

The Arizona Space Commission



*Report to
The Arizona Legislature
and The Governor*

December 1992

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EXECUTIVE SUMMARY

The 40th Arizona Legislature enacted Senate Bill 1054 creating the Arizona Space Commission. The purpose of this commission is to create for the State of Arizona a unified direction for space-related economic growth and educational development. With the down sizing of the defense/aerospace industries, the struggle with economic conversion and the desire to maintain economic prosperity, the emerging commercial space industry takes on a new importance. This is an opportunity which will stimulate growth in the state's high technology industries, give our educational institutions new directions and involve the state in the exploration and development of one of the last great frontiers.

Over the past year, the commission has studied the activities of other states as well as looking inward to the activities already underway within Arizona. What once might have seemed as an impossible lead of other states in the pursuit of commercial space industry was narrowed recently with the legislation that encouraged defense industries to consolidate into Arizona and convert defense technologies to commercial application. In addition, the legislation makes the Williams Air Force Base location more attractive for aerospace industry. Recognizing this advantage, the commission sets forth the vision for the state and the road map which will allow us to emerge as the recognized leader in commercial space and space related activities.

The fundamental strategy is clear; maintain the momentum and plan for the long term. Defense and aerospace industry did over \$20 billion worth of business in the state in 1991. Our universities did \$50 million in NASA funded research last year. McDonnell Douglas is investigating a single stage to orbit space ship concept the Delta Clipper. Motorola is making a significant long range investment in its Iridium™ telecommunication satellite program. Hughes has announced the consolidation of its missile manufacturing in Arizona.

Behind decisions for the relocation and conversion of manufacturing will be decisions concerning centers of technical excellence. Arizona should redouble its efforts to encourage relocation and expansion of high-technology research and development institutions. The research and development tax credit and other incentives should be expanded. Williams Air Force Base provides an excellent opportunity to attract launch systems such as the air launched "Pegasus" commercial space vehicle developed by the Space Data Division of Orbital Science Corporation located in Chandler, Arizona. If Arizona could attract this program to the state, we would be in perfect position to move towards "single stage to orbit" systems development and implementation. Our higher educational institutions will play an important part in the application of these technologies for much research and development is already under way in Arizona.

Specific recommendations included within this report are summarized as follows:

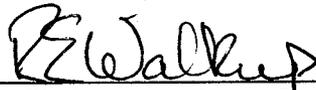
- Continue to utilize economic development initiatives*
- Attract air launch missions*
- Expand space research and development efforts*

- *Encourage joint Arizona/Mexico ventures*
- *Initiate development of commercial space launch facility and associated support resources*
- *Focus educational efforts on work force preparation to support the growing commercial space industry*
- *Expand research and development incentives*
- *Selective legislative initiatives to improve competitiveness*
- *Expand the APTAN data base*

The commission needs the support of the Governor, Arizona Legislature and the people of the State of Arizona in order to make the vision a reality.

The commission respectfully submits this report and stands ready to coordinate the implementation of a plan which will be a cooperative venture between government, education and private business.

Respectively submitted by:



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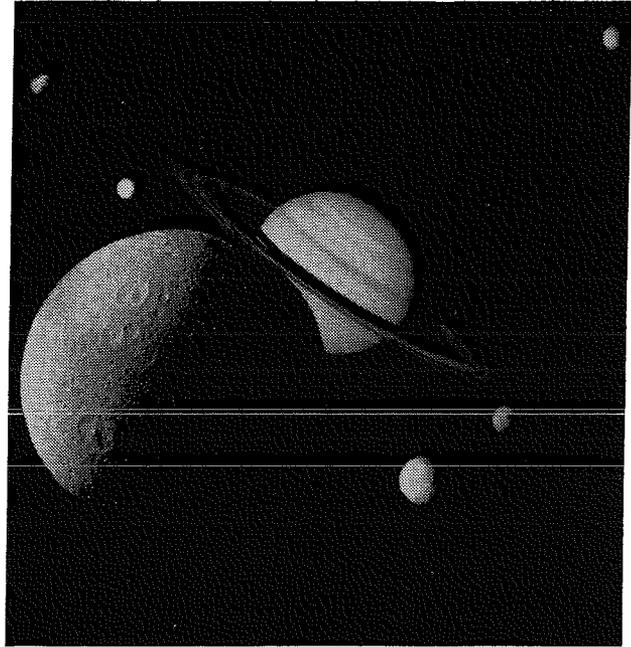
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OVERVIEW

Outer space is no fantastic, far-off Cibola. It's only 100 miles above our heads, closer than Phoenix is to Tucson or Flagstaff. Getting there in the past has been difficult because it required new technology. Now we have that technology. This has been developed and paid for in the NASA space program over the last thirty years.

Space ventures don't take place solely in outer space. Nearly all of them happen here on Earth. This is where people raise and invest capital, create and operate companies, hire and pay other people, build and maintain equipment, and levy and collect taxes. Money "spent on space" is really spent here. A dollar on the moon won't buy anything there...yet.



THE STRATEGIC VISION

"In the year 2015, Arizona is recognized as an international space center, providing research, development and manufacturing of space-related products and services. Arizona has become a major space operation center. As a result, the educational, cultural, environmental and economic standard of living is one of the highest in the country. High-technology firms have created a demand for a multi-talented work force that is one of the most competitive in the world." The trigger that caused these events to happen was the initiatives of the 1992 Arizona Legislative session that opened the door for defense industrial consolidation, diversification and the movement of the centers of high technology to the State of Arizona.

The primary goal of the Arizona Space Commission is the creation of a well-integrated, highly advanced research, industrial, educational and commercial complex of activities dedicated to

space-related enterprise. Arizona is in a position to take advantage of certain scientific, environmental and infrastructural factors that are not present in other states. Further, it is the objective of the commission to coordinate implementation actions that take advantage of a variety of initiatives.

