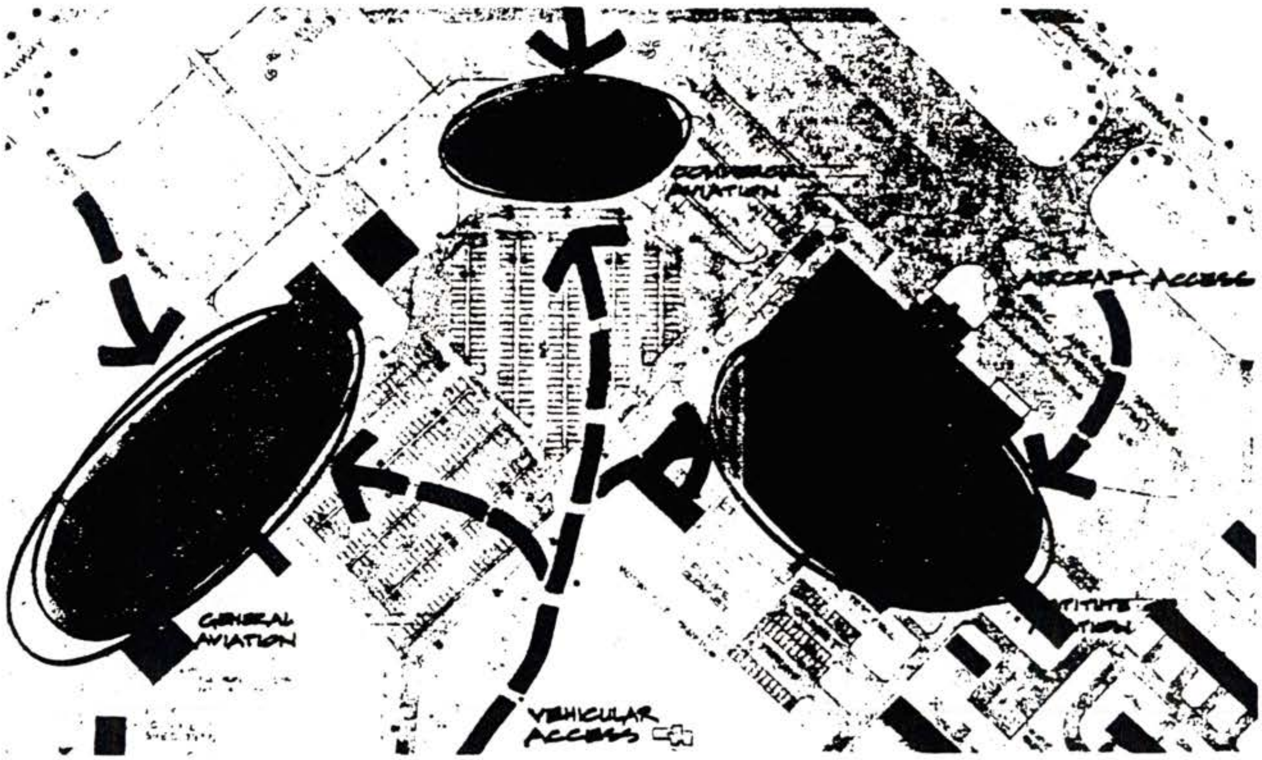

FIG. 7
EXISTING LANDUSE

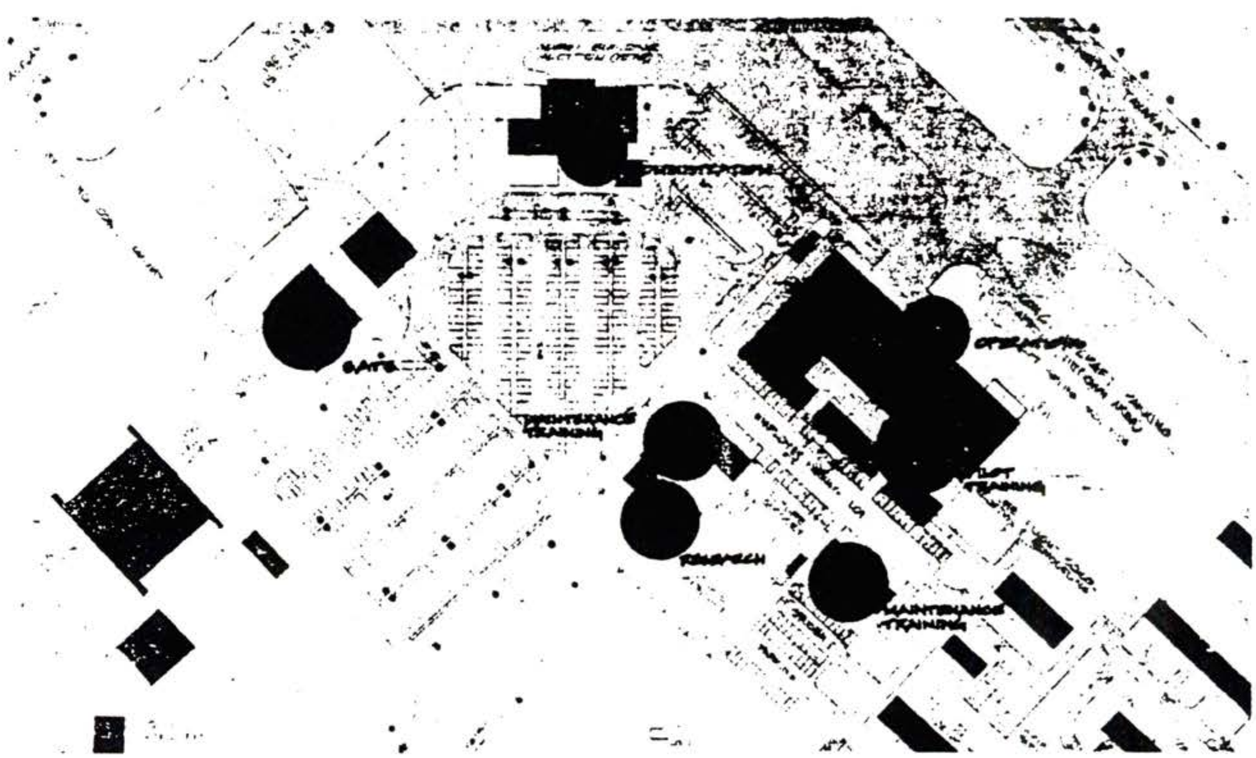

FIG. 8
INSTITUTE DEPARTMENT LOCATIONS

As the Institute needed to remain in operation using existing structures concurrent with any new facility development, the concept plan needed to be organized such that connection to both existing facilities and future construction could occur. Also, the Institute operation is such that both an airside front door and a landside front door are important features. These needs gave importance to the idea of an internalized pedestrian circulation system which could serve as an organizing framework for connecting of various operational components. These various constraints and ideas are illustrated in a conceptual bubble diagram overlayed over existing site conditions. (See Figure 9.)

This concept was then developed into a more definitive diagram. This was done utilizing both the programmatic areas developed in the previous study and the current program completed by the aircraft systems facility committee. (See Figure 10).

