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FEASIBILITY STUDY OF AN AEROSPACE MUSEUM IN THE
WESTERN UNITED STATES

(In Four Volumes)

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Volume One

Summary, Conclusions and Recommendations

Contract NASW-2215
Final Report
31 July 1972

Smithsonian Institution
National Air and Space Museum
Washington, D. C. 20560

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- III. National Air and Space Museum, Smithsonian Institution Policy for Loans of Space Artifacts, October 1971
- IV. Methods of Developing Support for Museum Projects, by Frank A. Taylor, July 1968
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I. Introduction

A. Origin and Purpose of Study

This report stems from the hearing by an Ad Hoc Subcommittee of the House of Representatives Committee on Science and Astronautics held 16 July 1970 (Vol. Three, Section I). The subcommittee heard testimony by representatives of the Smithsonian Institution, National Aeronautics and Space Administration and the Defense Department and Honorable Charles S. Gubser, Tenth District, California on the bill H.R. 10771. This bill proposed ". . . that the Administrator of the National Aeronautics and Space Administration shall investigate and report to the Congress as to the advisability of establishing a permanent National Aeronautics and Space Administration Aerospace Museum. . . ." The Bill was introduced in the House of Representatives in the First Session of the 91st Congress by Representatives Charles S. Gubser, Don Edwards, Alphonzo Bell, Paul N. McCloskey, Jr. and Jerry L. Pettis and was referred to the Committee on Science and Astronautics.

Based upon the testimony at the hearing on H.R. 10771, it was concluded that existing statutory authority would permit the accomplishment of the proposed study. All

witnesses agreed that such a study, conducted by the Smithsonian Institution, would be desirable. Consequently, H.R. 10771 was tabled, and NASA provided, under contract to the Smithsonian Institution's National Air and Space Museum, funds to conduct a "Feasibility Study of an Aerospace Museum in the Western United States" by July 31, 1972. The contract work statement contained three tasks:

1. To survey existing aerospace museums in the U.S. ;
2. To study the feasibility of establishing an aerospace museum in the Western United States;
3. To draw conclusions and make recommendations based upon the findings.

B. Methodology

The first task under this study was to conduct a survey of U.S. museums which have aerospace exhibits. A questionnaire was prepared and, as required by the Office of Management and Budget under the Federal Reports Act, approval was obtained.

To be certain that full coverage was obtained letters were addressed to the governor of each state. A list of known museums was enclosed and inquiry made of the existence of any others.

Mailings were made, returns tabulated and programmed into a Honeywell H-2015 computer at the Smithsonian Institution which permitted varieties of data to be correlated and printed.

It was suggested that the region of the "Western United States" be defined to include the states of Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington and Wyoming. This definition was concurred with by the NASA technical director of this contract. Numerous visits were made to those locations in California, Washington and Arizona which were the areas of greatest aerospace activity and employment. Discussions

were held with representatives of state, county and municipal offices concerned with education, tourism and commerce.

Visits were made and discussions held with directors of all museums of aerospace interest in California, Washington and Arizona. Consultants were engaged for professional expertise, economic and location analyses, engineering and construction costs.

In the language of the Bill the objective was to determine the advisability of establishing in the Western United States a permanent National Aeronautics and Space Administration Aerospace Museum. The title of the report of the hearings on the Bill is Feasibility Study Regional Aerospace Museum. At the hearing some agreement was expressed that the proposed museum would be more appropriately under the direction of the Smithsonian. Combinations of advisable, feasible, national, regional, NASA and Smithsonian lead to a variety of conjectural configurations of the museum and the study.

It was assumed early that the question "Is the museum feasible," i. e. , "capable of being established" or "possible" was the primary question but that the question of whether it was advisable, i. e. , prudent or sensible, should not be avoided.

The question of whether an aerospace museum in the West is possible certainly must be answered in the affirmative. Enough historical air and space objects exist to install a significant museum and more are being produced. Curatorial and administrative personnel are available to plan and operate the museum and more can be trained. One can hardly question the capability of the United States, i. e., federal and state governments, the aerospace industry, and community leaders together to provide the financial support to create and support another museum. The museum is possible, i. e., feasible.