We envision Arizona hosting a network of existing and yet to be created space and space-related complexes consisting of:

- Major space research and development universities
- Major observatories
- Repositories of space related data and imaging research materials

- A profitable space transportation operation center
- Satellite development and manufacture
- Large public research libraries
- A network of space museums, planetaria and learning centers
- A teachers' resource and training center
- A center for technology excellence
- A strengthened public school system featuring science, technical and vocational education
- A space commission charged with the regulation, promotion, development and coordination of high technology and space-related industry in Arizona
- A center for space law
- A network of diverse, environmentally benign, large and small space related firms doing business in Arizona
- A large-scale planetary simulation facility for research and development
- A junior college system dedicated to technological education
- A well trained and technically proficient work force

Arizona represents a unique opportunity for the development of an international center for research, integrated development and manufacturing of space related products and emerging technologies. A long range and multi-stage plan will be developed by the Arizona Space Commission to make this prospect a reality in the next 20 to 35 years.

Existing research and technical resources present in the state lend themselves to interpretive, industrial, educational, commercial, scientific and recreational uses as part of a comprehensive, space related master plan for Arizona. The work of the commission will be to develop the master plan and to ensure its implementation over time.

The ongoing economic development efforts in Arizona will be supported and strengthened by the development of this effort as a focus for an international effort in space.

A strong, well-supported commercial space interest in Arizona will improve and strengthen the US/Mexico/Canada relationship through the creation of a series of international agreements pertaining to space related activities. The emerging free trade relationships and the expanding needs of the Mexican and Canadian economies will provide considerable opportunity in space and space-related activities. Already the Russian, French and Chinese commercial space interests have made inquiries.

The educational infrastructure in Arizona will benefit by the creation of a regional market for the skills of a well-trained and technically proficient work force. Additional benefits include the improvement in international competitiveness to be derived from an educational system emphasizing excellence in science and mathematics in support of industry.

The benefits to other segments of the Arizona economy will be significant. High paying jobs will be created in the expanding commercial space industry. The need for a small business support structure will create opportunities for Arizona entrepreneurs. Major manufacturing of hardware both for vehicles and payloads will demand the kind of work force talent that commands high wages. The multiplying factor for these manufacturing payrolls is as high as 3.5 to 1.

One of the most significant benefits to the state is the opportunity for the transfer of defense technology into a commercial product that is part of a newly emerging industry. Most Arizona defense industries will benefit from the development of commercial space industry. For example, Arizona's aerospace industries have been providing equipment for every major U.S. space operation. At present, over 50,000 persons are employed in the Arizona space industry. Additionally, the state's small businesses and industries will benefit by an emerging support role with major manufacturing entities in Arizona and other states. This close relationship is demonstrated by the statement from Hughes Missile Systems Company during legislative testimony in 1992 that Hughes supports up to 850 small businesses in Arizona.

ARIZONA: A UNIQUE OPPORTUNITY



To assess factors shaping the space industry and evaluate the feasibility for Arizona to expand its strengths in this high technology arena, one must understand some generally accepted criteria for attracting growth of commercial space-related enterprise. Factors the space industry consider more significant in determining where to locate operations include:

- quality of education at all levels
- local labor force characteristics and demographics
- access to transportation
- communications infrastructure

- proximity to other space-related facilities, subcontractors and vendors, as well as;
- community support.

Arizona possesses a number of strengths, while at the same time, a few areas that could be improved.

STRENGTHS

Heritage

Arizona has a rich heritage of involvement in space-related industry and space science. The establishment of the Lowell Observatory in Flagstaff exemplifies the interest in space and the vision of our forebears. Steward Observatory operates more than a half dozen research tele-

scopes at various sites throughout southern Arizona and with its associated academic divisions, the Department of Astronomy, the Vatican Observatory and the Lunar and Planetary Laboratory, form the finest centers for astronomical studies in the world. In addition, the National Optical Astronomical Observatory (NOAO), funded as part of the National Science Foundation, is located on the University of Arizona campus. NOAO controls astronomical research facilities in Southern Arizona (Kitt Peak) and Cerro de Tololo in Chile. The Smithsonian Institution's multi-mirror facility and Lowell Observatory in Flagstaff round out the state's astronomical facilities.

Beginning with NASA's Mercury, Gemini and Apollo programs in the 1960's, and evolving through the spectacular technological advances of more than three decades of space missions, companies with major Arizona ties such as Allied Signal, Goodyear Aerospace, Honeywell, Hughes, McDonnell Douglas, Motorola and Orbital Sciences (Space Data Division) and hundreds of small Arizona businesses have played substantial roles in our nation's space program. Contributions of Arizona to virtually every NASA mission include a wide array of technologies, technical expertise and applications.

State Universities

Our universities have also made significant contributions to the advancement of space research and development. Both the University of Arizona and Arizona State University are recognized leaders in space science, astronomy and space research and development. Universities provide the foundation for technological skill development through NASA sponsored space-related research and engineering programs. The Arizona Space Grant College Consortium is one of 17 NASA selected consortia. The members of the consortium include: the University of Arizona in Tucson; Arizona State University in Tempe; and Northern Arizona University in Flagstaff. The Space Grant Consortium is an academically

oriented series of programs at various stages of development.

The University of Arizona is among the world's leaders in basic research and education in space science. One of several departments and colleges making a direct contribution to NASA is the Department of Planetary Sciences/Lunar and Planetary Laboratory (LPL). LPL scientists are involved in all existing and planned NASA planetary spacecraft missions. Imaging systems, built and operated by a scientific team at LPL, provide astronomical information about the planets at a level of detail far exceeding that otherwise obtainable. LPL scientists also participate in data analysis, ground based observational programs and internationally coordinated research programs.