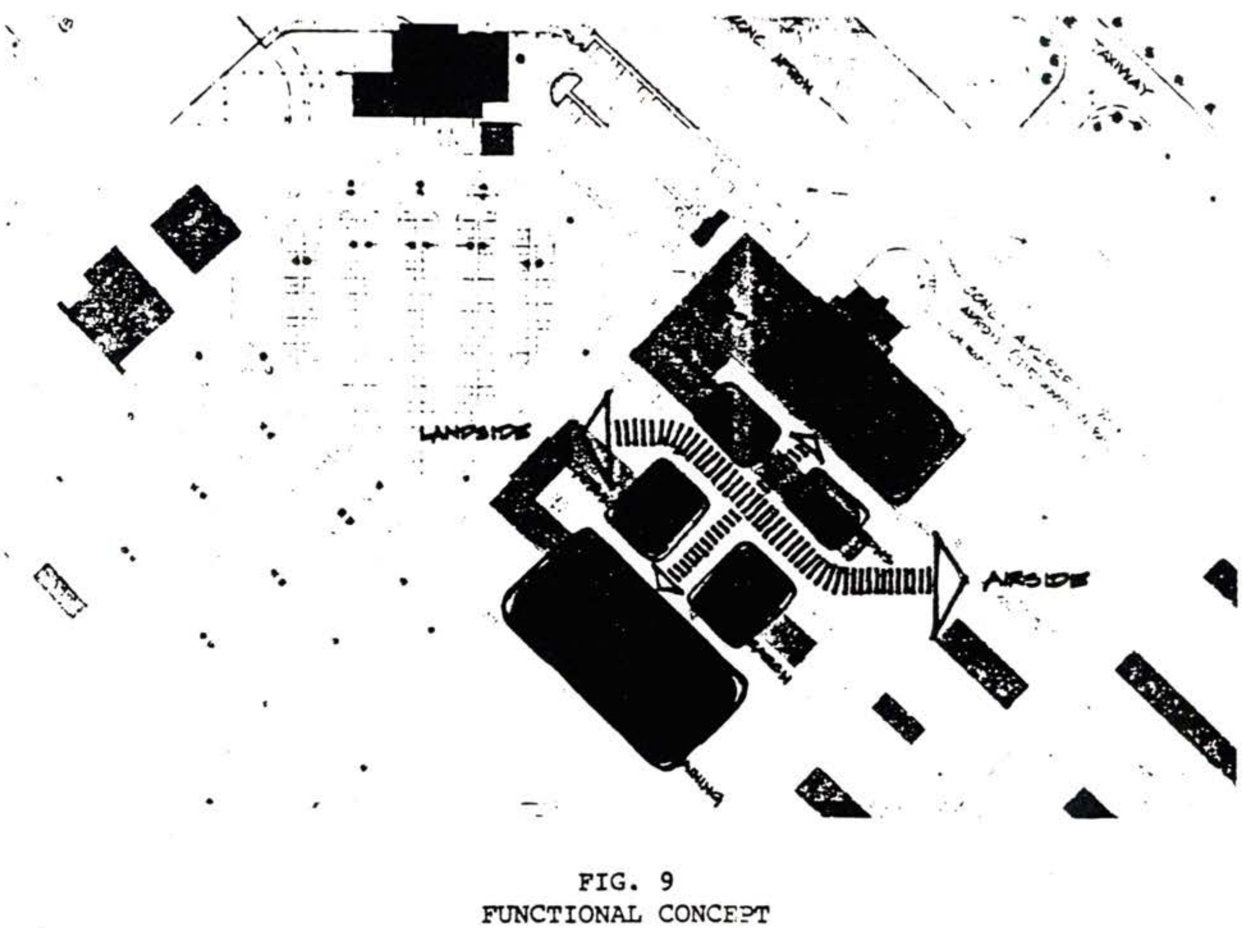

FIG. 9
FUNCTIONAL CONCEPT

In the summer of 1982, the seminar was conducted with the planning material presented, discussed, and analyzed. Minor organizational changes were suggested, prepared, and reviewed by the Institute staff during the summer. Following this, the concept development model was constructed. It was prepared in a manner to show both existing conditions as well as phased approaches to new facility construction.

