

Colorado's Strategic Plan for Space

Prepared
for

Space Foundation
[Colorado's Space Strategy Initiative]
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Colorado Springs, CO 80906

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1. Executive Summary

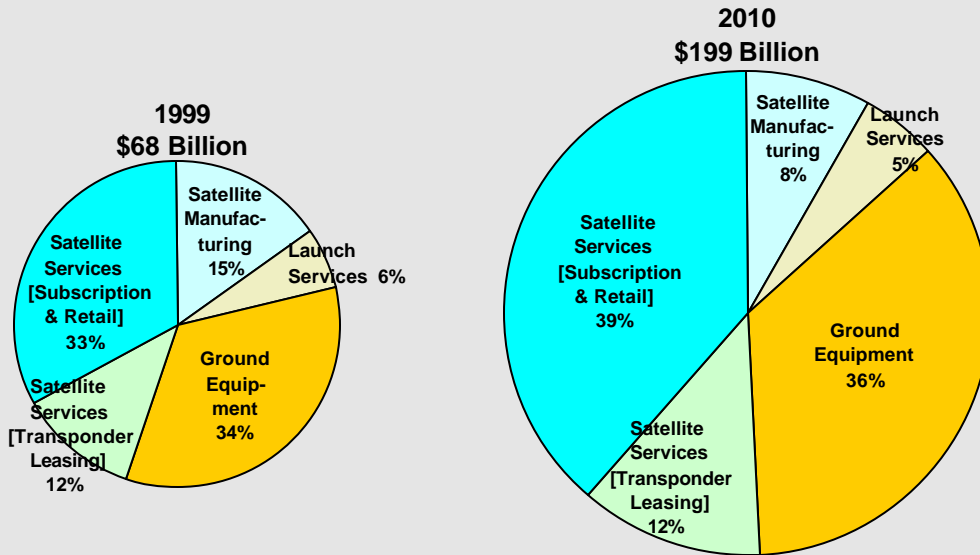
1. Executive Summary

The high tech space industry is, and can continue to be, an important part of Colorado’s knowledge-based economy. In Colorado, the space industry currently provides directly for nearly 38,000 jobs and indirectly for an additional 75,000 jobs. The broad based “space industry” encompasses both the Department of Defense [DoD] and civil sectors, and includes the manufacture, assembly, test, and operation of launch vehicles and satellites [including communication, direct broadcast, Earth observation, navigation and control, weather, and intelligence satellites] and related infrastructure. The space industry plays a significant role in national defense and makes possible an ever increasing range of consumer and business services including television, entertainment, education, disaster management, fishing, transportation, environmental and land use management, telemedicine, and more. Indeed the “new” information economy itself depends upon space-based infrastructure and value added space-based or space derived technologies where Colorado companies are well positioned.

Recognition of and appreciation for the importance of Colorado’s space sector, coupled with a statewide commitment of policy and economic support, can maintain and attract new jobs and revenues for Colorado communities. However, Colorado is in competition with other states that have initiated aggressive actions to attract the space industry. As a result, Colorado may see an erosion of its space industry base to other states and consequent adverse impacts on the State’s economy, unless it undertakes appropriate proactive and responsive measures.

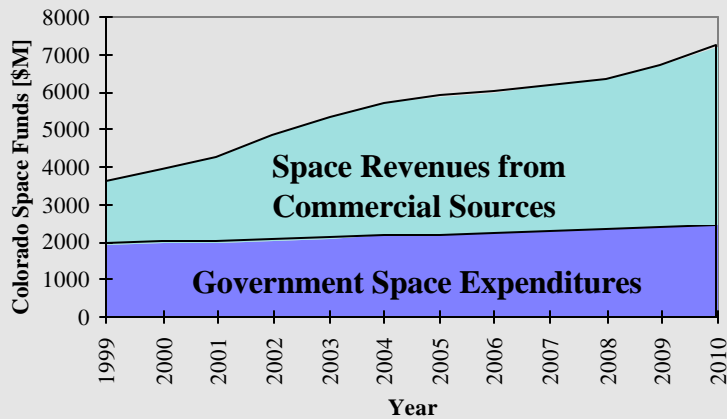
In response to the above and other considerations, the Colorado Space Strategy Initiative [CSSI] was implemented as authorized by Executive Order of the Governor to develop a strategy for the State’s space economy that would “retain and expand Colorado’s preeminence in space activities within the next decade.” The objective of this Initiative has been accomplished with the delivery of this **Colorado Strategic Plan for Space**, the successful completion of which required and embraced statewide participation of public and private organizations and individuals. **The Strategic Plan treats space as an all-Colorado opportunity.**

Space Industry World Revenue

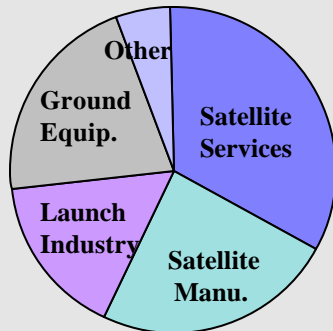


Note: Commercial space revenues excluding human flight program and space science revenues.

Forecast of Colorado Space Funding



Colorado's 1999 Space Industry Employment



Direct Employment: 24,000
 [Commercial]
Direct Employment: 13,900
 [Government]
Indirect Employment: 75,800
Total Employment: 113,700 [Jobs]

Why Focus on Space?

The space industry is alive, well and growing rapidly. In 1999, the space industry generated direct [world] revenues of approximately \$68 billion. This is expected to increase to \$199 billion by 2010, almost tripling over the next 10 years – an average growth rate in excess of 10 percent per year.

The space industry, both because it provides the basic infrastructure upon which many services are built, and because of its high technology content which creates the opportunity for new business development, has become an important component in global economics and provides a significant number of jobs in the U.S. and in Colorado. Assuming that Colorado will take the necessary actions to counter the aggressive actions – such as establishment of space development offices -- by California, Florida, Alaska and other states, **current Colorado space industry revenue and government expenditures are expected to increase from the current level of at least \$3.3 billion to nearly \$7 billion by the year 2010, corresponding to an average growth rate in excess of 6 percent/year.** Aggressive actions by Colorado could lead to an even greater market share, particularly in the government sector, which would result in even greater growth than forecast for Colorado's space industry. Similarly, it must be stressed that inaction by Colorado could lead to a loss of market share to other, more proactive states.

Colorado's space industry currently generates approximately 38,000 jobs which in turn create an additional 75,000 jobs in the State; this total of 113,000 jobs can be expected to increase to a total of 232,000 jobs by 2010. Colorado's space activities are intellectually rich,

software and services intensive, environmentally friendly and comprise skills and workers synergistic with other high-tech industries and initiatives within the State.

The State of Colorado and various economic development initiatives and organizations have not yet focused on the vast importance of Colorado's space industry.¹ For example, the recently released Convergence Corridor Report² omitted the space industry from its "high technology" industry group; singled out for consideration were high tech manufacturing; communication services, and software and computer services; biomedical products and devices; computer storage and peripherals, software for telecommunications infrastructure, and equipment for telecommunications infrastructure. These four "convergent" industries combined could provide "as many as 117,000 jobs....by 2020;" the space industry alone is expected to provide 76,000 [direct] jobs by 2010 [a decade sooner] and is likely to continue its significant growth into the following decade.

Colorado in Space

Colorado is rich in space technology, research and applications.

Within its borders are many of the leading laboratories, installations and companies that use space for national security, probing the mysteries of the universe and taking advantage of the space infrastructure for applications that benefit all peoples of the world. Many of the most outstanding space scientists and engineers have selected Colorado as their home. Research facilities have been established in Boulder, Denver, Fort Collins, and Colorado Springs to carry out leading edge projects in astronomy, astrophysics, atmospheric physics, propulsion and remote sensing. Technology centers are located in Denver, Boulder, Pueblo and Colorado Springs. Colorado is one of the leading states for the production and assembly of launch vehicles, with manufacturing facilities located in Denver and Pueblo. The United States' three largest and most capable expendable launch systems are all manufactured and/or assembled in the State: Titan, Atlas and Delta.

There are more than 100 companies in the state of Colorado which provide materials, equipment, software and services for the space infrastructure and to end users of space applications. There are also several key military organizations in the state of Colorado which provide national security functions using space assets and the space infrastructure and act as a magnet for attracting the space industry.

¹ As of this writing, neither the Colorado Institute of Technology [CIT] nor the "convergence corridor" initiatives discuss or address the space industry.

² **The Convergence Corridor**, prepared by Development Research Partners for InterMountain/RKH in support of Metro Denver Network Tech Vision, Denver Metro Chamber of Commerce, January 2000.

Several universities are involved in space-related research and technology projects. The University of Colorado in Boulder has many academic and research programs focusing on space. Of particular note is the National Center for Atmospheric Research [NCAR] in Boulder. Other active universities include Colorado State University and the University of Colorado in Colorado Springs.

Colorado is well positioned to maintain and increase its market share of space-related activities and investments. The space industry is high-tech and its magnitude is large in the context of the Convergence Corridor – including and integrating the space segment within this initiative could bear significant economic fruit for the State.

Colorado’s Strategic Initiatives for Space

Colorado’s economy is increasingly knowledge and information-based, driven by the ability of firms to innovate and develop new products and processes. Colorado’s space industry plays a major role in this type of economy by providing both a strong base with infrastructure for both continued expansion as well as new industries.

This strategic plan has been developed to maintain and expand Colorado’s space industry, to contribute to expansion of the State’s economy while maintaining the highly valued quality of life. As an essential means of safeguarding this highly valued quality of life, the CSSI Team has concluded that Colorado must **retain and grow** it’s space and related industries. This strategic plan provides the strategies, tactics and baseline information about the space industry and space economy to enable the State to do so.

The Colorado Strategic Plan is premised upon a shared value amongst the individual members of the CSSI Oversight Committee, Technical Committee, state Administration officials, and the people of Colorado. This value, to *contribute to an increasing standard of living and a high quality of life throughout Colorado with a robust, geographically balanced, and environmentally conscious space economy*, is the extension to the space industry of a widely articulated appreciation for Colorado’s unique environmental and lifestyle offerings. The goals of the plan are to:

- ⇒ ***Retain existing space business and government activities,***
- ⇒ ***Expand existing space business lines and government activities,***
- ⇒ ***Attract and foster new space and space-related business and government activities.***

Strategies for achieving these goals were developed by the Colorado Space Strategy Initiative's Oversight and Technical Committee members and serve as the basis of this Strategic Plan. The strategies, including the metrics for measuring the degree to which the goals have been achieved, are intertwined and require an integrated approach for their implementation. As a result, the following three initiatives, which encompass the strategies, have been identified:

⇒ **SPACE ADVOCATE INITIATIVE:**

Create a public/private "Space Advocate Office", housed within the Governor's Office of Business Development and/or the Office of Technology and Innovation, funded for three years at the outset, by a strategic partnership including the Colorado Economic Development Commission, Industry and the Governor's office. Led by a respected, bipartisan Executive Director,³ the Colorado Space Advocate, the Office would be responsible for advocacy, coordination, information dissemination and data collection [particularly as required to measure progress], and overall strategy execution and update. The Office would be accountable to a seven member Space Strategy Steering Committee consisting of the Secretary of Technology, Director of the Office of Business Development, the Chair of the Colorado Economic Development Commission, a representative from the Space Foundation and a representative from each of the three largest industry contributors to the effort.