The study has assembled facts about existing air or aerospace museums in the Western United States some of which might be the nucleus for development; facts about populations and the concentration of the aerospace industry; suggestions about what the concept of the museum might be; and other options for accomplishing some of the objectives of the museum such as by circulating exhibits into a number of communities. But beyond the foregoing obvious statements and these facts, the question of the advisability of establishing

a new museum or multiple support of existing museums is one of judgment which at this point must be based largely on general observations. These are summed up in the recommendations which follow.

II. Conclusions and Recommendations

A. Existing Museums

There is widespread interest in aerospace activities throughout the Western United States and sixteen museums* now exist in California, three in the state of Washington, three in Arizona, and one each in Colorado, New Mexico, Oregon and Utah with a wide variety of aerospace exhibits. Strong interest has been expressed by many of these organizations in developing and improving their aerospace exhibits. (Volume Three, Section XVII)

Study and analyses (presented in detail in Section III. B. of this Volume and in Volume Two) show that by virtue of population density and percentage of aerospace employment California is the most logical state in which to consider establishment of an additional aerospace museum. However, these studies also show that there are at this time no dearth

* In this report the term "museum" is interpreted broadly to include a variety of institutions ranging from state, regional and community organizations or display centers with permanent exhibits of aerospace history, science and technology to the classic museum with curatorial and research staffs. In all cases, public communication of historical and contemporary aerospace subjects is effected. In some instances this is the total purpose of the organization; in others, it is a significant part of the total exhibit activity.

of aerospace museums in California. Sixteen museums with aerospace exhibits now draw an annual attendance of over seven million. Each of these activities contends that the major obstacles to improved aerospace representation are the costs of transforming objects into exhibits (labels, cases, audio-visuials, etc.), transportation and in many cases, the costs of providing additional exhibition space.

Capital value of these sixteen California museums is estimated conservatively at \$25,000,000. Existing administrative and technical staff of these museums represent a major intangible asset and a strong reason for support of existing enterprises. Additionally, aerospace museums are in the process of formation in Palmdale, Pasadena, Oakland, and Sacramento, as well as at Phoenix and Tucson, Arizona. Aerospace museums in Colorado, New Mexico, Utah and Washington also desire development and expansion of their exhibits. To establish a new aerospace museum at one location would provide a quantum increase of aerospace exhibits at that location at the expense of better regional coverage by established and willing institutions for the same, or less, investment of resources.

In the interest of maximum benefit to the maximum number of users it is our conclusion and we therefore recommend that prime consideration should be given to carefully considered support of development of aerospace exhibits of existing museums rather than the establishment of a new major museum.

B. California Museum of Science and Industry

If it is decided, however, to pursue the establishment of a single new major aerospace museum in the Western United States, the \$2.1 million aerospace exhibit expansion proposal (Volume Three, Section XV) by the California Museum of Science and Industry (CMSI) at Los Angeles would appear to be the best investment. This judgment is based upon the facts that: (1) the CMSI has the largest aerospace museum attendance (3.3 million visitors annually) and (2) has an existing building available which is capable of renovation and modification. The CMSI proposal has the endorsement of the Office of the Governor of California. It is recommended that should it be decided to request Federal funds for a single major aerospace museum in the Western United States, the CMSI proposal should be given first consideration.

C. Aerospace Museum at Moffett Field

An intensive study was made of the proposal by Charles C. Kubokawa (Volume Three, Section XII) to convert the large dirigible hangar at Moffett Field Naval Air Station to a new major aerospace museum. The results of this study are discussed in Section III. E. of this Volume and in Volume Three, Section XIII.

It was found that this facility is in active operational use by the Naval Air Station and that reduction of this effort is not anticipated (Volume Three, Section XIV). An engineering analysis of building modification and construction costs, conducted for the Smithsonian staff by Erkel Greenfield and Associates, Inc., indicated that initial estimates were low. It was found that the probable cost of the facility would be \$62.5 million rather than the \$28 - \$42 million believed. The study also indicated that an appropriate new building could be built at a site optimized for higher attendance for less than the cost of converting the hangar.

It is our conclusion that even if the hangar could be made available for the purpose its location and cost of conversion would not recommend it.

