



As airlines continue to strive for competitive advantage in the commercial aviation industry, they place increasing emphasis on operational efficiency and cost control. Operational efficiency mandates that airlines have cost-effective airplane hangars that support productive maintenance activities. Unlike repetitively manufactured and assembled products, an airplane hangar is a highly customized structure tailored to a specific site. For this reason, strong project planning is required to ensure new hangar facilities meet airlines' business objectives.

AERO
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PLANNING AIRPLANE HANGARS

FOR OPERATIONAL EFFICIENCY
AND COST EFFECTIVENESS

FACILITIES

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Although airplane hangars have been around since the dawn of flight, the hangars of today are more complicated and costly than ever before. Numerous technological advancements, shortened project schedule requirements, and increased regulatory oversight have made the management of a successful hangar project much more demanding.

The greatest challenge faced by a new hangar project team (see “Assembling the Project Team,” p. 12) is to properly manage schedule, cost, and quality throughout the planning, design, and construction phases of the hangar project. The key to successfully meeting this challenge is to carefully plan the hangar *before* moving to the design and construction phases of the project (see “Planning Considerations,” p. 12).

A properly engineered project plan allows all other aspects of the project to proceed as simply as possible, while minimizing complicated and costly factors such as multiple design and construction packages, bid escalation due to uncertainty, high change rates, estimated-cost construction contracts, and large project management staffs. The planning phase yields the highest opportunity for saving cost while requiring relatively insignificant project funding to perform (fig. 1).

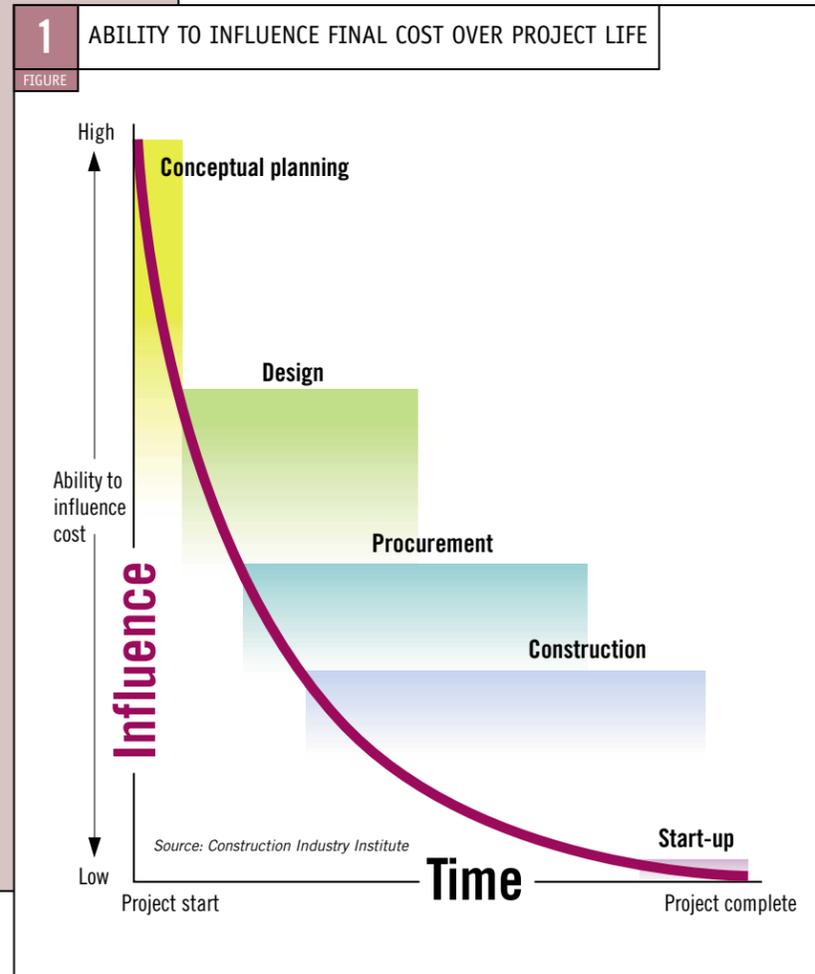
A good hangar project plan specifically addresses the following:

1. Airline objectives.
2. Airport-related issues.
3. Site development.
4. Site utilities.
5. Building requirements.

1 AIRLINE OBJECTIVES

The category of airline objectives encompasses the specific maintenance and operational requirements of the new airplane hangar facility. These requirements must be identified early in the project to ensure the hangar will support the needs of the airline. Specifically, the hangar project team should

- Identify the current and long-term projected airplane fleet, including the number of airplanes that will use the facility, the annual use of airplanes, and maintenance-hour requirements.
- Identify the types of maintenance to be performed, the number of components annually serviced, and estimated workload projections including room and space requirements. In addition, the team should identify specific shop-equipment needs to determine the building’s mechanical and electrical service requirements. Specific hangar functions to be reviewed are listed in table 1.