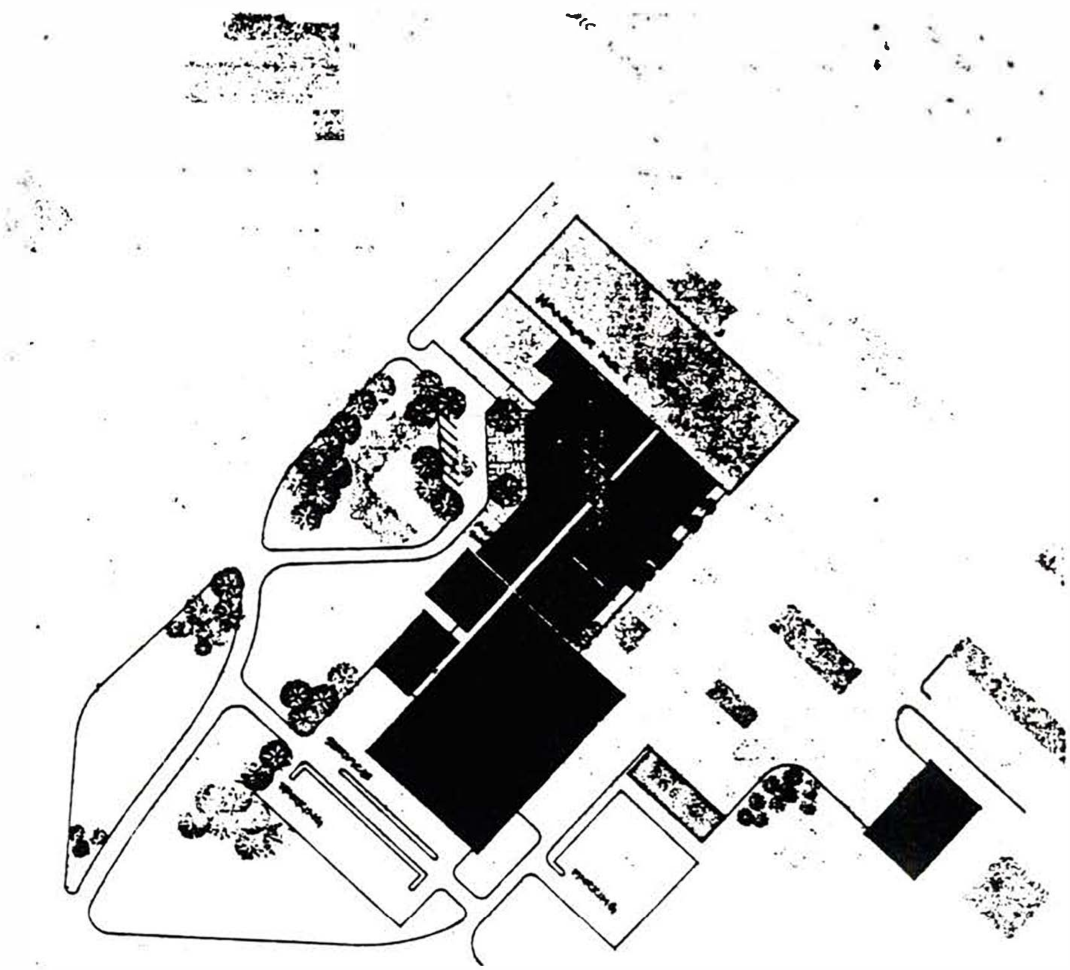

FIG. 10
CONCEPT DEVELOPMENT

Figures 11, and 12 illustrate the model as a three-dimensional concept. The first shows partial development of phase one (the Aircraft Systems Department). Figure 12 is an oblique angle view of the completed complex focusing on the landside front door.