⇒ **COLORADO TECHNOLOGY WORKFORCE THROUGH SPACE INITIATIVE:**

◆ Using the excitement of space as both a motivating influence and source of space-enabled tools, continuously increase the percentage of Colorado students graduating from high school with credentials that prepare them for a technology career, in a strategic partnership that includes the Colorado Space Advocate, the Space Foundation, Colorado Department of Education, the Space industry, and Colorado colleges, universities and community colleges.

³ Due consideration should be given to the title this "Space Czar" will hold – Executive Director is used here as a placeholder. Other possibilities might include Special Assistant to the Governor, Deputy Secretary of Technology for Space, and so on.

- ◆ Using the excitement of space as both a motivating influence and source of space-enabled tools, continuously increase the number of graduates of Colorado colleges, universities and community colleges with the skills needed to be employed in high technology careers, including space, in a strategic partnership that includes the Colorado Space Advocate, the Colorado Institute of Technology, the Colorado Commission on Higher Education, and all Colorado colleges, universities and community colleges.

⇒ **COLORADO SPACE ECONOMY INITIATIVE:**

- ◆ Create the "Colorado Space Network" program to retain Colorado's existing space-driven economic base, obtain a growing market share of new space-driven economic opportunities, and create new space-driven enterprises [e.g., space incubator and space-focused venture capital] in Colorado, in a strategic partnership that includes the Colorado Space Advocate, the Colorado Congressional Delegation, Colorado General Assembly, Colorado Space Business Roundtable, AEA corporate members, NDIA corporate members, AFCEA corporate members, and interested chambers of commerce and economic development organizations from throughout Colorado. The network would maximize communication and collaboration among all civil, commercial and defense sectors of the Colorado Space community, Colorado state government, and the public and private members of the Colorado education community in support of all initiatives that are a part of the Colorado Space Strategy.
- ◆ Create the "Colorado Soars" program to continuously improve the competitiveness, efficiency and effectiveness of all Colorado business, education and government organizations by increased use of space-enabling tools such as GPS, space-based Earth sciences data, and space-based telecommunications in a strategic partnership that includes the Colorado Space Advocate, the Colorado Association of Commerce and Industry, Colorado space industries and all Colorado Chambers of Commerce and Economic Development organizations.

2. Introduction

2. Introduction

“A new, knowledge-based economy has supplanted the manufacturing economy that dominated the past 100 years. This new economy uses technology and intellectual capital, rather than energy and raw materials, as its primary inputs. In addition, a renewed globalization has taken hold. Market restrictions between borders are being reduced or eliminated, and modern communication and transportation networks are enabling jobs to flow anywhere in the world. Instead of heavy industry needing to locate near waterways, railroad junctions, and sources of fuel, knowledge-based firms in this new economy locate where educated and skilled workers live, where opportunities for lifelong learning exist, and where the quality of life is valued.”⁴

The high tech space industry has played, and can continue to play, both a direct and indirect role in this transformation process by paving the way for both new space businesses and for businesses that provide services based upon assets and technology provided by the DoD and commercial sectors of the space industry. In Colorado, the space industry currently directly provides nearly 38,000 jobs and indirectly an additional 75,000 jobs. The “space industry” is actually a basket of industries that are involved in or rely upon the construction, launch, operation, or maintenance of space assets and the processing, dissemination, and interpretation of space collected information. Space activities can be divided into two groups: [1] the commercial satellite services industry, and [2] government space operations. The commercial satellite services industry includes the manufacture, assembly, test and operation of launch vehicles and satellites [including communication, direct broadcast, Earth observation, navigation and control, and weather satellites] and related infrastructure, and makes possible an ever increasing range of consumer and business services, including telecommunications [including those for the broadcast media], entertainment, education, disaster management, fishing, transportation, environmental and land use management, telemedicine, and many more. Indeed the “new” knowledge-based or information economy itself depends upon space-based infrastructure and value added space-based or space derived technologies where Colorado companies are well positioned.

Recognition of and appreciation for the importance of Colorado’s space sector, coupled with a statewide commitment of policy and economic support, can maintain and attract new jobs and revenues for Colorado communities.

⁴ New Strategies for the New Economy, National Governor’s Association, February 2000.

However, Colorado is in competition with other states that have initiated aggressive actions, such as establishment of space development offices, to attract the space industry. As a result, Colorado may see an erosion of its space industry base and consequent adverse impacts on the State’s economy, unless it undertakes appropriate proactive and responsive measures.

In response to the above and other considerations, the Colorado Space Strategy Initiative [CSSI] was implemented as authorized by Executive Order of the Governor to develop a strategy for the State’s space economy that would “retain and expand Colorado’s preeminence in space activities within the next decade.” The objective of this Initiative has been accomplished with the delivery of this *Colorado Strategic Plan for Space*, the successful completion of which required and embraced statewide participation of public and private organizations and individuals. *The Strategic Plan treats space as an all-Colorado opportunity.*

2.1 Why Focus on Space?

The commercial satellite industry is comprised of four primary segments: the *satellite manufacturing sector* that designs, manufactures, assembles, tests and sells satellites to both commercial and government customers; the *launch sector* that manufactures, assembles, and tests launch vehicles and provides launch services; the *satellite services sector* that leases transponders and provides subscription/retail services [such as direct to home, television, satellite mobile telephone, satellite mobile data communications, VSAT services, and the sale of remote sensing imagery and value-added services⁵]; and the *ground equipment sector* that manufactures and sells major satellite-related hardware [such as gateways and satellite control stations, mobile uplink equipment, VSATs and USATs, and consumer electronics, such as DBS dishes, village phone booths, handheld and notebook size phones, and GPS receivers].

In 1999, the commercial satellite industry generated direct revenues of approximately \$68 billion. This is expected to increase to \$199 billion by 2010, more than doubling over the next 10 years – a compound annual growth rate [CAGR] in excess of 10 percent per year. While the revenues in all sectors are expected to increase, as illustrated in Figure 2.1, revenues in the satellite services [subscription and retail] sector are expected to achieve a more dominant share of the total. It is this sector that is closely related to information technology. While launch service and satellite manufacturing revenues are expected to grow, these sectors’ percentage of the total revenue will decrease.

U.S. federal space expenditures are another source of space industry revenues. While the figures cited above include government procurement of commercial

⁵ This includes the data processing sector that creates products from space collected information.

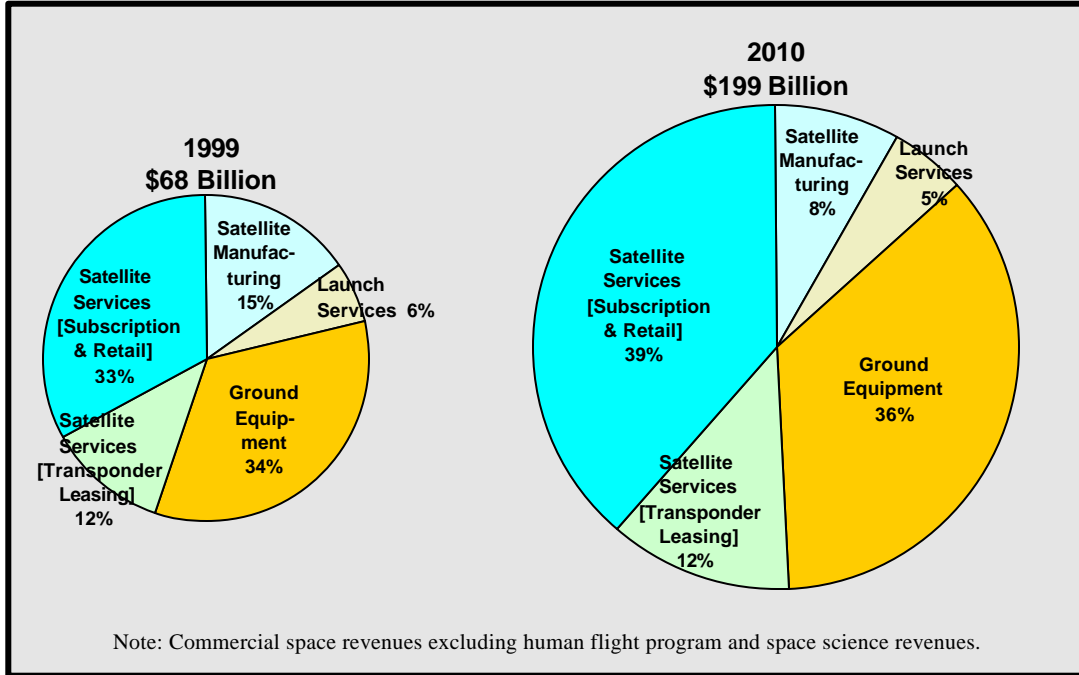


Figure 2.1 Global Commercial Satellite Industry Revenues

satellite industry services, significant federal space spending not related to the commercial satellite industry occurs. In 1999, the Department of Defense [DoD] spent more than \$6.8 billion on space-related procurement; space-related facilities and payroll constituted almost another billion in expenditures. NASA outlays exceeded \$12.5 billion [procurement] in 1999, more than 92 percent of its budget authority. After considering that the DoD numbers do not include classified procurement programs and are therefore understated, the U.S. government alone spent more than \$22 billion on space-related activities in 1999. Other world governments [excluding China and Russia] reported just over \$7 billion in space spending in 1999. Combined, the global commercial satellite industry, the U.S. government, and foreign [excluding China and Russia] governments accounted for close to \$100 billion in space spending and revenues in 1999.