1	CHECKLIST: TYPES OF MAINTENANCE
TABLE	<ul style="list-style-type: none"> ✓ Line maintenance ✓ Heavy maintenance, overhaul, or modification ✓ Corrosion control and cleaning ✓ Airplane painting and paint removal ✓ Airplane storage or logistics operations ✓ Engine maintenance or overhaul ✓ Maintenance by a third party ✓ Passenger or cargo logistics ✓ Component overhaul (e.g., propulsion systems, auxiliary power units, flight controls, air-conditioning systems, avionics systems, electrical power systems, structures, hydraulic and pneumatic systems, fuel system, interiors, and landing gears, wheels, tires, and brakes)

- Identify the shops and support functions that will be required to support the hangar functions (table 2).
- Assess airplane access requirements. The height of the hangar will be determined by the models of airplanes to be housed, the variety of work to be performed on those airplanes, regulatory requirements, and the types of airplane-access systems to be used. Areas for the project team to consider include airport obstruction height limitations (as required by U.S. Federal Aviation Administration federal aviation regulation 77), control tower line-of-sight issues, airport traffic control and radar systems, floor-mounted portable work stands and docks, roof-mounted suspended docks, teleplatforms, personnel protection systems, overhead traveling cranes, and airplane jacking or landing-gear pits.
- Assess airplane layout requirements. As with hangar height, the internal dimensions of the hangar will be

determined by the types and number of airplanes housed and the work performed. In addition, possible insurance or regulatory authority clearance requirements as well as maintenance policy will affect the internal dimensions of the hangar. Areas to consider include required horizontal clearances around airplanes including stands and floor- or roof-supported maintenance docks, the ability to move airplanes while others are in the hangar, tail-in versus nose-in airplane-parking configurations, building setback requirements, the proximity to adjacent buildings, the use of tail doors, and the installation of floor airplane power-supply stations.

- Assess company standards for interior and exterior finish quality, security, facility maintenance, access for people with disabilities, and corporate image.

2	CHECKLIST: SUPPORT FUNCTIONS
TABLE	<ul style="list-style-type: none"> ✓ Administration and engineering offices ✓ Airplane painting and paint removal ✓ Airplane parking, aprons, ramps, and taxiways ✓ Airplane washing ✓ Engine overhaul facility and test cell ✓ Ground-support equipment repair, storage, and staging ✓ Component storage and staging ✓ Car and bus parking, bathrooms, cafeteria, and locker rooms ✓ Computer room ✓ Electrical substation and emergency power plant ✓ Facility maintenance ✓ Fire-water reservoir and pump house ✓ Flight-crew support areas ✓ Guardhouse, fencing, and security ✓ Hazardous materials storage ✓ Maintenance library ✓ Maintenance training ✓ Passenger logistics ✓ Quality assurance and control

Once the airline's objectives for the hangar have been established, the project team must analyze certain facility design and construction elements to ensure the hangar design will support the airline's objectives.

2 AIRPORT-RELATED ISSUES

Airport-related issues are facility issues that must be closely coordinated with regulatory, airport, and environmental authorities. The hangar project team should consider the following elements:

Site location.

Determine the areas available for development and the procedures for procuring the land. For site selection, consider the ability to easily maneuver current and future airplanes from the site, taxiway access requirements,

existing rotary aircraft flight paths, and proximity to airline operations, runways, taxiways, and parking. The potential for horizontal and vertical expansion of the facility is also an important consideration, as are options for adjacent or other air- or land-side locations.

Terms and conditions.

Evaluate leasehold agreements, potential land acquisition, zoning issues, environmental limitations, setback requirements, and compatibility with the airport master plan.

Government and community.

Consider community attitudes toward airport development, potential local or state financial inducements for development, development schedule limitations, established application processes and points of contact, and airport or local jurisdiction site-development criteria.

Environmental conditions and noise-abatement issues.

Evaluate the likelihood and effect of severe weather (e.g., hurricanes, tornadoes, hail), earthquakes, prevailing winds, extreme heat or cold, bird hazards, and visibility problems. Also consider noise issues that may require dedicated noise-abatement facilities for engine and daytime taxiway runups.

Airport operations.

Review current and future airport capacity, runway capacity, airport navigation systems, landing fees, hours of operation, snow removal and deicing capabilities, airport fueling and defueling, air- and land-side access, airplane rescue and firefighting, and airport security.

Insurance underwriter reviews.

Contact the airline's insurance company to find out whether it has requirements beyond those required by the local building jurisdiction. Consider inviting one of the insurance company's loss prevention engineers to the hangar planning sessions and the early design meetings to ensure the final design is consistent with insurance requirements.