D. Artifact Loan Programs and Traveling Shows

There are many sources of aviation and space artifacts for use in museum exhibits. Major problems arise from the need to finance transportation and restoration of artifacts and to provide for curatorial care and handling of specimens. Also, creative design, research (to ensure technical accuracy) and the construction of permanent exhibits all require substantial outlays of money. It appears evident that available sources have so far been inadequate to support the desired level of exhibit development for western aerospace museums.

The Smithsonian Institution's National Air and Space Museum does collaborate with qualified museums to provide aviation and space artifacts on loan but this service is, however, limited by staff and funds.

A study is being made of the economics and staff requirements of developing traveling aerospace exhibits of different sizes for scheduling by the Smithsonian Institution Traveling Exhibit Service (SITES). The possible expansion of SITES activities in this way may be beneficial to aerospace museums desiring to improve their aerospace exhibits. Some initial suggestions on such traveling exhibits are contained in Volume Three, Section X.

III. Summary of Supporting Data

A. Survey of Aerospace Museums in the United States

It was found that comprehensive listings were not available of United States museums involved with aerospace science and technology. Consequently, a questionnaire was prepared and sent to 582 U.S. museums and planetaria which might qualify as having an exhibit of and/or collections dealing with aeronautics, astronautics or astronomy.

A total of 438 questionnaires were returned. Analysis of these questionnaires indicated that more than 200 organizations could be considered as having bona fide interest in aerospace exhibits and a desire to enlighten the general public to the achievements of flight in the atmosphere and in space. These organizations are listed in Volume Four of this report.

B. Regional Locational Analysis for Aerospace Museums in the Western United States

Analysis of the criteria affecting the location of aerospace museums in the Western United States was conducted for the Smithsonian project staff by Economics Research Associates (ERA).

In addition, the Regional Offices of the General Services Administration were contacted for information regarding surplus federal property in the Western United States. The results of their surveys appear as Volume Three, Section IX.

The ERA analysis is reproduced in Volume Two, Section II. A. of this report.

In summary, ERA considered three major criteria by which to judge regions as locations of the aerospace museum: population, aerospace employment and tourism.

Assuming that the greater the number of inhabitants there are (implying more schools and more students) then population becomes the primary quantitative measure of the regions. The fact that the proposed facility is an aerospace museum makes aerospace employment a significant quantitative gauge, not in terms of attendance, but in terms of locating in an area where aerospace is economically important and where there is the possibility of initial and continuing funding by major aerospace companies. Given that the museum will be exposed to the tourist market, based on a favorable location, tourism is another means of measuring regions as potential locations for the proposed museum.

ERA analyzed all of the 13 western states, dividing them into major regions to rank them with respect to their suitability as possible locations for the aerospace museum.

The Los Angeles region is by far the most populous region in the West, with 7.04 million people in 1970, more than twice the inhabitants of the San Francisco region in that same year. San Francisco with 3.11 million people also had more than twice the population of the third largest area, Seattle. Seattle and San Diego are about equal in size, with 1.42 million and 1.36 million residents, respectively.

An analysis of aerospace employment for 1970, reveals a similar ranking; Los Angeles is by far the biggest employer with 357,000 aerospace employees, followed by San Francisco with 92,100. The Seattle region had the third highest aerospace employment at 61,200, and Phoenix and San Diego ranked fourth and fifth, with 38,600 and 38,000 respectively.

ERA measured the importance of the aerospace industry to each region by computing the percentage of the area's total work force engaged in that industry. A level of 10 percent of total employment should be considered significant; therefore, the aerospace industry is about equally important to Los Angeles,

Seattle, Phoenix and San Diego. By this analysis, the industry carries only half as much weight in the San Francisco region as it does in the preceding areas. Even though the percent of aerospace employment is lower for San Francisco than for Seattle, Phoenix or San Diego, the factors of population as well as substantial aerospace employment recommend that quantitatively San Francisco should be ranked second, after Los Angeles.

Los Angeles with its significantly larger population, and greater number of students and aerospace workers, was shown to provide considerably more potential market support for the proposed aerospace museum than any other region. Further, as a second-choice location, San Francisco, for the same reasons, far exceeds any other region.

A study of the tourism market results in the same ranking. Los Angeles ranks first with 45 million visits, San Francisco is second with 30 million. San Diego is third with 14 million, and Seattle is fourth with 7 million.