Arizona State University space sciences research is actively pursued in several departments including the Department of Geology. In planetary Geology there is a Space Photography Laboratory containing an extensive library of spacecraft images and a dedicated Image Processing Facility for research and analysis of images of the moon, Mars, Mercury, the satellites of Jupiter and Saturn. Major contracts for the development of spacecraft instrumentation are underway and numerous other research programs in planetary geology are active.

Research activities in the Arizona State University College of Engineering and Applied Sciences have increased more than a factor of 10 since 1980. An Aerospace Research Center is presently being established to focus on two outstanding strengths within the College in the traditional subjects of aviation and in space power applications. Both the University of Arizona and Arizona State University have NASA sponsored centers of this kind. Only one other state has such an arrangement.

Northern Arizona University has an active program to enhance research activities and develop a better balance between teaching and research.

Three important aerospace research facilities are located in Flagstaff (Lowell Observatory, USGS Astrogeological Laboratory and U.S. Naval Observatory), Northern Arizona University has been developing its aerospace science program for the last three years through new faculty hires and formal linkages between Lowell Observatory and USGS. In addition the Center for Distance Learning at Northern Arizona University is one of the country's leading centers for satellite-based education.

Mining

Arizona has traditionally been a leader in mining and mineral exploration. There is a significant interest in the use of remote sensing equipment for prospecting on earth and resource surveys for use in mineral exploration in space.

Military Presence

The military presence in Arizona is of major importance. The estimated economic impact on a local basis is upwards of two billion dollars per year. This provides an economic stimulus that makes the area attractive for business. Military installations directly employ over 35,000 people in Arizona. Personnel leaving the various branches of the military frequently have transferable skills that can be put to use in the local economy. Retirees number in excess of 30,000 across the state. Many take with them extensive experience in the fields of aerospace, government contracting, manufacturing and management. These personnel represent a valuable resource for future companies moving into Arizona.

Arizona's military installations include:

- Davis-Monthan Air Force Base
- Luke Air Force Base
- Yuma Marine Corps Air Station
- Ft. Huachuca Army Base
- U.S. Army Yuma Proving Ground, etc.

Quality of Life

Arizona's climate is perfect for year-round recreation. The contrasting climates of northern and southern Arizona offer a wide diversity of activities. Numerous facilities and millions of acres of federal, state and municipal parks plus a moderate cost of living make Arizona a desirable venue for business to locate.

Arizona is blessed with a multi-cultural and multi-ethnic society which enhances the quality of life. Arizona offers a dynamic interweaving of the adventurous spirit of the old west with the exploration of the final frontier. The state has been able to maintain much of the heritage of the past while keeping place with modern developments.

State Economy

Arizona's population growth and strong economy is due in part to the continued shift in economic activity toward the Sun Belt. Arizona is one of only eight states where per-capita personal income grew faster in the 1990's than in the 1980's. The projected growth rates in personal income, jobs and population requires industrial infrastructure crucial to the anticipated needs of the emerging commercial space science industry.

AREAS FOR IMPROVEMENT

If Arizona is truly to become a leader in the new world of commercial space, there are several areas requiring attention. The commission believes that no major overhaul of any Arizona system is required, merely an adjustment of vision.

Although much has happened in recent years to strengthen the economic development posture in the state, continued pressure should be maintained to coordinate all the state development entities into a single cohesive organization. The Arizona Town Hall of 1990 on the subject of economic development recognized that cohesiveness of effort does not mean sacrificing individualism.

Small Business Support

The Arizona Automated Vendor Inquiry System (AAVIS) is an electronic data base program of Arizona Procurement Technical Assistance Network (APTAN), a statewide business retention and expansion program. This system is designed to provide direct assistance concerning the government acquisition process. The data base is designed to match Arizona businesses with Government contracts. This centralized data base is a free, publicly accessible, listing of thousands of companies located throughout the state. In order for this valuable asset to gain its full potential, it must be promoted and expanded to include vital data on all companies throughout the state. Additionally, the accuracy of the data must be assured and regularly updated.

Education

Arizona's educational system K-12 and including institutions of higher education must redouble efforts to stress math, science and problem solving skills. In addition, the adoption of a "Total Quality Management" approach within school administration has tremendous merit for improving our educational system.

Workforce

In order for the State of Arizona to attract and retain high technology industries, a highly trained and motivated work force must exist. As defense and aerospace industries shift emphasis to commercial applications, the state's work force must be retrained to support future industry. Arizona must keep its competitive edge through the continued availability of a highly motivated, skilled, and diverse work force.

EMERGING OPPORTUNITIES

Free Trade Agreement

The North American Free Trade Agreement (NAFTA) calls for the elimination of all tariffs on industrial goods produced by NAFTA partners.

NAFTA also offers a higher level of protection for U.S. copyrights, trademarks, patents and other intellectual property rights than other bilateral or multilateral agreements.

Arizona provides direct access to Mexican and Canadian manufacturing industry and is uniquely suited to capitalize on this near term opportunity. For example, the Port of Guaymas, Sonora is a deep water port capable of handling all types of cargo and container ships. The port is accessible by rail and new four lane highway. Arizona's proximity to the Pacific Basin and Mexico make it a perfect location for high technology firms.

One of the unique features of the Mexican State of Sonora is the NASA satellite tracking facility located in Guaymas. The station has been in place for many years and provides another benefit to Arizona for the development of its space launch support capability.