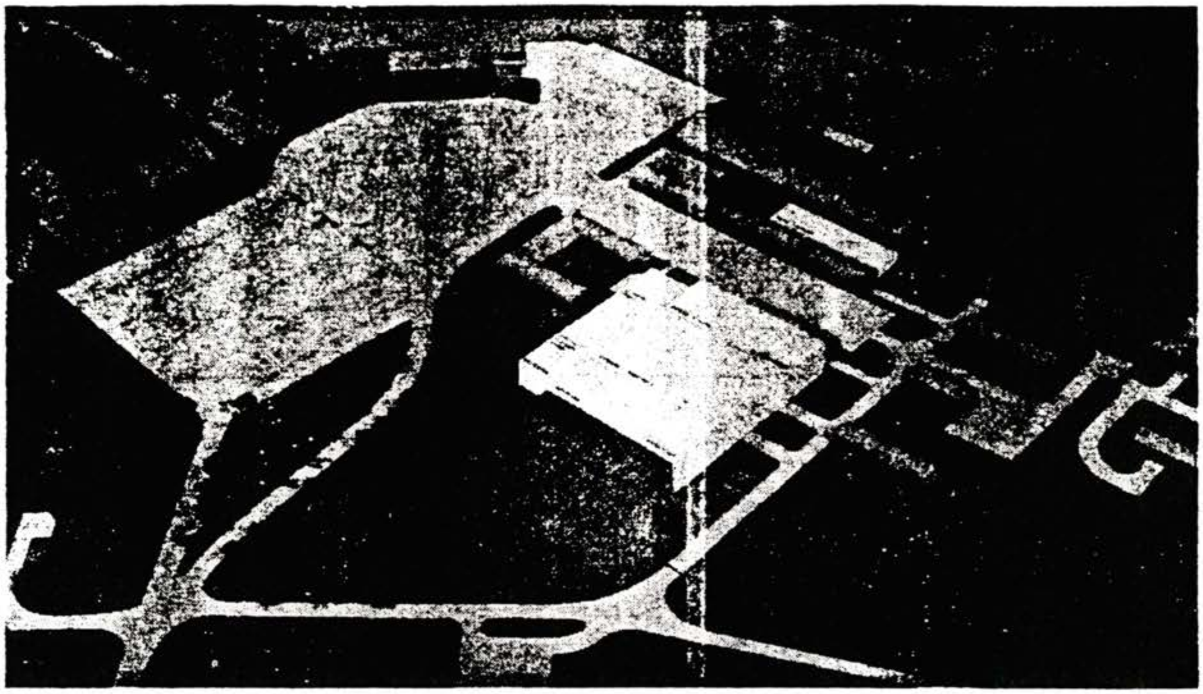

FIG. 11
CONCEPT MODEL - PHASED CONSTRUCTION

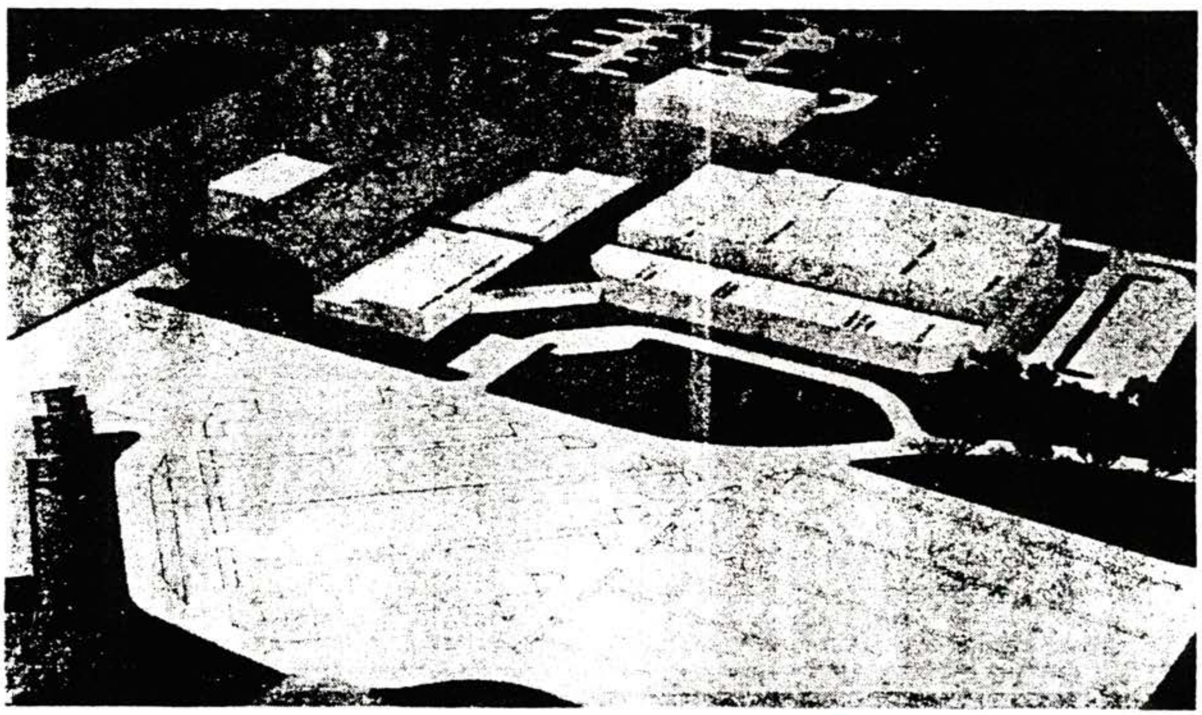

FIG. 12
CONCEPT MODEL - LANDSIDE VIEW

This most recent planning effort has resulted in two important products. The first is a definitive architectural program and functional plan for one component of the Institute, the Aircraft Systems Department. Detailed space needs and functional relationships have been identified by maintenance staff after a thorough investigative process. The second product is a model for development of the entire Institute facility needs into the foreseeable future. These products represent two extremes of scale. The first is detailed and finite, the second is generalized and conceptual. However, the first without the second is incomplete. An overall vision for the future is an essential part of any partial construction effort. While not yet a definitive architectural design, the concept plan does achieve a three-dimensional form and identity. As such it can serve as both a promotional resource and a physical framework for the planning and guiding of construction to follow over the years.

CONCLUSIONS

No doubt the old adage that "nothing is new, it's all been done before", applies to the planning process just discussed. However, review and analysis of new applications of accepted methods remains as a useful exercise, if only to confirm what is already known. The major value of such a review really is to enlighten those who may not have had previous exposure to such a comprehensive process and, to offer the possibility of new insights to those who have. Learning from the experience of others is a most fundamental, but useful educational technique.