Based upon the high rankings achieved by the Los Angeles, San Francisco and San Diego regions in the foregoing analysis, it was ERA's opinion that California would be the best possible state in which to locate a single aerospace museum if such action is ultimately recommended.

To illustrate the strength of California as a potential market for an aerospace museum, ERA ranked the 50 states and the District of Columbia by population. California surpassed New York by almost 3 million persons, with a total population of 18.5 million. Following New York's 15.7 million a considerable drop of more than 6 million persons marks the third-ranked Pennsylvania total of 9.4 million. The closest contender to California in the West is Washington, whose 2.2 million population can only draw 18th ranking nationally.

Extending this analysis to encompass the importance of the aerospace industry, each state was ranked by total aerospace employment and its percentage of total employment was also indicated. The states were ranked by aerospace employment only, but for a more comprehensive analysis, the percentage of aerospace employment to a state's total work force must also be considered a factor.

In view of California's population base, total employment statistics, an aerospace employment of 508,300 (nearly twice that of its nearest contender, New York State), and with aerospace being more than nine percent of total employment in the state, it is apparent that California becomes the

most logical location for general increase in aerospace museum activities in the United States.

Economics Research Associates concluded that Los Angeles offers the superior location for a museum of aerospace content. In every analysis, Los Angeles was rated as having the greatest potential for such a museum, with San Francisco ranking second. In further order of rank, San Diego, Seattle and Phoenix/Tucson are the most logical locations of aerospace museum development.

C. Aerospace Museums in the Western United States

A total of 26 museums and other organizations with significant public displays of aeronautics, astronautics or astronomy were identified in the Western United States as a result of the questionnaire survey and interviews with state and community officials (Volume Two, Section II. B.).

In California, Washington, and Arizona, the three states of primary interest, as indicated by a survey conducted for the Smithsonian project staff by Economics Research Associates (Volume Two, Section II. A.), directors of museums and other organizations with aerospace displays

were interviewed to determine their interest in advancing public awareness of aerospace accomplishments.

D. Surveys of Interest in Aerospace Museums

Mr. William C. Estler, Consultant to the Smithsonian project staff, conducted an Opinion Survey among fifty-one selected individuals active in the business, educational, cultural, governmental, and museum communities of California. The names of the individuals and their responses are reproduced in Volume Three, Section VII. The survey indicated overwhelming support among these community leaders for expanded activities to present to the public the benefits of the aerospace sciences.

A coincidental and independent survey was conducted in March 1972 for the NASA Ames Research Center at Mountain View, California, by the Diridon Research Corporation. The purpose of this survey was to provide data in consideration of establishing a Visitors Information Center.

This survey of the seven counties surrounding the Ames Research Center indicated that half of those interviewed favored a strong national space program, were significantly

impressed with the medical advances, communication and electronic achievements brought about through the space technology of the NASA program, and felt it would be exciting to visit a special government research center.

The public was surveyed with regard to interest in "Discoveries Made Through Space Exploration," "Rockets and Space," "History of the Space Program," "How Much It Costs," and "Medical and Environmental Advances" and other subjects. Significant elements of this study are reproduced in Volume Three, Section VIII of this report.

E. Study of Proposal to Establish an Aerospace Museum at Moffett Field Naval Air Station

In 1967 an imaginative concept was proposed by Charles C. Kubokawa to convert the large dirigible hangar (1124 feet long, 308 feet wide, 194 feet high and with an internal volume of 40 million cubic feet) at Moffett Field Naval Air Station into a major West Coast aerospace museum. Mr. Kubokawa, a research scientist at the NASA/Ames Research Center, presented his ideas in the role of a private citizen, concerned with means of increasing interest in the past, present and future of the aerospace research field.

Subsequently, Mr. Kubokawa made several revisions to his concept and, when the present feasibility study began, became a consultant to the Smithsonian project staff. Two versions of his Moffett Field Aerospace Museum study are presented in this report; the 1970 version is discussed in Volume Three, Section I and a version reviewed by Mr. Kubokawa specifically for this feasibility study is presented in Volume Three, Section XI.

When it was found that the Moffett Field dirigible hangar was still in active operational use by the Naval Air Station, and that reduction of this effort was not anticipated (Volume Three, Section XIV), Mr. Kubokawa began the consideration of creating a museum with similar approaches to aerospace exhibits, education, and public involvement, called "Technocon," which would be capable of being built at another location. The resulting preliminary treatment of the "Technocon" is presented in Volume Three, Section XII.