As indicated in Figure 2.1, the space industry, both because it provides the basic infrastructure upon which many services are built, and because of its high technology content which creates the opportunity for new business development, has become an important component in global economics and provides a significant number of jobs in the United States and in Colorado. The current and forecasted Colorado space funding is illustrated in Figure 2.2. Current Colorado space industry revenue and government

expenditures are expected to increase from \$3.3 billion to almost of \$7 billion by the year 2010.⁶ This corresponds to a real

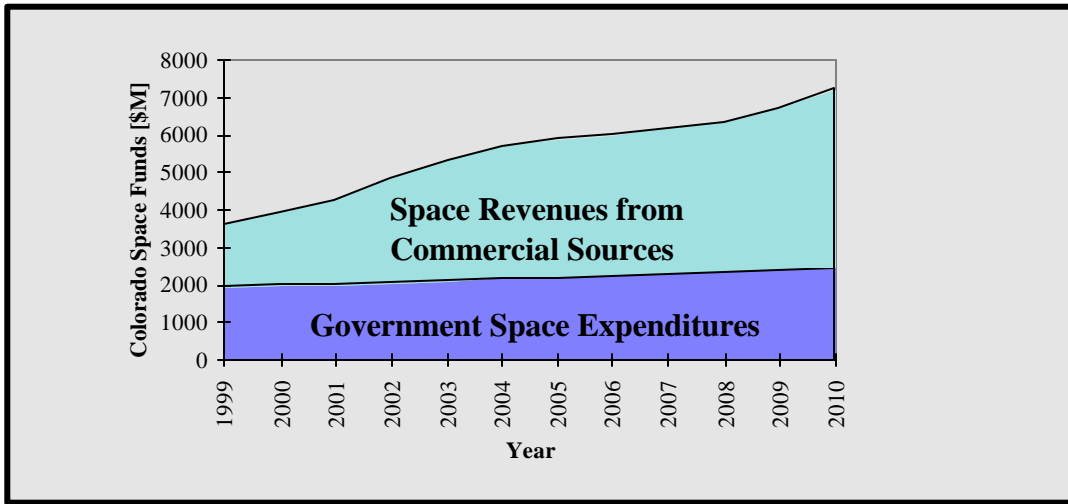


Figure 2.2 Forecast of Colorado Space Funding

CAGR in excess of 6 percent per year. Aggressive actions by Colorado could lead to an even greater market share, particularly in the government sector, which would result in even greater growth than forecast for Colorado’s space industry. Similarly, it must be stressed that inaction by Colorado could lead to a loss of market share to other, more proactive states.

As indicated in Figure 2.3, Colorado’s space industry currently generates approximately 38,000 jobs which in turn create an additional 75,000 jobs.

The State of Colorado and various economic development initiatives and organizations have not yet focused on the vast importance of Colorado’s space industry.⁷ For example, the recently released Convergence Corridor Report⁸ omitted the space industry from its “high technology” industry group; singled out for consideration were high tech manufacturing; communication services, software and computer services; biomedical products and devices; computer storage and peripherals, software for telecommunications infrastructure, and equipment for telecommunications infrastructure. These four “convergent” industries combined could provide “as many as 117,000 jobs....by 2020;” the space industry alone is expected to provide 76,000

⁶ Revenues to commercial firms from government sources are included in the government series only.

⁷ As of this writing, neither the Colorado Institute of Technology [CIT] nor the “convergence corridor” initiatives discuss or address the space industry.

⁸ **The Convergence Corridor**, prepared by Development Research Partners for InterMountain/RKH in support of Metro Denver Network Tech Vision, Denver Metro Chamber of Commerce, January 2000.

[direct] jobs by 2010 [a decade sooner] and is likely to continue its significant growth into the following decade.

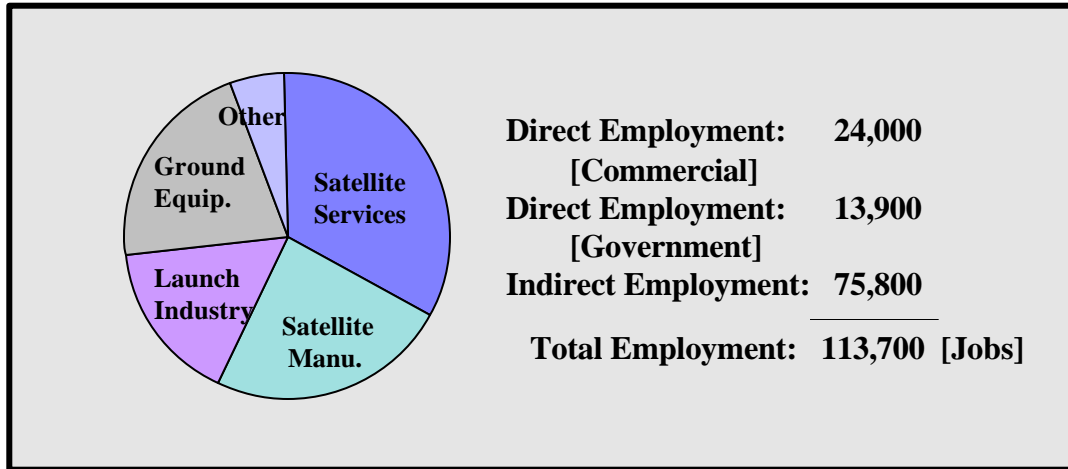


Figure 2.3 A Result of the Investment in Space: Colorado Employment [Estimated]

2.2 Colorado in Space⁹

Colorado is rich in space technology, research and applications. Within its borders are many of the leading laboratories, installations and companies that use space for national security, space exploration, and commercial opportunities. Many of the most outstanding space scientists and engineers have selected Colorado as their home. Research facilities have been established in Boulder, Denver, Fort Collins, and Colorado Springs to carry out leading edge projects that include astronomy, astrophysics, atmospheric physics, propulsion and remote sensing. Technology centers have been established in Denver, Boulder, Pueblo and Colorado Springs. Colorado is one of the leading states for the production and assembly of launch vehicles, with manufacturing facilities located in Denver and Pueblo. The United States’ three largest and most capable expendable launch systems are all manufactured or assembled in the State: Titan, Atlas and Delta.

Colorado hosts a variety of space activities including the design, development and manufacture of satellites and space systems,¹⁰ development and manufacture of space

⁹ Refer to Appendix A for a more detailed discussion of space technology.

¹⁰ Colorado is one of the few states that can boast of such capabilities. Lockheed Martin and Ball Aerospace are two outstanding examples of leading production companies working in the satellite arena.

transportation systems and launch infrastructure, provision of satellite services,¹¹ development and manufacture of ground equipment, and the performance of space related research.¹² There are more than 100 companies in the state of Colorado which provide materials, equipment, software and services for the space infrastructure and to end users of space applications. There are also several key military organizations in the state of Colorado which provide national security functions using space assets and the space infrastructure [see Appendix B] and act as a magnet for attracting the commercial space industry.

Several Colorado universities are involved in space-related research and technology projects. The leading institution is the University of Colorado in Boulder with many academic and research programs focusing on space. Of particular note is the National Center for Atmospheric Research [NCAR] in Boulder. Other active universities include Colorado State University and the University of Colorado in Colorado Springs.

Colorado is well positioned to maintain and increase its market share of space related activities and investments. Colorado is a leader in space science with outstanding facilities, resources and talent. Its leading areas of scientific strength in astronomy, astrophysics and atmospheric sciences are all well established and should continue to flourish.

Technology areas of strength include the development, manufacture, and assembly of scientific and specialty spacecraft, development and manufacture of large commercial and military launch vehicles, new spacecraft sensors and advanced satellite subsystems, mission planning and mission data processing system development, integration and operations. Colorado houses and hosts the only organization in the Western hemisphere responsible for tracking and forecasting space debris hazards, the Air Force's Space Surveillance Network. Federal space policies are consistent with continued support of these areas. There is great emphasis on expanding planetary and near-Earth science programs, on reducing the cost of space access, and on cleaning up the near-Earth orbits. Colorado is already a leader in these arenas.

¹¹ Colorado has the enviable position of hosting a tremendous amount of technology developed for space. In the corridor from Fort Collins to Pueblo, there are dozens of organizations working on new technologies. These include electronics, new satellite systems, applications of GPS, new software, satellite command and control, advanced communications, Internet applications, and complex systems integration. In Colorado Springs, UTMC Microelectronic Systems is a world leader in radiation-hardened electronics. Colorado State University is a leader in electric propulsion technologies. NORAD is the government organization responsible for orbital debris tracking and collision prediction.

¹² Colorado is a leading state in hosting space-related science research activities. The University of Colorado is a recognized powerhouse in space and atmospheric research through its work in advanced information technologies, astrophysics and cosmology, astronomy, robotic exploration, planetary studies, and transportation.

Recent and continuing developments in expendable launch vehicles are helping to reduce the cost of placing satellites in orbits. Lockheed Martin, with a major launch vehicle manufacturing facility near Denver, and Boeing with a major launch vehicle assembly facility in Pueblo, are leaders in this effort for both military and commercial vehicles. Several commercial and government organizations have been pursuing more advanced space access solutions, such as reusable launch systems. More than ten such efforts nationwide have been started in the past five years. All of the commercial such efforts have fallen on hard times, thanks to the recent series of weak market performers [e.g., Iridium, ICO, Orbcomm and Globalstar]. This has significantly reduced investor funds for continued development of commercial reusables. NASA's X-33 program is severely behind schedule and there are serious doubts as to its ultimate viability. It is anticipated that a successful commercially available reusable vehicle will not be operational before 2010. Thus, near-term chances for related activities in Colorado appear to be minimal.

Commercial applications of space will continue to emphasize the already active areas of communications, navigation, and remote sensing. A winner is going to be direct to home [DTH] broadcast services; revenues from DTH already surpass \$5 billion received from over 10 million customers. Continued expansion of Internet and GPS applications are likely. Remote sensing is not yet a commercial success, but the addition of new technology should expand its usefulness to the consumer community toward profitability. Colorado is well positioned to support and take advantage of all these activities.

Beyond the space applications that have already been implemented, there are many more which await new technology and greatly reduced space access costs. One of particular interest is space tourism. Over the next five to ten years, there will likely be a continual increase in the pressure to perform research that will ultimately lead to the development of systems that will permit, at a reasonable price, members of the public to travel in space. However, the development of such systems will likely occur beyond the time horizon of this strategic plan.

2.3 Why Develop a Strategic Plan?

States often undertake strategic planning efforts in response to an actual or perceived downturn in the economy. Economic re-structuring, a recession, downsizing within a key industry such as defense, or actions of other states can cause a state to examine its economy and develop policies to promote future economic growth. Equally important for states is to periodically assess their development priorities.¹³

¹³ **Science and Technology Strategic Planning: Creating Economic Opportunity**, Economic Development Administration, U.S. Department of Commerce, October 1997.

Colorado's economy is knowledge and information-based, driven by the ability of firms to innovate and develop new products and processes. Colorado's space industry plays a major role in this type of economy by providing a strong base for continued expansion as well as an infrastructure and knowledge base upon which new industry can build. However, in attracting and retaining today's space companies, government facilities and expenditures, and space related activities, Colorado must compete with other countries, states, and regions in a competitive environment that includes creative cost reductions, public sector efficiencies, labor/skill availability and training, and quality of life. Aggressive actions by other states [including California, Florida, Alabama, Texas and Alaska], if not countered, are likely to adversely affect Colorado's space industry and consequently the overall economy of Colorado.

A strategic plan has thus been developed which aims to maintain and expand Colorado's space industry, commercial and DoD, thereby continuing the expansion of the State's economy while maintaining the highly valued quality of life. Implementation of the programs and strategies outlined in this plan aim to:

- ⇒ *Retain existing space business and government activities,*
- ⇒ *Expand existing space business lines and government activities, and*
- ⇒ *Attract and foster new space and space-related business and government activities.*

Not aggressively pursuing the programs and strategies outlined in this plan will likely result in an erosion of Colorado's space industry base and have adverse impacts on the State's economy.