Mexico

President Salinas has made space programs an area of study and importance in the universities in Mexico. There is strong interest in Mexico in the astronomical programs operated by the University of Arizona and other institutions. We believe that Arizona will have a full partner in Mexico for future cooperation in the area of commercial space.

Canada

Canadian industry has been involved in government sponsored space venture for years. We anticipate that Canada's role in international aerospace will increase and become more diverse once NAFTA is ratified. Arizona's long term business relationship with Canada will form the basis for new ventures.

THE STRATEGIC PLAN FOR THE STATE OF ARIZONA

With a clear vision for the future in mind, we must capitalize on the current momentum of strong economic development within the state and use existing resources to their fullest. The strategic plan for expansion of the emerging commercial space industry within the State of Arizona is outlined as follows.

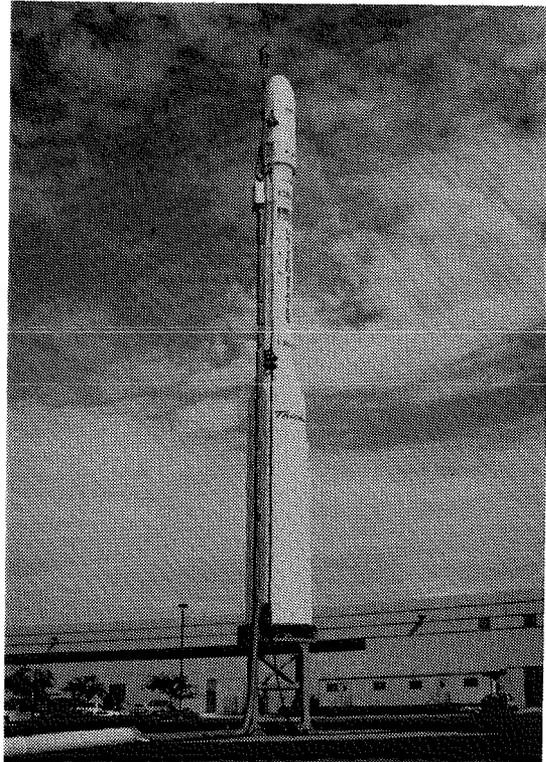
THE VISION

In the year 2015, Arizona is recognized as the leading international space center, providing research, development, and manufacturing of space related products and services. The state is a vital component in the nation's space transportation system. As a result, the educational, cultural, environmental, and economic standard of living is among the highest in the country.

THE MOMENTUM

On October 23, 1989 Congressman Jim Kolbe chaired the "Arizona Looks to the Future: Space, Technology and the Economy" Conference. Since that time, interest has grown for expanding Arizona's space-related economy. Private efforts have emphasized space science education (Challenger Center), space life science (Biosphere 2), and economic development support for emerging commercial space ventures.

On July 7, 1992 Arizona created landmark legislation which encourages defense industries to consolidate their activities in the state. This legislation allows for tax credits toward the creation of new jobs that result from defense technology conversion to commercial products. At least one



major defense contractor announced their intention to relocate over 2,000 jobs into the state in 1993. The decision was based on economics. Arizona turned out to be the most cost effective place to manufacture high-tech products both in the near term and in the future. It should also be noted that in 1992 interest in relocating to Arizona has increased over 80% from the same period in 1991. Many of those firms are high technology research, development and manufacturing companies.

Incentive for reuse of Williams Air Force Base and targeted research and development tax credits will also have a significant economic influence on the future. To date, there have been many inquiries into incentive packages for the possible reuse of Williams Air Force Base.

EDUCATION

It became clear in the 1980's that education is a strategic business issue in the United States. As the technology of our products expand, the demand for a smarter work force increases. It was estimated in the 1980's that 57% of the work force was engaged in manufacturing that demanded a high degree of skill. That same industry made a study of the skill level required to support the manufacturing of products in the year 2000. Their conclusion was that 75% of the work force would require highly technical skills to produce the products of the future. Couple this expansion with demand for a skilled work force and the complex issues facing our school systems today, and there is a serious shortfall between supply and demand. Many businesses in an attempt to close the gap have formed partnerships with schools in order to make a difference in the capabilities of the recent graduate entering the work force.

There have been many studies and proposed courses of action regarding what approach is best to improve the educational process. The direction to be taken that best supports the need of the future is difficult to define. State, public and business must work together to define what must be done and expand the study of science, math, physics, and chemistry. It is essential that actions be taken to improve the retention rate in our schools:

- to make subject matter interesting,
- to motivate students to learn,
- to improve parental/student dialogue,
- to expand science, math, physics, chemistry, and
- to make these subjects relevant for all students.

SPACE RELATED ACTIVITIES AT ARIZONA'S UNIVERSITIES

The Arizona Space Grant College Consortium is one of 17 NASA selected institutions. The members of the consortium include: The University of Arizona in Tucson, Arizona State University in Tempe, and Northern Arizona University in Flagstaff.

Taken as a group, this consortia, supported by the state's community college system represents a major factor attracting businesses to locate or existing businesses to expand in Arizona. Numerous programs at the state universities/community colleges contribute directly to the preparation of the state's work force, the creation of new firms, the expansion of existing space-related business and on-going aerospace research and development activities. Arizona's investment in these educational institutions contributes to the region's leadership in astronomy, space science and engineering, optics, telecommunications and electronics.

SPACE VENTURES

For the last thirty years, the federal government has operated and controlled space ventures as a part of national security. However, with the end of the Cold War, we're in an era of astounding change. The nature of space ventures is becoming privatized, capitalistic, and market-driven. The federal government cannot create and operate commercial space ventures any more then it could (or did) operate a national railroad or a national airline. Now private enterprise has the opportunity to engage in profitable space ventures. Private enterprise and government must work together in cooperative or joint ventures as they did in the past. Railroads obtained government guaranteed loans and land grants. Airlines built aircraft using government research findings and air mail contracts to help them get started.