A number of key issues can be readily identified from this case study. First and foremost, comprehensiveness of method and scope of planning effort are essential. This has been clearly emphasized throughout this project. Included is the idea of understanding of and responsiveness to constraints and opportunities arising from the planning analysis itself. The analysis should encompass physical and environmental considerations as well as human and economic ones.

Secondly, in any physical planning process the issue of interaction and sharing of ideas and knowledge is critical. The clients and facility users have a firsthand and indepth knowledge of both operational and functional needs. A close working relationship with planning and design professionals who are involved in any given project must take place. In addition, several specific design professionals working on an interdisciplinary team basis are normally vital to a successful outcome.

A third primary issue is that of adaptability and flexibility to change. This applies both to the products of the planning and design process, as well as the method by which the realization of facility needs is achieved. Masterplans for hypothetical future facilities which cannot accommodate change may be worthless, and to many worse than no masterplan at all. A masterplan must be utilized as a general framework for orderly progression from what exists to what will eventually occur. At the same time the environment for accomplishing facility development, especially within educational institutions, has changed over the years, and will no doubt continue to change in the future. The various techniques and methods of facility planning must be utilized in a flexible and changing manner in order to accommodate this evolving economic climate.

Finally, perseverance is also a mandatory ingredient. Organizations should not forego planning for future facility needs just because the present outlook is bleak. If planning for the future has taken place, the stage is set for a series of actions which should follow, whatever the time frame.

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