2.4 The Strategic Planning Process

The State of Colorado, in recognition of the vital role space activities and the space industry play as an economic, technological and educational force within the State and around the world, and initiated the development and implementation of **a Colorado Strategic Plan for Space**. The Office of the Governor of the State of Colorado and the Colorado Economic Development Commission contracted the Space Foundation – an internationally recognized U.S. national non-profit organization headquartered in Colorado – to manage the Colorado Space Strategy Initiative [CSSI]. Advised by an Oversight Committee and a Technical Committee [both appointed by Governor Bill Owens], the Foundation selected the PSI Team¹⁴ to perform the necessary data collection and reduction, analysis, and market characterization to support strategy development by the Committees and then delivery, for implementation, of a Colorado Strategic Plan for Space.

¹⁴ The PSI Team, led by Princeton Synergetics, Inc., consists of the Futron Corporation and consultants associated with Launchspace and George Washington University.

Strategic planning provides an opportunity to examine the health of the State's economy, identify strengths and weaknesses, and determine the role government should play in facilitating a healthy business environment. The strategic planning process relied heavily upon a series of meetings with the Oversight and Technical Committees to identify goals, objectives, metrics, and concerns, and to identify strategies. The information obtained, together with in-depth data collection and market characterization, resulted in the formulation of the Colorado Strategic Plan for Space. This Plan has been reviewed by those who participated in the planning process, and will be summarized on the Space Foundation's web site to provide a means for public comment.

The strategic planning process:

- brought together key public and private stakeholders, to develop consensus,
- provided an opportunity for business, academic, and community representatives to share their input with state decision-makers,
- provided an opportunity to forge partnerships within and between the public and private sectors,
- increased public understanding of the economy, the role of the space industry within this economy, and how it is changing,
- enhanced the State's ability to achieve a maximum return on its investments,
- sharpened the focus of the State's development efforts, and
- set goals/objectives against which to measure success.

The resulting strategic plan identifies:

- where we are [characterization of the space industry],
- where we wish to be [determination of goals and objectives],
- what we must do to get there [development of strategies], and
- how we will know that we are on a correct path [development of metrics for measurement] to get to where we wish to be.

2.5 Report Structure

This report contains a description of the Study Team followed by an identification of the Oversight and Technical Committees' participants. Section 1 presents the Executive Summary highlighting the major findings of the Study and resulting Strategic Initiatives. Section 2, Introduction, identifies the importance of the space industry to Colorado's economy, describes Colorado's space industry, discusses the need for a strategic plan, and describes the strategic planning process.

Section 3, Colorado Is Positioned for Space, summarizes the form and magnitude of Colorado's space related business, employment, and market share and emphasizes the size and form [type of jobs and multiplier effects] of space business relative to other

business areas. Also discussed are the importance of space to Colorado's economy and the State's strengths and weaknesses in maintaining the current level of space business and for increasing this business. Section 3 also presents forecasts for the space related economy.

Section's 4 and 5, Values, Goals, Objectives & Targets and Strategies for Colorado, respectively, summarize the results of workshops with the Oversight and Technical Committees. Section 4 summarizes the identified values, goals, and objectives and the metrics to be used to measure success. Section 5 identifies a specific set of initiatives and supporting strategies that are aimed at meeting Colorado's goals and objectives. The discussion of the strategies includes an identification of the related goals/objectives and the associated metrics.

Section 6 presents a summary of the strategic plan and the implications for State Government actions.

A number of appendices are provided in a companion volume that contains supporting details. Appendix A, Space Technology: An Overview, summarizes the space technology base required for future missions and discusses related Colorado strengths. Appendix B, Summary of Colorado's Military Space Organizations, presents a summary of the DoD organizations that make their home in Colorado. Appendix C, Description of Representative Colorado Commercial Space Suppliers and Service Providers, presents a summary of representative space related firms located in Colorado.

Appendix D, Addressable Markets: Space Spending & Revenue Patterns, presents a summary of world space related revenues and expenditures. Appendix E, Economic Multipliers, provides a brief overview of economic multipliers and their limitations. Appendix F, Colorado's Space Situation, describes the survey that was conducted to estimate Colorado's space related revenues and expenditures as well as related jobs. In addition, Appendix F presents forecasts of Colorado's space revenues from commercial customers, and DoD and NASA spending in Colorado.

Appendix G, Space Education in the State of Colorado, summarizes Colorado's education programs. Appendix H, State Incentives, summarizes typical space incentives provided by other states. Appendix I, Space Strategic Plans in Other States, describes strategic plans prepared by other states for supporting their space industries. Appendix J, Resources, provides a list of references utilized in the course of the preparation of the strategic plan as well as providing a list of those organizations that participated in the Colorado survey.

3. Colorado Is Positioned for Space

3. Colorado Is Positioned for Space

3.1 Introduction

The State of Colorado currently houses a space industry, composed of the public and private sectors, that results in significant contributions to state revenue and employment. Approximately \$3.3 – \$5.1 billion in company revenues plus government expenditures have been estimated; this range of figures includes \$2.5 - 4.3 billion in revenues [from commercial and government sources] plus \$0.8 billion in other government expenditures. Colorado's space base directly generates nearly 38,000 jobs and indirectly provides another 75,000 jobs. Though contributing less than 5 percent of state revenue, the high-tech space industry in Colorado is growing rapidly and shows the potential to continue doing so. Fortunately, Colorado is well-positioned within this rapidly expanding market, such that it can maintain and expand upon its share of an industry that is forecasted to reach \$199 billion by 2010. In addition, approximately \$30 billion in U.S. and foreign government space expenditures are excluded from these estimates.

To understand the value of the space industry to the overall Colorado economy, livelihood and common wealth, the Colorado Space Strategy Initiative [CSSI] undertook an extensive examination of its structure, revenue and employment. The results of the industry survey and analysis are described in the following paragraphs, with details presented in appendices. Data on the current space industry and from the survey were utilized in developing forecasts through the year 2010 for the space industry and Colorado's position in particular. The rationale for and the results of the forecasts are also described in the following paragraphs, with details presented in appendices.

These forecasts must be submitted with one essential caveat: analyses are predicated upon the assumption that Colorado will remain competitive with other states [such as California, Florida, Texas, and Alaska] that have become more aggressive in seeking to maintain and increase their shares of the space business market.

3.2 Strengths, Weaknesses, Opportunities, and Threats [SWOT]

The Colorado space industry is flourishing within the larger, highly competitive, and dynamic global space industry. While Colorado enjoys considerable strengths in the launch, satellite services, and military space markets, significant internal weaknesses and external threats to these markets exist. Fortunately, many elements of market positioning can be proactively controlled by Colorado, and as such may present valuable opportunities for the state to expand its space offerings.

Far from being monolithic, the space economy can be dissected into numerous, diverse industries that comprise both traditional and high-tech elements of manufacturing and services. All space industries nonetheless share a reliance upon space technologies, or at least the exploitation of space technologies, to advance their market position. However, the space industries' growth profiles vary widely, as do their many of their market drivers and key success factors. As a result, the individual strengths, weaknesses, opportunities, and threats [SWOT] identified in Table 3.1 may be relevant to select components of the Colorado space economy; other SWOT elements, such as a highly educated workforce, likely pertain to the space economy as a whole.

As in traditional SWOT analyses, strengths and weaknesses are internal evaluation factors, while opportunities and threats are based upon an assessment of the external environment. Moreover, the difference between an opportunity and threat can often lie in the perspective and the proactive stance used to exploit trends in the national space industry. Historically, the space sector has been highly integrated with the dynamic information/computing industry, generating both demand for leading-edge data-handling capabilities and software and hardware later adopted more generally. Strengths, weaknesses, threats, and opportunities applicable to these "sister" industries will directly affect the space economy.

The situation characteristics indicated in Table 3.1 suggest that Colorado must take decisive and immediate action to reap the benefits of its space heritage and quality of life and to advance its base of space business. Indeed, because other states have taken aggressive actions to secure a part of this valuable economy, Colorado will likely need similar actions to even maintain its base of the current space industry. Education and training of the state workforce, attraction of new businesses with state incentives and infrastructure, and mobilization of government support in Denver and Washington are but a few prominent examples of the ways in which Colorado might better support its space industry. Sections 4 and 5 discuss the implications for the state's space value, goals, objectives, and strategies.

Table 3.1 Colorado Strengths, Weaknesses, Opportunities, and Threats in the Space Economy

Strengths		
Historical military space presence [US, Air Force, & Army Space Commands]	Leader in direct-to-home industry	Central location in the US for redistribution of information, durable consumer goods, and services
High R&D component of federal space funds	Leader in navigation and timing	Highest per-capita high tech workers in the Nation
Historical presence in launch manufacturing	Leader in computer network attack/defense	Unique and sought-after quality of life [environment]
Low corporate income tax	Leader in satellite remote-sensing businesses	High average education of the workforce
Weaknesses		
Lack of space advocate and supporting organization in state government	Limited internal recognition of the space industry's importance to the Colorado economy	Too few technology workers to fill space jobs, requiring import of workers or export of work
Few state business incentives focus on or are accessible to the space industry	Inadequate external marketing of space industrial base outside state	Significant portions of space manufacturing are no longer high technology
Traditional secrecy associated with defense space operations & technologies [limiting cross-pollination]	High corporate property/inventory tax	Large space companies may have difficulty attracting IT professionals from dot-com startups
Traditional reliance on government work hinders industry cultural flexibility	Transportation infrastructure beyond the Eastern range is sometimes limited.	Limited options for space-related education
	Environmental consciousness can limit business options	High average wage demand
Opportunities		
Rapidly expanding space services sector	Move by major manufacturing firms to consolidate operations means labor growth will flatline in 2013 in United States, possibly emphasizing quality of life considerations to an increasingly in-demand and mobile labor pool	Labor costs less burdensome than #1 space state, California
Commercial growth plans of major national aerospace firms represented in Colorado		Corporate taxation less burdensome than #1 space state, California
Venture capital is available for space start-ups	Potential for developing distribution of multi-media data and space-durable goods	

Table 3.1 Colorado Strengths, Weaknesses, Opportunities, and Threats in the Space Economy [Continued]

Threats		
Other states' aggressive pursuit of traditional Colorado space markets	Other states' greater flexibility in offering business incentives/low tax burden	Space hardware sector not growing
Highly aggressive federal representation for other states	Higher wages offered to high technology workers in other industries [e.g., Internet]	Lower labor costs in other states [such as the Sun belt]
Move by major manufacturing firms to consolidate operations	Labor growth will flatline in 2013 in US, tightening national supply of high tech workers	
Federal restrictions on the export of space technologies		

Table 3.2 Estimated Colorado Space Jobs by Economic Sector

Type of Employment	Private/Commercial Sector	Public/Government Sector	Total Space Related Employees
Direct	24,076	13,899	37,975
Indirect	48,152	27,798	75,950
Total	72,228	41,697	113,925

3.3 Employment

Survey results indicate that the private sector currently employs 63 percent of Colorado's total space industry while the public sector employs 37 percent. Table 3.2 shows the distribution of the approximately 38,000 space-related employees in the state of Colorado.