But where are space ventures going in the near future? If the people of Arizona are going to lead and grow with the expanding new frontier, they need to share a vision that includes the consequences of the changes now taking place.

Space activities during the next decade and into the next century can provide new jobs, new business opportunities, additional opportunities for existing businesses, and increased commercial activity while at the same time preserving our environment, improving our life style, and expanding our tax base.

Issues

The primary issue is “where is this going to happen”? California, Florida, and Texas are the centers of the old traditional government-operated, tax-funded space program. The new commercial space age will seek a new center of gravity. That center can and should be Arizona.

The new commercial space age will involve many areas of technical, social, economic, and political activity.

The new spaceships such as the proposed McDonnell Douglas Delta Clipper will be built and operated like ocean ships or airliners. They will be different from the expendable rockets used thus far. They will take off and land at places resembling airports. They'll be good for more than one flight. They will be as safe to operate as airliners.

The new spaceships must be built somewhere. And they must have one or more bases — spaceports — from which to land and takeoff.

Arizona has the land, the nucleus of the experienced high technology work force, modern educational institutions, available energy sources, and an excellent position in the nationwide transportation network. In short, Arizona has a relatively new high-technology, educational, industrial, and political environment that's perfectly suited for the task.

The new spaceships and spaceports will require services other than fuel supplies and the facilities for maintenance and repair. The examples of Phoenix Sky Harbor International Airport and Tucson International Airport demonstrate the extent and variety of the services and supporting businesses which will cluster around the New Millennium spaceports. Such spaceports will become the industrial hub of the twenty-first century economy.

Such spaceports will become the industrial hubs of the twenty-first century economy. Hydrogen production and handling facilities will be installed at spaceports because liquid hydrogen is currently the most efficient known fuel.

In the past, Arizona wasn't considered as a place for space launch facilities. This is because the existing sites evolved from test ranges for the intercontinental ballistic missiles which became throw-away space launch vehicles. These vehicles are really long-range artillery shells, and existing space launch facilities are nothing more than modern artillery ranges.

The New Space Transportation System

Today, the United States is in a transition from a space transportation system based on the long-range artillery shell (the NASA space shuttle and the various ICBM-based expendable launch vehicles) to an airline-type system based on aerospaceplanes and single-stage-to-orbit (SSTO) spaceships. These will be reusable vehicles that will have short turnaround times and will require an on-site staff of technicians and service personnel between flights. They will be the space-going counterparts of airliners, trains, buses, trucks, and ocean-going ships. Thus, a twenty-first century spaceport is more likely to resemble and be operated like a large metropolitan airport.

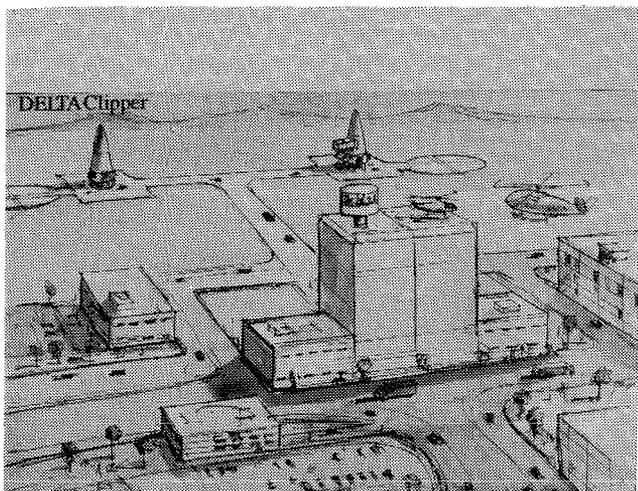
In addition, air and sea-launched vehicles are also emerging technologies that warrant further investigation and serious thought. These and various

hybrid propulsion systems will be interim applications that could have economic development impact in Arizona.

Spaceport Requirements

A spaceport will not emerge overnight. It will develop over a decade or more. Requirements for a successful spaceport include:

- Transportation access by rail, highway, and air
- Clear airspace corridors for departures and arrivals of both vertical-takeoff-vertical-landing (SSTOs) and horizontal-takeoff-horizontal-landing (areospaceplanes)
- Proximity to other transportation nodes — high speed railway, extended and improved highways and air
- Proximity to existing natural gas pipelines; natural gas is a source of hydrogen which can be processed into liquid hydrogen rocket fuel
- Proximity to a high-capacity electric power grid



Over Flight Safety Concerns

“What if these spaceships fall on our heads?”

People asked the same question about airplanes sixty years ago.

The safety concern of flying spaceships over populated areas disappears with the introduction of single-stage-to-orbit and aerospaceplanes. Neither drops boosters or lower stages in flight. Both have engine-out capabilities and safe abort modes similar to aircraft.

Arizona: As a Place for Spaceports

Arizona has vast expanses of state-owned and federal owned land whose locations meet the five criteria for the new spaceports. In cooperation with companies who are designing, building, and testing the prototypes of the new spaceships we should be studying likely spaceport sites. The state needs to determine and keep abreast of evolving requirements. Arizona needs to look at all the factors — technical, financial, social, political, legal, environmental, and commercial. Arizona can be ready in this decade to be a favored location for new commercial space activities.

Emerging Markets

Transportation of cargos to and from orbit will not be the only profitable market. Historically, faster transportation has always been profitable and beneficial for business, and there is no reason to assume that space ventures will not be consistent with this past experience.

A 15-hour flight to Tokyo becomes a flight of less than an hour using “Fractional Orbital Transportation” — take off, climb above the atmosphere, cruise through space, and come down to land at the destination. Furthermore, it’s environmentally benign. Several express package delivery services are closely following the development of the new spaceships. Fast transportation will pay because it traditionally has.