The structural engineering firm of Erkel/Greenfield & Associates prepared an engineering cost analysis (Volume Three, Section XIII) based on Mr. Kubokawa's conceptual sketches

of the Moffett Field dirigible hangar converted into an aerospace museum and in consultation with him.

Excellent cooperation was obtained from the United States Naval Air Station in making available construction drawings of this hangar completed in 1934.

The cost of construction, modification and installation of exhibits were found to be \$62.5 million rather than the earlier estimates of \$28 - \$42 million. The study also indicated that an appropriate new building could be built at a site optimized for higher attendance for approximately \$7 million less than the cost of converting the hangar.

As pointed out in Volume Three, Section XIII, the preliminary nature of Mr. Kubokawa's "Technocon" script precluded the preparation of an engineering cost estimate within the time period of this study.

F. Aerospace Museums—Roles, Activities and Functions

Aerospace museums offer a great opportunity to enrich the education of youth and to instruct the public in the principles and technology of flight in the atmosphere and space. During the past several decades mass commercial air transport, manned flight to the moon, operational

applications satellites and the furthering exploration of the planets, the sun and stars have already produced feedback of tremendous benefit to man in improved earth-bound technologies. The subject matter is attractive and exciting to young people. It is also important that it be understood by the taxpaying citizen.

The supporting paper (Volume Two, Section II. C.) discusses the importance of increasing participation and involvement of visitors in museum exhibits. An attempt is made to categorize the user-visitor and his motivation. The responsibility of aerospace museums to prepare museum visitors for psychological adjustment to rapidly changing technology is considered to be increasingly important. Finally, the importance of a soundly based, professional curatorial staff is emphasized.

G. Sources of Museum Funding

The supporting paper (Volume Two, Section II. D.) sets forth the major sources of funding of private, local, community, regional and federal museums. It is pointed out that museums are seldom, if ever, self-supporting.

Many major U.S. museums are having financial problems

and caution is indicated in thinking of new museums as

potentially self-supporting enterprises.

H. Sources of Aerospace Artifacts

There exist many potential sources of aerospace

exhibits and artifacts ranging from the military services,

commercial airlines, aerospace industry, and federal

agencies including NASA and the Smithsonian Institution.

The supporting paper (Volume Two, Section II.E.) lists

and discusses these sources as well as the importance of

curatorial care. It should be noted, however, that

transportation and insurance costs required on large arti-

facts may be substantial and even prohibitive. The concept

of rotating exhibits traveling from one aerospace museum to

another offers a possibility for enrichment of museum

exhibits at a cost significantly less than permanent exhibits.

This is particularly so when the museums are not widely

separated geographically.

IV. Participants in Study

Principal Investigator
F. C. Durant, III

Assistant Director for Astronautics
National Air and Space Museum
Smithsonian Institution

Program Coordinator
George S. James

Aerospace educator, technical
information specialist, historian;
18 years Aerojet-General Corpora-
tion; Chairman, AIAA History
Committee; founder, chairman
of Rocket Research Institute,
Inc.

Administrative Assistant
Carol Lee

Secretary to Director, American
Association of Museums (1969 - 1971)

Consultants

Frank A. Taylor

Former Director-General of
Museums, Smithsonian Institution;
Director, U.S. National Museum;
Retired (1971)

S. Paul Johnston

Former Director, National Air
and Space Museum, Smithsonian
Institution, (1964-1969); Director,
Institute of Aerospace Sciences
(1946-1964), Retired (1969)

William C. Estler

Public relations counselor;
Director of Public Relations,
Stanford Research Institute
(1949-1956); art collector,
critic and writer

Charles C. Kubokawa

Research Scientist (human factors),
NASA/Ames Research Center
(1963 - present), NASA Aquanaut,
inventor

Contractors

Economic Research Associates
Los Angeles, California

Major professional consulting
firm specializing in public
planning, urban systems, real
estate and land use, recreation
and tourism, transportation
and educational economics

Erkel / Greenfield and Assocs.
Los Angeles, California

One of the largest structural
engineering firms in California;
designers of dozens of major
office, apartment, hospital
buildings