Survey results suggest that an additional 24,000 space-related employees work in the private sector in Colorado, with another 14,000 employed by the government. Thus, direct employment by Colorado's space industry corresponds to 38,000 jobs. This direct employment, in turn, creates an additional 76,000 jobs—i.e., indirect employment¹⁵ resulting in a total of 114,000 jobs created by Colorado's space industry. Figure 3.1 indicates the general distribution of space-related

¹⁵ Direct employment is the result of procurement of products and/or services directly related to the space industry, and indirect employment is the result of dollars being spent in a community by the

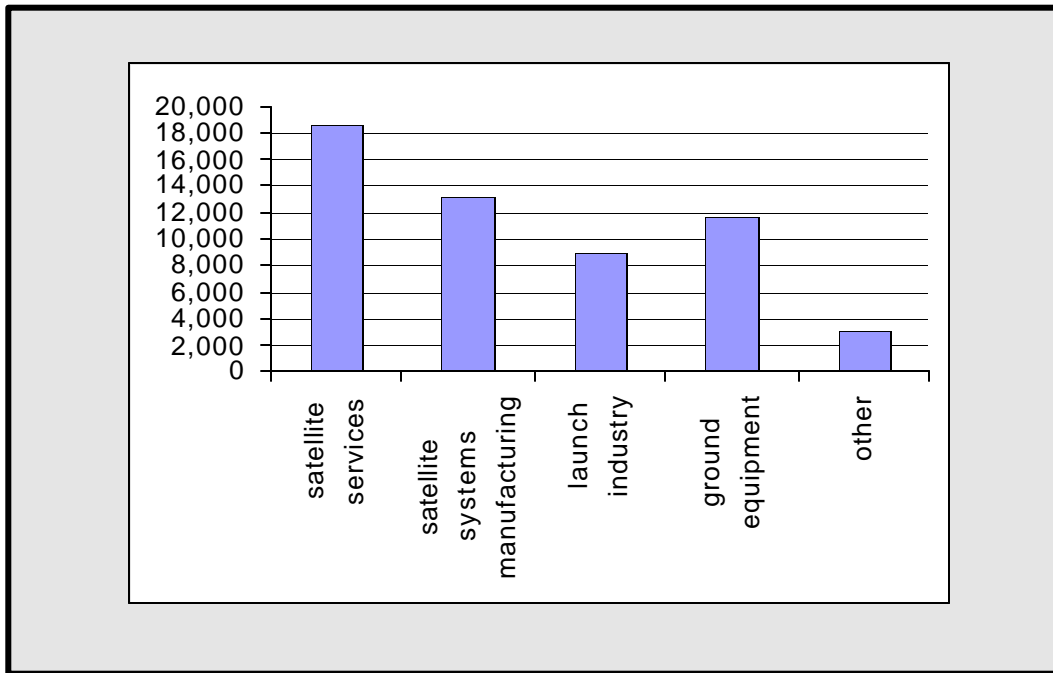


Figure 3.1 Estimated Colorado Space Jobs by Industry Segment [Excluding Government]^{16,17}

employees in the Colorado space industry; however, the sum of the segment estimates shown is greater than 24,000 and is overstated due to firms involved in more than one industry segment. The greatest number of Colorado space-related workers are employed in the satellite services industry—one of the highest margin, fastest growing segments of the space industry—followed by the satellite systems manufacturing segment.

In addition to private sector employees, nearly 14,000 government employees in Colorado work in the space industry.¹⁸ Similarly, military personnel involved in the space industry have a significant presence in Colorado, and particularly in Colorado Springs: 7,712 military personnel and 5,337 civilians stationed at Cheyenne Mountain, Schriever AFB, and Peterson AFB combined. The personnel at those facilities work for the U.S. Space Command, Air Force Space Command, and Army Space Command, while another 762 military personnel and 88 civilians are employed at Buckley NGB. [These latter figures are conservative compared to a recent report of

direct employees of the space industry – for example, laundry, medical, and other services and products. This short-term “multiplier” effect amounts to an approximate factor of 2 and is discussed in more detail, along with other multipliers, in Appendix E.

¹⁶Some jobs may be counted in more than one industry segment.

¹⁷ These results are based upon interviews of CSSI committee members and a telephone survey of Colorado’s space industry.

¹⁸ Economic Impact Analysis and Governor Owens’ Tri-Command Brief, March 27, 2000.

over 2000 military and civilian employees assigned to space missions at Buckley; in both cases, contractors are assumed to be covered elsewhere by surveyed company responses.] In addition, a high concentration of both private and public sector space employees are concentrated in Colorado Springs.

As Colorado strives to establish itself as a space state, the growth of space business in some sectors is exceeding the rate of development and workforce retention. As discussed above, the state currently draws upon a strong employee base but must attract more personnel with education and experience in the space industry. CSSI recommends research into whether Colorado grade schools are supporting job growth in high tech positions and how many graduates of Colorado universities find employment in other states. Such research could reveal the various options for developing the Colorado space workforce, without resorting to the “import” of personnel from elsewhere in the U.S. or overseas. Some space firms have already been forced to import their workforce. In brief, the state needs to improve space education, retain in-state university graduates, link space businesses to education and training, and attract employees with high tech skills. Section 5 of this report enumerates several strategies for attracting and retaining the well-educated workforce that is necessary to the growth and development of the state’s space industry.

3.4 Colorado’s Space Business

The State of Colorado boasts over 100 firms that contribute to the space industry. These firms range in size from one to thousands of employees and contribute a sizable portion of the state’s approximately \$4.8 billion in annual space revenues.¹⁹ Eight major firms generate about 90 percent of Colorado’s space revenues: Ball Aerospace, Boeing, Computer Sciences Corp., Echostar, Hughes Space & Communications, Lockheed Martin, Raytheon, and TRW.²⁰ According to their responses, the “Colorado Eight” produce about \$4.3 billion of the total private-sector space revenues generated by the state. The revenues of these companies derive from both commercial [39 percent] and government [61 percent] contracts. Table 3.3 compares the space industry with a sample of other key industries in the state, based on 1997 data from the U.S. Census Bureau. Interestingly, the 1999 space industry estimate exceeds or approaches the size of several manufacturing and service segments.

Survey responses suggest commercial space firms located outside of Colorado consider it to be a space state with a broad range of space-related capabilities. The Colorado Eight attest that most of their \$1.7 billion in non-government revenues

¹⁹ To place Colorado’s space industry in proper perspective, note that revenues from mining amounted to \$3.6 billion, construction amounted to \$19.1 billion and all manufacturing amounted to \$41.9 billion.

²⁰ The “major” firms were identified from CSSI and Space Foundation input as well as estimates of revenues and employment data from other sources.

Table 3.3 Revenue Comparison of Space with Selected Other Colorado Industries

Industry	Revenues [\$B]
Chemical and allied products	1.182
Communications services [includes broadcasting]	8.405
Electronic and other electric equipment	4.272
Industrial machinery and equipment	6.778
Instruments and related products	5.156
Mining	3.586
Space	4.751
Trucking, except local	1.223

come from commercial customers located outside the state. [Interestingly, 61 percent of all commercial revenues flow to the satellite services segment of the space industry.] Furthermore, the Colorado Eight seem to obtain slightly less than 40 percent of their product value from suppliers outside of the state. In other words, these Colorado firms create over half of their product value with in-state resources, while subcontracting about 17 percent of their commercial revenues to

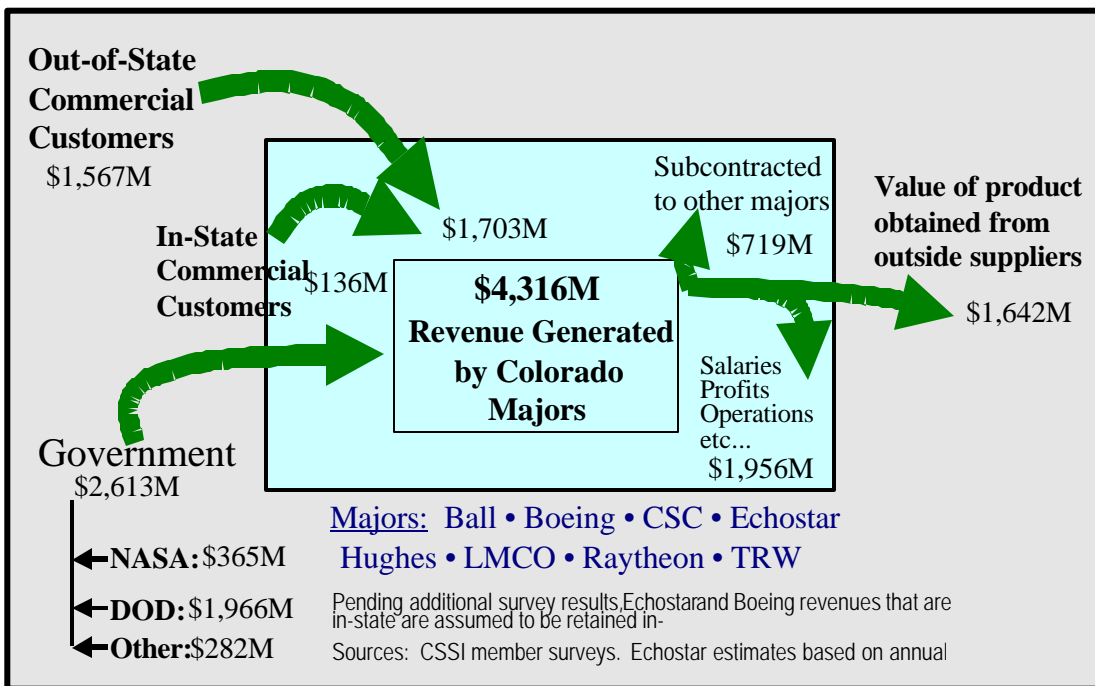


Figure 3.2 Flow of Space Revenues for the Major Colorado Space Firms

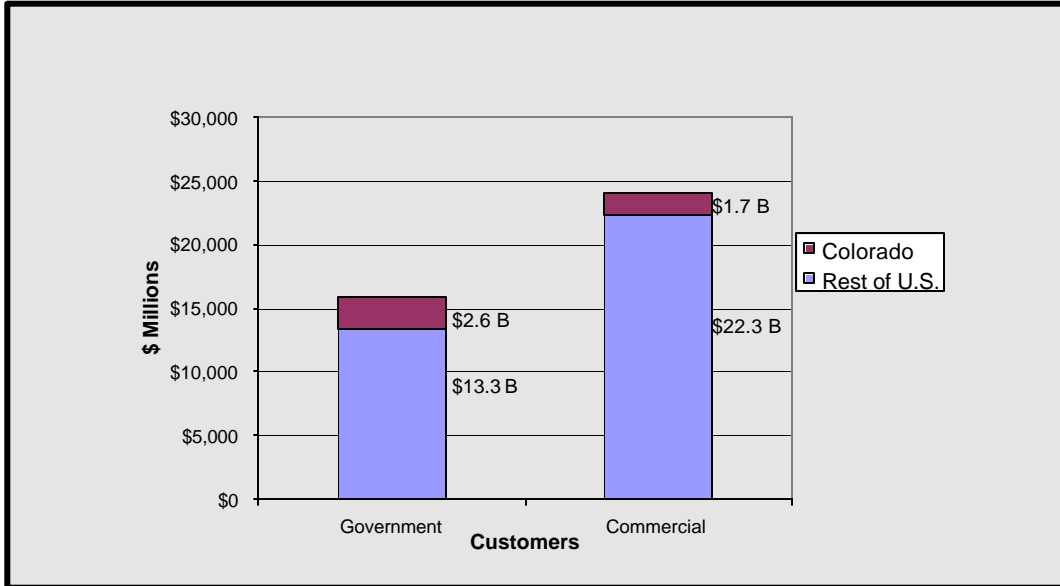


Figure 3.3 Colorado Eight’s Space-Related Revenues from Commercial Customers and Government Space Expenditures Compared to the Rest of the U.S.

each other. Approximately 45 percent of their commercial revenues are retained by Colorado facilities for own expenses or profits. The flow of funds, based upon the data obtained from the major space firms, is illustrated in Figure 3.2.