Arizona is on the Pacific rim of an area that encompasses half the world. High speed transportation is a key element in doing business there. Arizona can become a high-speed aerospace transportation hub for the Pacific rim if its people heed the signals of technological change.

Cheyenne, Wyoming was one of the early air mail and airline stop-over points. However, Cheyenne didn't foresee the march of technology that produced the DC-3 airliner. Denver did, and Denver's Stapleton International Airport is now the fifth busiest airport in the world.

Space is in Business in Arizona

We must let it be known that space is in business in Arizona, that we intend to lead, and that we have what is necessary to do the job.

The Arizona Space Commission must continue to monitor and regulate space venture developments in the new commercial space age.

The Arizona Space Commission should commence surveys to identify the best locations for space-

ports. The Arizona Space Commission should commence surveys to identify the best locations for spaceports. McDonnell Douglas is already considering where they will build the commercial Delta Clipper spaceships which should be certificated and ready for service in 1999. These spaceships will be about 100 feet high and weigh 100,000 pounds empty; they will have to be ferried to users by flying them from the factory. Thus, the first spaceport will be the place where the spaceships are built. Other states have not recognized this simple fact yet. Therefore, Arizona should move quickly and aggressively to get McDonnell Douglas and other potential spaceship builders to locate their plants in Arizona. Because at least 5 years will be required to bring this recommendation to reality, work on this task must commence as soon as possible.

What is our vision? Simply this: Arizona was on the last American frontier, and it can carry on this tradition by becoming a leader on the final frontier.

COMPETITION: THE OTHER STATES

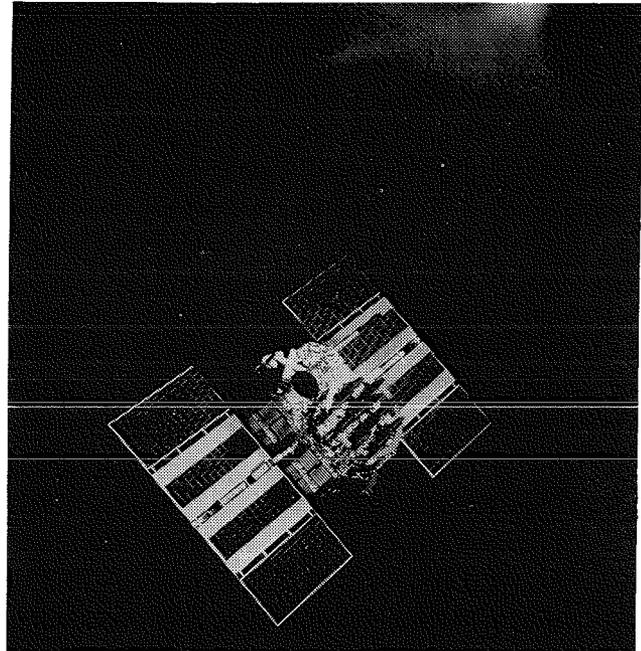
Over thirty states have taken action to increase their attractiveness as a favorable location for space related high technology industry. Six states have been most aggressive in protecting what they have and encouraging expansion. NASA and the military require elaborate facilities with which to carry out their missions of exploration, surveillance, experimentation, and research. Space related industry has located near the major federal facilities to support the various needs required by such elaborate technology.

Florida state government has been the most active in providing support to encourage space-related high technology industries to locate within their boundaries.

Other states have also recognized the importance of the space industry and the need to evaluate means of attracting more space research, development and manufacturing. Several states already devote substantial resources to attracting expanded space activities.

Florida

With America's most active launch facilities the state has taken an aggressive role in pursuit of government and commercial space-related programs. The Office of Space Programs with a \$1.5 million budget was established within the Florida Department of Commerce. This office is charged with making a long-term commitment to developing space commerce and the establishment of the Florida Spaceport Authority, supported by a \$1.9 million appropriation by the legislature. A recommendation to issue in excess of \$200 million in bonds to finance the development was favorably acted upon by the legislature. The Florida Spaceport Authority is currently exploring the establishment of state operated launch facilities for sounding rockets as well as orbital and sub-orbital satellites for commercial scientific clients.



Texas

Realizing they can no longer rely solely on federal funding to sustain the massive aerospace infrastructure that has been the backbone of their high technology industry, the state is investing large sums to increase the incentives for firms to locate their space-related businesses in Texas.

Virginia

In 1988, the state legislature appropriated \$5 million for development of an Air and Space Center which opened in the spring of 1992. The state-funded Center for Innovative Technology was established to develop a strong commercial space sector. To support this goal Virginia recently allocated \$500,000 for commercial space research and development within joint university-industry projects. Some \$30 million a year in NASA-funded research is being conducted by the state's universities. The Center for Innovative Technology created the Virginia Space Development Consortium (VSDC) to provide a means for corporations to join together to pool their funds to support

research and development projects at Consortium member universities. VSDC provides over \$250,000 a year, plus other funds from foundations and government agencies, to support significant research projects that may lead to development of commercial products.

New Mexico

The New Mexico Space Technology Directorate has allocated \$1 million in state funds for a study by the Governor's Technical Excellence Committee on ways that the state can exploit and capitalize on the development of a commercial aerospace industry. A specific recommendation has been submitted to the Governor to establish a Technology Expansion Department to take advantage of the assets already in existence that may be utilized to encourage commercial development.