3	FACILITY SPECIFICATIONS																																				
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3 SITE DEVELOPMENT

Site development requirements are facility issues dealing with the land on which the hangar will reside. The hangar project team should perform the following studies to gain a realistic understanding of project requirements:

- Survey the site under consideration for existing buildings, parking areas, or other structures. If the site has existing structures, it is important to identify who will be responsible for demolition of those structures.
- If demolition is necessary, survey all structures for hazardous materials such as asbestos and lead paint. Hazardous materials may be costly to remove and significantly increase project schedule requirements.
- Survey the site for contaminated soils, ground water, or other materials requiring environmental remediation before development. This can have serious cost and schedule implications for a hangar project.
- Have a soils engineer make necessary field tests to establish foundation and pavement design criteria. The study should also address any potential unstable soils or high water-table conditions. If unstable conditions are encountered, additional site preparation and special foundations may be required and should be identified early in the project.
- Assess landscaping requirements.
- Assess parking requirements for airplanes, cars, buses, and service vehicles.

4 SITE UTILITIES

Site utility requirements are facility issues involving the utilities that will be needed by the hangar facility. The hangar project team should perform the following studies:

- Identify, locate, and establish the capacities for existing utilities to determine whether they will be sufficient to meet hangar facility utility demands.

- Meet with the airport authority or utility purveyor to develop requirements for connecting or extending existing utility systems. In some situations, airport authorities may provide utility connections to the hangar site at no additional cost. In other instances, they may require fees and design approval before accessing airport utilities. In other cases, the airport may not have the needed utilities and the airline will have to bring in such services at its own expense. These issues can impact both project cost and schedule and should be considered early in the planning process.
- Identify the utility systems required to support the hangar facility:
 - **Potable water, fire water, and airplane wash water, including water recycling systems and oil-water separators.** Typically, hangars with doors higher than 28 ft require overhead-deluge aqueous film forming foam (AFFF) fire-protection systems. For DC-10, 767, and larger airplanes, underwing foam monitors are also often required. Hangar fire-protection systems can require water storage capacities of 200,000 to 500,000 gal or more. Above- or below-ground water storage tanks may be required if the local airport or municipality cannot furnish necessary quantities. Further, many airport water systems cannot meet flow-rate requirements without supplemental on-site pumps.
 - **Sanitary and industrial-waste sewer systems.** Hangar fire-protection water often is discharged at rates of 3,000 gal or more per minute. In many situations, the discharged water must be directed, contained, treated, and either taken off site by waste-handling contractors or pretreated and metered into the sanitary sewer system.
 - **Storm-water sewer systems.** This includes potential requirements to treat or retain on-site storm water.

- **Electrical power, including emergency power availability.** The stability of current or future power sources should be carefully analyzed with respect to airplane fleet ground-power requirement specifications and power-quality sensitive systems such as computers that may be incorporated into the hangar facility.
- **Natural gas, compressed air, high-pressure steam, and chilled water systems.**
- **Telephone, data, video, and security systems.**
- **Heating systems.** Most hangars in moderate to cold climates have heating systems. Hangars in tropical environments often are partially open and use natural ventilation; hangars located in desert environments may require air conditioning. Paint and strip hangars, regardless of their geographical location, typically require controlled temperature, humidity, and air-quality systems.

5 BUILDING REQUIREMENTS

Building requirements are the elements of planning used to prepare detailed documents from which a construction contractor can build the hangar. When a designer completes the design phase of the project, the completed design package consists of two major categories of information: plans and specifications. *Plans* are drawing instructions to the construction contractor that describe the physical characteristics of the facility. *Specifications* are written instructions to the construction contractor that describe quality requirements.

For example, the plans will stipulate where concrete is required, whereas the specifications will specify how strong the concrete should be. Facility specifications generally are categorized in the format shown in table 3. When the hangar project team is determining building requirements, it should address all the applicable areas listed.



The Boeing Flight Test hangar in Seattle, Wash., is an excellent example of good planning. Built nearly 50 years ago, it is still able to house the larger commercial airplanes now produced by Boeing.

SUMMARY

No element of a hangar project is as important as the development of a strong project plan. No matter how well a hangar is designed and constructed, the final product will not meet airline expectations if it has not been planned properly. The hangar project team must be led by an effective and empowered project manager and include representatives from all functions that will use the new hangar. This team should be supplemented by planning consultants who have a proven record in the planning, design, and construction of airplane hangars similar to the project under consideration. When planning the hangar site, the project team must try to envision airline needs for the next 20 years and then site the hangar accordingly. A successful project team carefully balances schedule, cost, and quality, placing appropriate emphasis on each factor.