The Department of Defense provides the most significant government procurement revenues to Colorado space firms. In 1999 major Colorado space firms alone received \$2.0 billion from DOD for space-related activities. Similarly, the launch industry sector of the state’s space industry benefited from 37 percent of total government expenditures to the major space firms in 1999. In addition to expenditures to the major space firms, DOD spends an estimated \$1 billion on space programs and personnel in Colorado. NASA contributes an additional \$75 million for education and’ space-related activities by non-profit organizations. The magnitude of these expenditures indicates that the federal government highly values Colorado’s space capabilities and has invested significant sums in the future of the Colorado space industry; the challenge for Colorado, then, becomes one of capitalizing on this investment and expanding it in new ways. Figure 3.3 reveals that the Colorado Eight obtain an estimated 16 percent share of total U.S. government space expenditures and about a 7 percent share of total U.S. commercial space-related revenues [excluding GPS].

Figure 3.4 shows the distribution of revenues generated by commercial firms for space industry segments. In comparison to the rest of the U.S., Colorado has a notable share,

amount to about 11 percent, of the satellite services segment. This industry segment generally yields 15 - 50 percent higher operating income/revenue

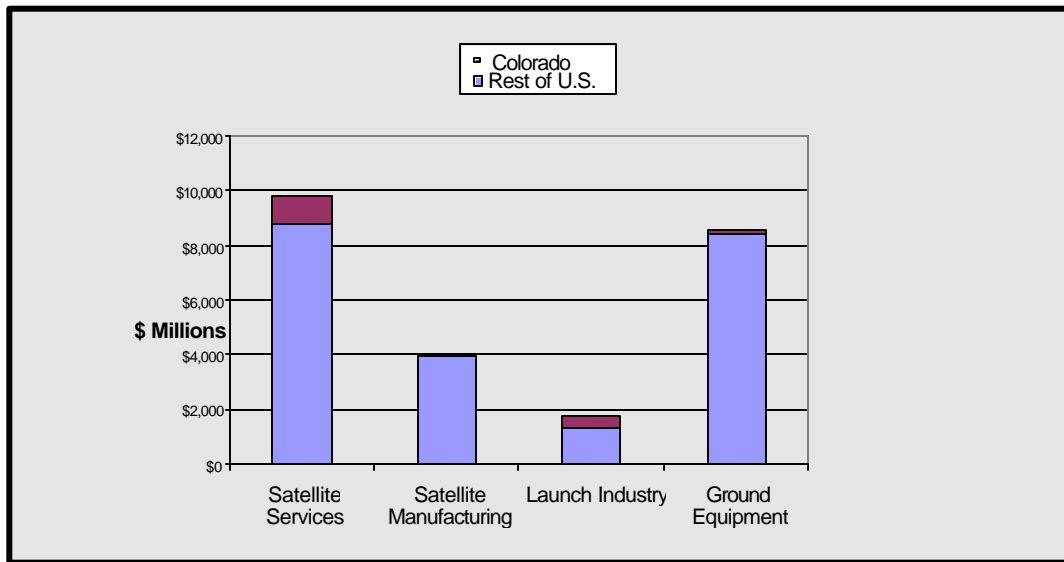


Figure 3.4 Colorado Eight's Revenues from Commercial Customers by Industry Segment Compared to the Rest of the U.S.²¹

margins than other industry segments. In addition, satellite services provided by Colorado space firms will generate considerable jobs and tax revenue for the state. Colorado also enjoys a respectable share [27 percent] of the overall launch industry revenues generated by commercial firms compared to those generated by commercial firms in the rest of the country.

In summary, Colorado enjoys a significant share of government and commercial space expenditures in this country, with the space industry translating into significant economic benefit for the state including higher quality of life, added jobs, etc. The Colorado space industry is diversified across the public sector and four key segments of the private sector. Perhaps the only significant space activity not currently found in the state is a spaceport. Accordingly, the space industry represents an important foundation for the state's emerging high-tech economy and merits appropriate attention from economic decision makers. To best understand how the state may advance this valuable element of its economy, Section 3.5 considers in greater detail the original cornerstone of Colorado's space industry, the government sector.

²¹ Satellite services and ground equipment revenues from the U.S. are considered to be all commercial revenues. The government may in some cases be a minor customer, but not to a degree that can be readily estimated. Data was obtained from the CSSI member surveys and the SIA database.

3.5 Colorado's Current Federal Space Market Share

Historically, Colorado has maintained a large share of the federal procurement dollars for space, especially from military expenditures. This strength is due, in large part, to the long-time presence of space launch manufacturers, a highly regarded research and development capability, and a strong military presence. More recently, Colorado's burgeoning information services industry has been receiving more federal space dollars.

Colorado's major sources of federal space expenditures are the Department of Defense [DoD] and the National Aeronautics and Space Administration [NASA]. Other federal agencies, such as the National Oceanic and Atmospheric Administration [NOAA], also fund space activities around the nation, but at marginal levels in comparison to cumulative DoD and NASA spending. This CSSI analysis of federal space expenditures in Colorado, then, focuses exclusively on DoD and NASA spending patterns. *The data detailed in the following paragraphs are derived from CSSI analysis of federally reported procurements and awards; in contrast, the revenue reported in the prior section relies on CSSI survey responses from major space companies.*

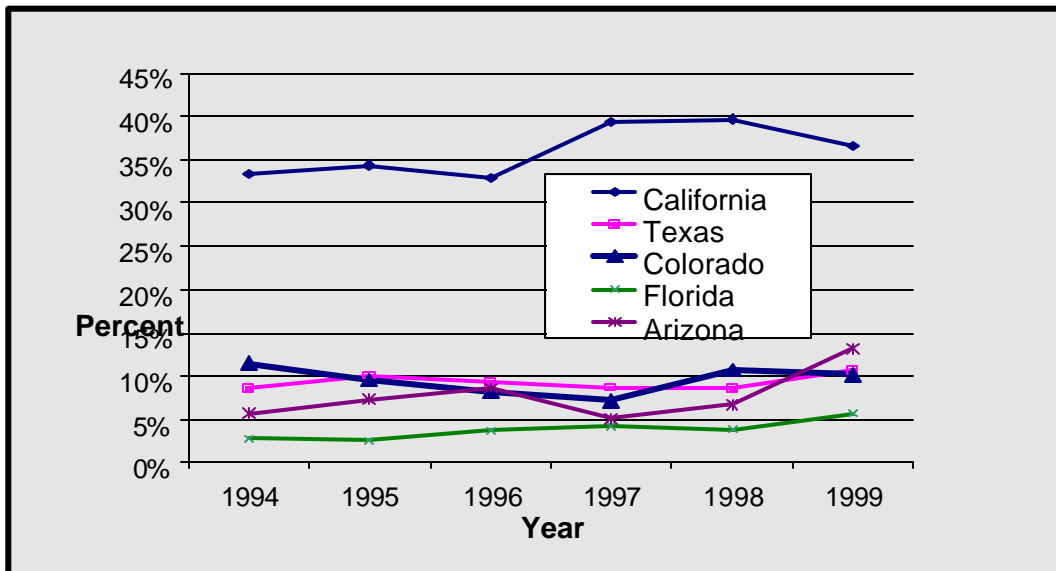
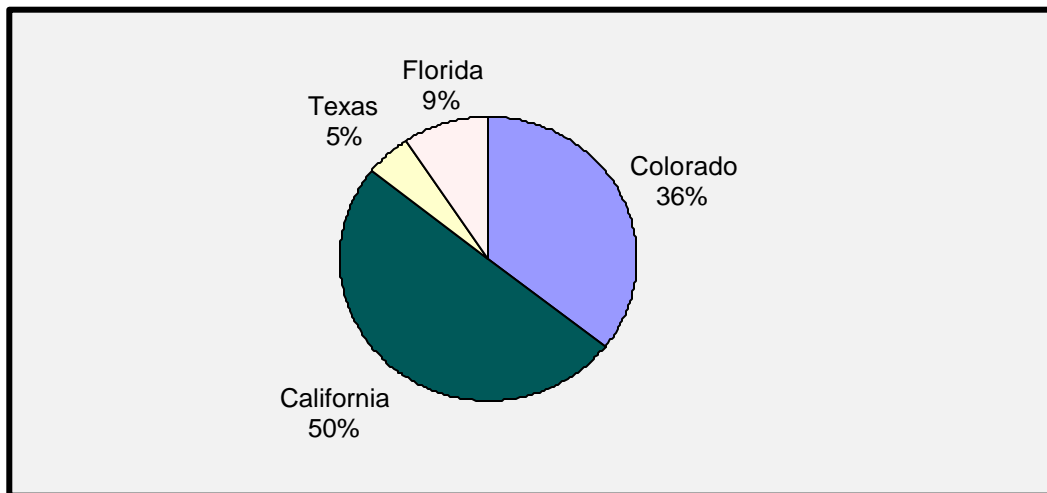


Figure 3.5 Historical Allocation of DoD Space Procurement Among Major Recipients

Colorado firms received a total of \$1,138 million in DoD missiles and space procurement in 1999. Of this, CSSI estimates that 61 percent, or approximately \$690 million, is space-related.²² Overall, the ratio of Colorado missiles and space procurement to total military procurement is five times greater than the national average. Among states receiving space procurement funds, Colorado ranked fourth in total space procurement receipts during 1999. Figure 3.5 details recent historical trends in major state space procurement.

Overall, Colorado's federal space expenditures profile is highly R&D intensive for both science and technology. The state receives more than 10 percent of military space procurement and ranks second among states for receipt of DoD funds for Research, Development, Test, and Evaluation [RDT&E] for space activities.²³ This is illustrated in Figure 3.6.

Colorado has performed exceptionally well in procuring NASA obligations, despite the lack of a major NASA facility in the state. Colorado ranked eighth in 1999 among recipients of NASA procurement funds. Most notably, of the states



²² Department of Defense Directorate for Information, Operations, and Reports [DIOR], *Online Database*, 2000. Procurement information included here does not include classified military spending.