Colorado

The Colorado Space Initiative was established by the state's General Assembly to, among other things, make the state an internationally recognized space capital, attract new space-related businesses and make Colorado the preeminent state in space education. Recent figures are not readily available but it is estimated that Department of Defense prime contracts in 1988 were \$2.9 billion with directly related expenditures of \$2.2 billion. Even with possible cuts in defense spending, reductions in this amount are not expected to be significant due to the continued importance of space-related activities of our military forces. Non-military government agencies also contribute substantially to Colorado's economy through the work of the National Center for Atmospheric Research, the National Oceanic and Atmospheric Administration and the Solar Energy Research Institute. The associated private sector industries have not, for the most part, been located in proximity to these facilities. It appears that the state will provide considerable funds to provide incentives to encourage high technology industries to relocate in Colorado.

California

The Council on California Competitiveness, headed by Peter Ueberroth, released a report earlier this year examining job losses in the state, citing causes of the economic problems and calling for a number of reforms. The state has no equivalent to the Arizona Space Commission. In related actions, the state has:

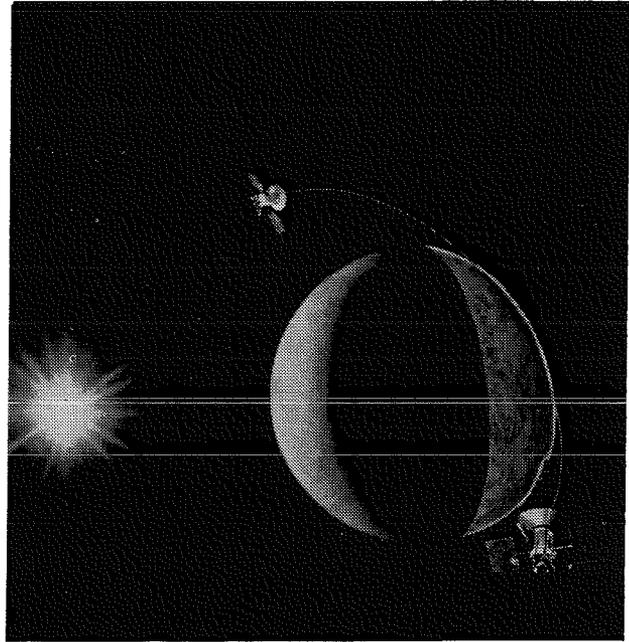
- Coordinated an effort to keep USAF Space and Missile Systems Center at Los Angeles Air Force Base.
- Worked through its congressional delegation to get its fair share of defense conversion program funds.
- Secured \$13 million in federal funds for small and mid-sized aerospace companies to take advantage of the latest manufacturing technology.
- Established Project California to explore advanced ground transportation systems and develop an action plan.
- Proposed a program to assist major manufacturers who are trying to compete internationally.
- Created a supplier improvement program in which more than 3,000 people in nearly 700 companies have been trained in the principles of Total Quality Management.

RECOMMENDATIONS

The recommendations of the Arizona Space Commission are consistent with the strategy of keeping and maintaining a high level of momentum in long term development. It is our belief that the last great frontier, that of space, will provide enormous benefits to society as a whole. The state of Arizona is in a perfect position to take advantage of this new and growing opportunity. The following recommendations are consistent with the vision for Arizona's participation in commercial space.

CONSOLIDATION

The Defense Restructuring Bill of 1992 provides for corporate income and property tax credits as incentives for certain defense and aerospace industries to consolidate into the State of Arizona as well as incentives for the creation of new jobs as a result of conversion from defense work to commercial applications. Additionally, tax incentives are provided for aviation and aerospace companies utilizing Williams Air Force Base. It is recommended that the Arizona Space Commission in conjunction with the Arizona Department of Commerce should coordinate an all out effort in pursuit of national organizations engaged in space or space-related activities. The Arizona Space Commission will act as an extension of the Arizona Department of Commerce for contacting, recruiting and assisting in the relocation process. The Arizona Space Commission, as a member of the Aerospace States Association will have many opportunities to make close contacts with other organizations that are engaged in space research, development and manufacturing.



RELOCATION OF A COMMERCIAL SPACE MISSION TO ARIZONA

To establish the seriousness of the intentions of the State of Arizona to enter the commercial space arena, the State should establish as a near term goal, the attracting of an existing commercial space mission to the state. There are several such missions that exist today both nationally and internationally. Again the Arizona Space Commission in conjunction with the Arizona Department of Commerce should be charged with the responsibility of making the appropriate contacts to initiate actions which promote the benefits of the state to interested entities. The Arizona Space Commission should also acquaint these firms with the initiatives set forth in the Defense Restructuring Bill. An example of an opportunity for relocation consideration is the Orbital Science Corporation (OSC) air-launched Pegasus program. The use of Williams Air Force Base, located just east

of Chandler, Arizona, as the "home" and principle staging area for the Pegasus orbital launch vehicle offers several strategic advantages to OSC and its Pegasus customers. Pegasus launches payloads into equatorial or near-equatorial (low inclination) orbits from launch points over the Atlantic Ocean and to polar or high inclination orbits from launch points over the Pacific Ocean. Arizona's geographical location in the southwestern United States reduces the flight time needed to reach both coasts and the equator. The fact that flight routes to bodies of water are short (less than one hour to the Pacific Ocean and less than two hours to the Gulf of Mexico) and pass over sparsely populated desert is a flight certification and safety advantage. The weather in Arizona for flying is the best in the country (approximately 305 "good flying" days per year), resulting in a minimum of costly scheduling problems due to weather. The proximity to OSC's primary manufacturing facility in Chandler (13 miles) eliminates sending teams to the "field"; enhances field operations, integration and test; minimizes transportation costs and turnaround time, and avoids the cost and logistics of a new company operations center. Williams Air Force Base already has runways, hangars and bunkers for operating and parking the B-52 carrier aircraft, pre-launch system assembly, integration and checkout, and permanent storage of ground support equipment.