"Missiles and space" is one of the DoD's top 25 procurement programs and includes numerous SIC codes, most notably those for space vehicles and guided missiles. The DoD publishes state-by-state figures only for the major procurement programs, and the methodology used to extract the space portion of Colorado's missiles and space procurement is detailed in Appendix F.

²³ DoD reports total RDT&E by state. CSSI methodology for extracting space RDT&E by state can be found in Appendix F.

Figure 3.6 1999 Space RDT&E Apportionment Among Major Recipients of DoD Space Spending [\$1,036 million]²⁴

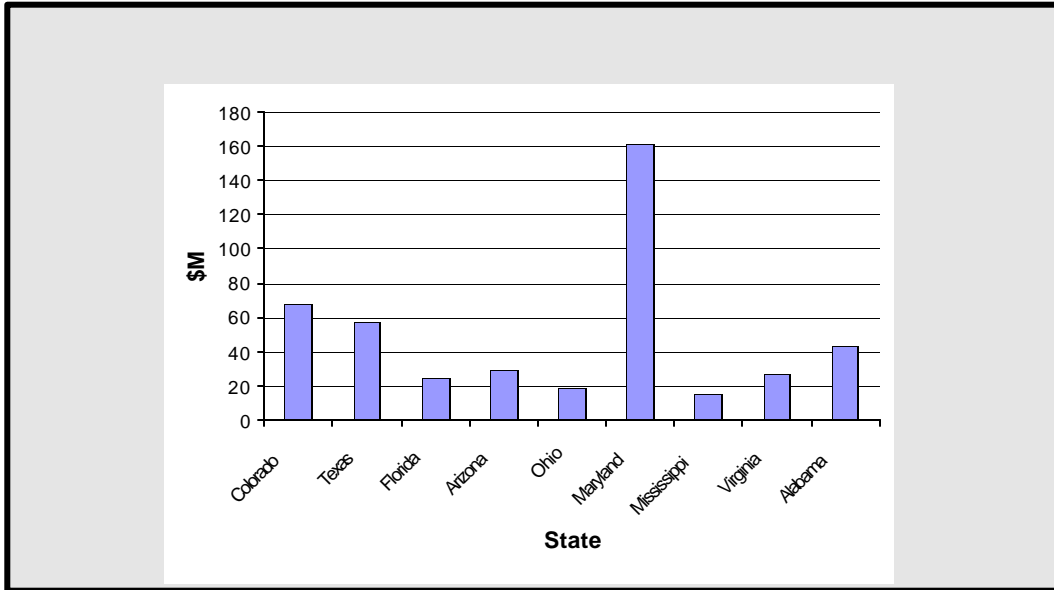
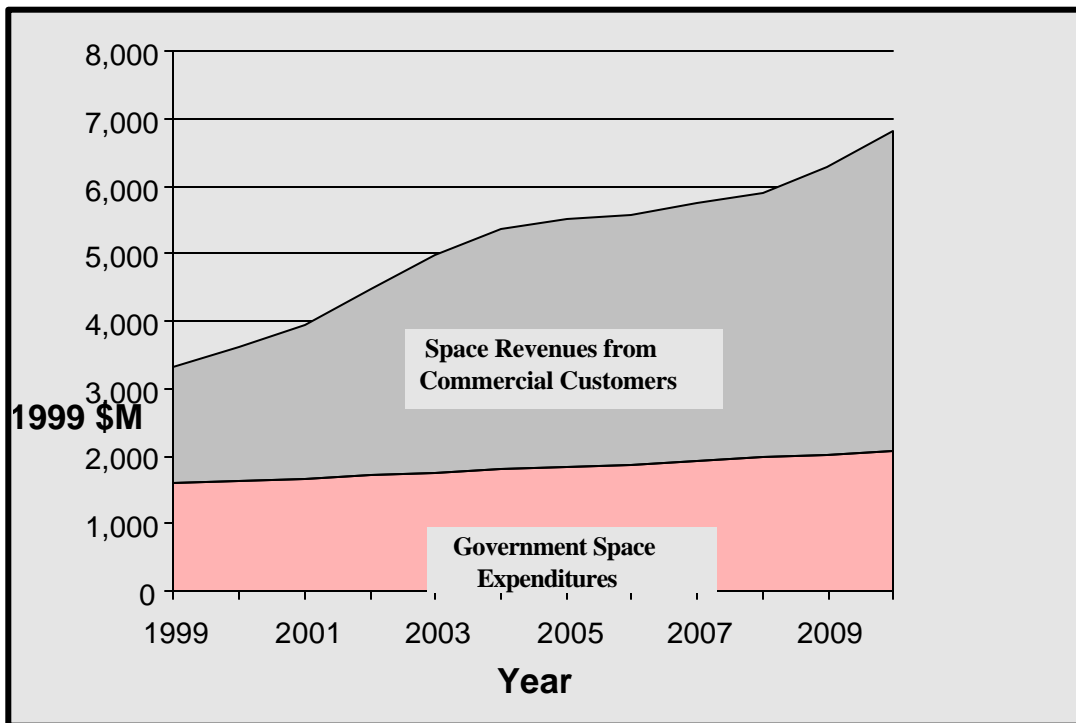


Figure 3.7 1999 NASA Obligations to Educational Institutions [California omitted for graph scaling purposes]



²⁴ Total noted in caption does not include space RDT&E to states other than the four largest included here.

Figure 3.8 Forecasted Space Revenues from Commercial Customers and Federal Space Expenditures in Colorado

without major NASA facilities, Colorado ranked first in total receipt of NASA funds in 1999.²⁵ Moreover, Colorado ranked third in NASA funds received by educational institutions during 1999, with more than \$68 million flowing into educational coffers. Those states ranking above Colorado in funds received by educational institutions were California [with more than \$1.5 billion] and Maryland [with \$161 million]. California's figure is exaggerated by the Federally-Funded Research and Development status of the Jet Propulsion Laboratory, which is operated for NASA by the California Institute of Technology. Figure 3.7 indicates Colorado's position among the top eight states receiving NASA funds to educational institutions [excluding California].

3.6 Colorado's Space Forecast

Colorado's space industry will experience significant growth if the industry as a whole maintains a competitive position vis-à-vis other states. CSSI premises this prediction on the anticipated continuation of historical trends, the realization of federal procurement plans, and the continuation of growth in commercial satellite services markets. The CSSI forecast of Colorado's space industry is broken into two major components: [1] revenues from commercial customers, and [2] federal space expenditures in the state. Base year space revenues from commercial customers are drawn from data supplied to CSSI by Colorado's largest space firms [see Section 3.4], while federal expenditure information is obtained from federal reporting of space procurement, awards, personnel, and facilities spending.²⁶ The federal and commercial revenue forecasts for Colorado are summarized in Figure 3.8.

1999 was the first year in which Colorado space business revenues from commercial customers exceeded federal space expenditures in the state [\$1,703 million vs. \$1,609 million, respectively]. This trend tracks that of the global industry, for which commercial revenue exceeded government expenditures for the first time in 1997.²⁷ CSSI forecasts that Colorado's overall space market will grow at a *real* [after inflation] compound annual growth rate [CAGR] of 6.5 percent through

²⁵ *NASA Acquisition Internet Service*, Online database, 2000. The states receiving the most NASA procurement funds are, in rank order: Texas, California, Maryland, Florida, Alabama, Virginia, Ohio, and Colorado. "NASA procurement" includes all awards made to businesses, educational institutions, and non-profit organizations.

²⁶ For a more thorough description of the CSSI forecast methodology, see Appendix F.

²⁷ Source: Futron Corporation proprietary data.

2010.²⁸ This growth will be driven primarily by robust revenue growth from commercial customers, which CSSI projects to increase at a real CAGR of approximately 10 percent. In contrast, CSSI projects federal expenditures to increase at a comparatively modest real CAGR of 2.4 percent.

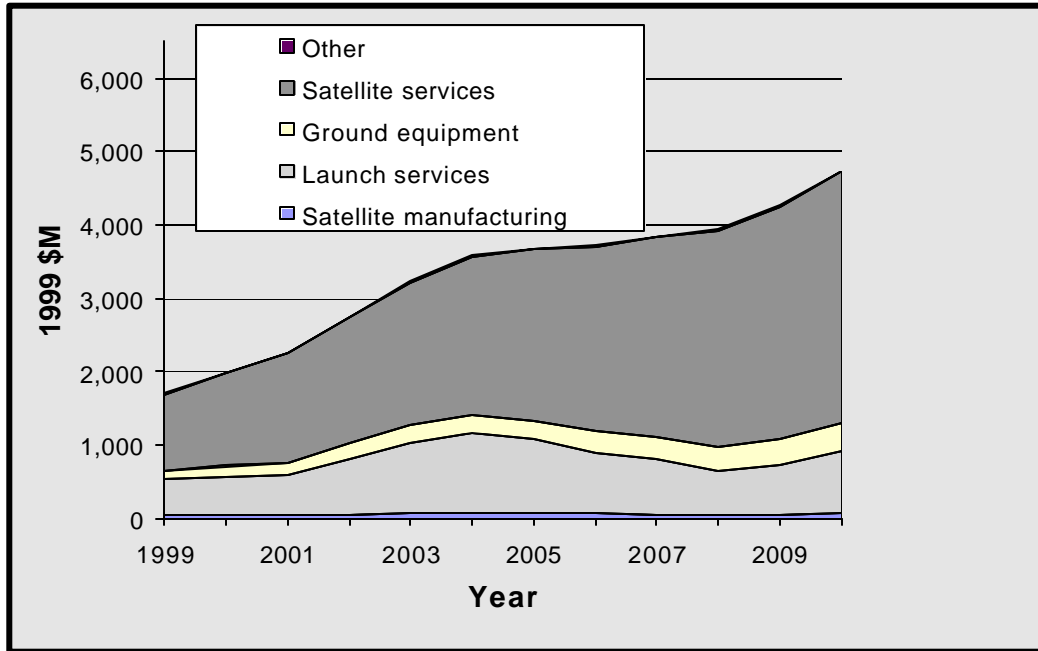


Figure 3.9 Forecasted Colorado Space Revenues from Commercial Customers by Industry Segment

Growth in revenues from commercial customers, summarized in Figure 3.9, will be led by strong initial growth in satellite services, starting at just over 21 percent real annual growth and stabilizing to single digits in the second half of the forecast period. Continued strong build-up in direct-to-home services in the United States will propel this sector forward in Colorado, building on the state's strong incumbents in the field, Echostar, and Hughes DirecTV. At over \$1 billion in 1999, revenue from the satellite services sector comprises more than half of Colorado firms' revenues from commercial customers. Following global trends [refer to Appendix D], more than three-quarters of the services sector valuation is derived from subscription and retail services versus transponder leasing.