The designation of Williams Air Force Base as the home base for the Pegasus system would also have prestige and economic benefits for the State of Arizona. It is anticipated that within two years, Pegasus will be launching approximately once per month. As the "launch pad" for the world's most frequently launched orbital rocket, Arizona could quickly become the world's busiest "spaceport". This would obviate the necessity of waiting on technology advancements required for making space launches from land-locked sites feasible. Frequent space activity would increase the employment base of OSC and all of the inherent support businesses in Arizona. The subsequent

economic boost and the attraction of additional aerospace business and support services to Arizona is apparent.

A coordinated effort on the part of the Arizona Department of Commerce and the Arizona Space Commission can make this relocation happen.

RELOCATION OF MAJOR RESEARCH AND DEVELOPMENT SPACE FUNCTIONS

On August 7, 1992, Hughes Aircraft Company announced the planned relocation of approximately 2000 manufacturing jobs from various locations to Tucson, Arizona. This was part of the consolidation of tactical missile operations into a single, highly competitive location. Although the defense budget is being significantly downsized, it is the strategy of Hughes to maximize cost effectiveness by taking advantage of the highly skilled and available work force that exists at its Tucson plant. This, coupled with other recent internal productivity improvements and the defense restructuring incentive, allowed the decision to consolidate in Arizona to be made. The decision that still has to be made by Hughes is whether or not to consolidate its missile research and development to Tucson as well. As of the end of 1992, the missile engineering functions were located in Canoga Park and Pomona, California. The CEO of Hughes Missile Systems Company has announced that the consolidation of the engineering functions is under consideration. The decision will be made on the basis of both cost and quality of life issues.

The commission recommends that a strong effort should be made to promote the State of Arizona, our strong economy and our interest in space and space-related activities. There is a close relationship between missile development and commercial space ventures. Having this technical base residing in the state of Arizona will seed further space development activities and allow the con-

version of defense missile technology to the new frontier of commercial space. With the location of an additional 2,000 person engineering work force coupled with the efforts currently underway at the State Universities, a recognized international center of excellence in space technology will be established in the state.

DEVELOP CONCEPT OF ARIZONA SPACEPORT

Over the next 2 years, the Arizona Space Commission will develop the details surrounding the establishment of an Arizona spaceport. It is envisioned as a partnership between private businesses and the Department of Commerce will facilitate the collection of sufficient resources in order to bring this project to the planning stage. There is an extraordinary pool of talent in the state's existing defense and space industries as well as our three principal universities. Arizona is capable of completing the definition stage of the "Arizona Spaceport". It is the recommendation of the commission that it provide the leadership role in collecting the necessary volunteer resources to implement a thorough study. The study will provide a conceptual design of the spaceport including a transitional support role from air launch to single stage to orbit missions, logistical requirements, technical issues concerning location safety, manning, cost and forecasted return on private investment. Part of the conceptual plan would be the identification of master schedule, action responsibilities and functional relationships between private and governmental entities.

EXPAND THE ARIZONA AUTOMATED VENDOR INQUIRY SYSTEM

A key to successful economic development of space and space-related business activities is an understanding of what is already going on in the

state. If the state is going to provide a home for the emerging commercial space industry, it must involve all of its available resources, namely Arizona's small businesses. Commercial space is not just a big business venture. In order to be competitive the manufacturing, testing, and delivery of launch vehicles, satellites, and support equipment must involve an integrated diverse network of large, medium and small business from all over the state. In the manufacturing process, typically over 60% of the parts that are assembled into the final product are purchased items. One of the keys to keeping the manufacturing of end items and parts in Arizona is the establishment of concurrent engineering with the manufacturing process. With the establishment of a center of excellence for space research and development in the state, the availability of a large supplier base is made possible. It is imperative for small and medium sized suppliers to make their internal capabilities clear to the engineering staff as well as the procurement organizations. This proximity relationship between suppliers and engineering is often overlooked when building an economic development strategy. It is recommended that the Arizona Space Commission coordinate with the Arizona Procurement Technical Assistance Network in order to insure that the data base is expanded to include all relevant businesses. This will provide greater accessibility and verify the accuracy of the information. Small and disadvantaged businesses must be included in the data base so they may take advantage of the emerging commercial space program.

LEGISLATIVE AND EXECUTIVE ACTIONS

A critical piece of legislation to assist in the establishment of a viable commercial space program in the state has already been enacted. The Defense Restructuring and Williams Air Force Base Reuse Zone Legislation is expected to continue yielding significant returns.

Current educational reform considerations are all aimed at making the state of Arizona a highly respected K-12 educational champion. A refocusing of the education process to stress math and science career opportunities will benefit all Arizona space initiatives. Students graduating from Arizona schools must be prepared to live in an intensively technological world. The Arizona Department of Education should be directed to actively encourage the use of a wide-range of technologies (computers, satellite-based learning, modems, etc) in all of Arizona's schools.

Although the research and development credits and incentives included in the Defense Restructuring and Williams Air Force Base Reuse Zone Legislation will do much for small organizations, it is the recommendation of the Arizona Space Commission that an expanded level of research and development credits be considered. Large

industries in the process of converting from a defense base to a commercial base will be expending considerable funds to do so. The State of Arizona will provide considerable strategic advantage to existing companies as well as providing substantial relocation advantage if research and development credits are significantly expanded.

It is the intention of the commission to exist as a partnership with private and governmental institutions. The benefits of the developing space frontier are equally shared between all sectors of society.

The Western author Louis L'Amour wrote in his only non-fiction book, "The question I am most asked is, Where is the frontier now?" The answer is obvious. Our frontier lies in outer space.

Arizona is where it should begin.