The forecast also projects that ground equipment manufacturing will grow at a robust pace through 2010, starting off at more than 20 percent real annual growth and, following the services sector, stabilizing in mid-single digits in the second half of the

²⁸ Sources: Futron Corporation, *2000 Satellite Services Forecast* RAND Corporation, GPS SIA, *Satellite Industry Indicators 2000*, compiled by Futron Corporation for the Satellite Industry Association.

forecast period. The growth rate of the ground equipment manufacturing sector will be boosted by strong expansion in GPS user equipment, which comprised only one-fourth of the ground-equipment market in 1999, but is forecast to encompass more than 40 percent of the sector by 2010.

In contrast to the satellite services and ground equipment sectors, the forecast predicts sporadic growth for satellite manufacturing and launch services. Increasing satellite capability enables services growth without any significant increase in on-orbit satellites. Moreover, an anticipated new market for launch services—low-Earth orbit [LEO] satellite constellations—has yet to be fully realized. These two factors have combined to create a launch industry faced with deepening overcapacity and a need to consolidate operations in order to reduce costs. Despite anticipated growth through 2004, these factors may contribute to a revenue decline starting in 2005. Figure 3.9 illustrates the forecasted space revenues from commercial customers as a function of industry segments.

The forecast predicts government space expenditures in Colorado will progress at a real CAGR of 2.4 percent. These expenditures reflect a modest growth anticipated in federal space budgets and a slightly increasing share of that budget subsumed by Colorado. DoD space expenditures are by far the largest component of government space spending in Colorado, amounting to more than \$1.4 billion in 1999 alone [see Section 3.5]. NASA contributed a comparatively small \$206 million, but with heavy emphasis on university-based research.

Much of the forecasted DoD expenditures derive from space procurements. After a significant decline in federal procurement activities throughout most of the 1990s, DoD projects that the missiles and space procurement budget will level off through 2010. Moreover, defense space spending projections suggest that space is slated to take an increasingly larger share of the missiles and space procurement program over the next ten years.²⁹

Given Colorado's historic strength in obtaining space procurement dollars, DoD space procurement dollars flowing into Colorado should increase at a real CAGR of 4.2 percent throughout the forecast period, although year-to-year growth may vary. Comprising slightly under half of Colorado's \$1.4 billion in DoD space dollars in 1999, space procurement will likely overtake DoD's stagnant expenditures on personnel and base activities, with growth to more than \$1 billion [real, after inflation dollars] by 2010. These are conservative estimates of the valuation of Colorado's military space market because classified expenditures [including much of NRO procurement] are not included in the DoD published procurement data. CSSI survey results [see Section 3.4] suggest

²⁹ General Accounting Office, *Defense Acquisitions: Improvements Needed in Military Space Systems' Planning and Education*, GAO/NSIAD-00-81, May 2000.

that because Colorado firms capture a significant share of classified space spending, the actual value of DoD space

procurement to Colorado may be much larger than the figure cited here. Figure 3.10 illustrates the anticipated Colorado share of DoD missiles and space procurement.

Virtually all of Colorado's NASA dollars are the result of commercial procurement, research grants, cooperative agreements, and educational awards. As noted in Section 3.5, NASA funding in Colorado indicates the strength of

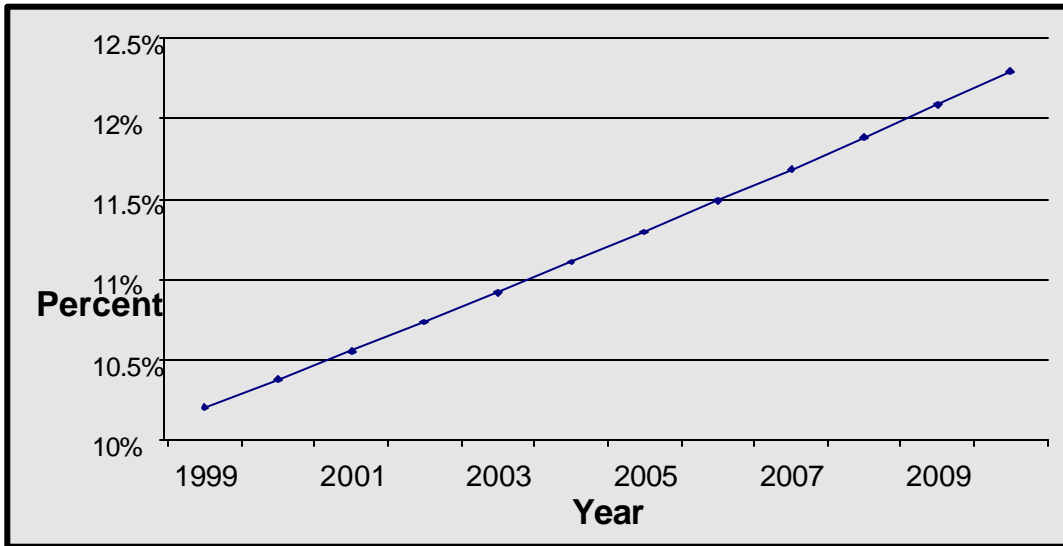


Figure 3.10 Forecasted DoD Missiles & Space Procurement in Colorado as Percentage of DoD National Missiles & Space Procurement

Colorado's university research capabilities. Despite decreasing NASA budget authority since 1997, funding to Colorado has *increased* in absolute terms, growing from 1.3 percent in 1997 to 1.5 percent in 1999 of NASA budget authority. As the International Space Station proceeds with on-orbit assembly, NASA plans to reduce construction costs while simultaneously increasing its investment in research activities. Given Colorado's historic strength in securing NASA research funds, CSSI forecasts that Colorado will capture up to 2 percent of NASA's budget authority by 2010.

Figure 3.11 details the forecasted DoD and NASA spending in Colorado and Figure 3.12 summarizes forecasted total government and commercial spending in Colorado by sector.

Colorado is well positioned to exploit the forecasted growth trends for both the government and commercial marketplace, with the state being particularly strong in the

two largest components of space revenues: satellite services and military space procurement. In addition, Colorado has a strong foothold in the smaller but rapidly developing ground equipment sector. As noted above, however, these forecasts presume Colorado maintains its competitive position vis-à-vis other states which have already indicated, by their aggressive actions, that such will not be the case unless Colorado takes proactive steps. These steps are outlined in the strategies found in Section 5. The space industry presents itself as an increasingly attractive marketplace for states shopping for new businesses. Both traditional space states and those states that can offer particularly appealing incentives [such as low labor costs and less burdensome taxation] are soliciting space start-ups and/or consolidations. Many of Colorado's major space firms already have a

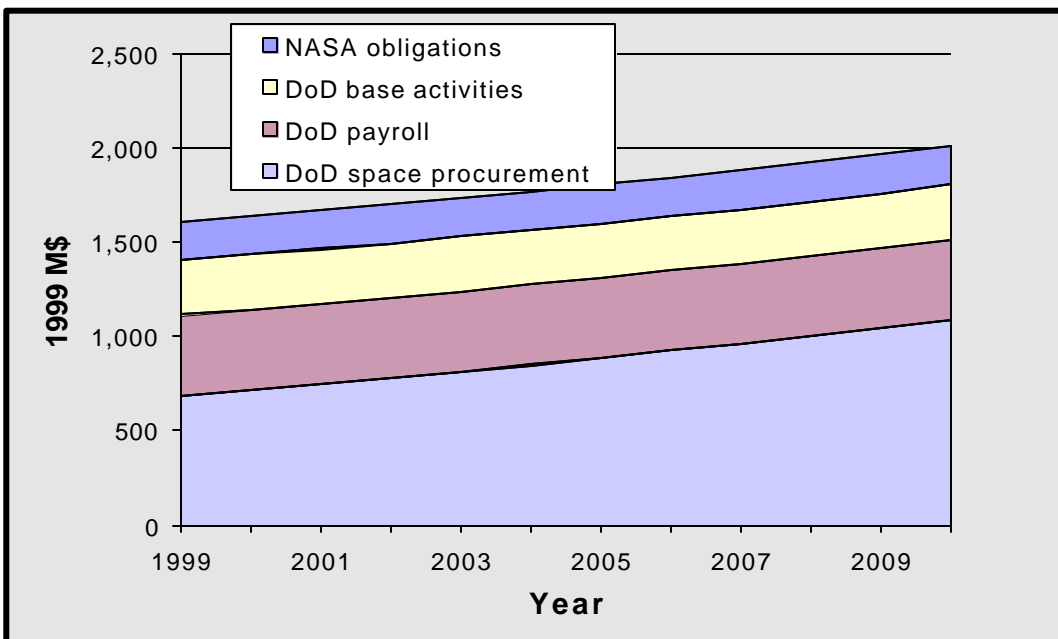
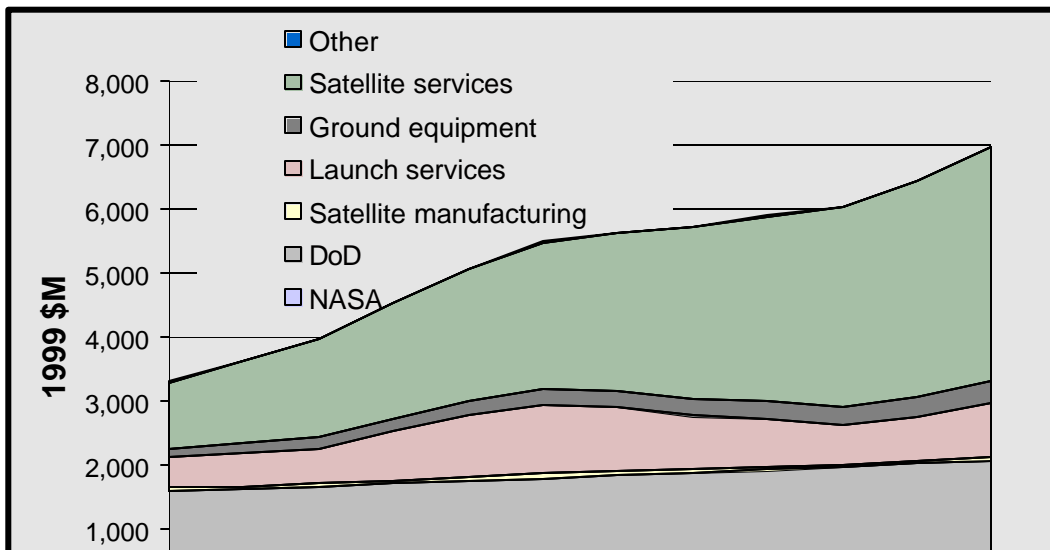


Figure 3.11 Forecasted DoD and NASA Space Spending in Colorado



**Figure 3.12 Forecasted Federal Space Spending in Colorado and
Colorado Space Revenues from Commercial Customers,
by Source and Industry Segment**

presence in competing states, such that Colorado must present advantages to these companies to ensure the industry's continued presence and expansion within the state.

Appendices H and I depict how states like Florida, California, Texas, and Virginia already have a significant advantage over Colorado in terms of government support for their space industries. In sum, Colorado must identify and advertise advantages for the space industry's continued presence and expansion within the state. As with other space states, those advantages can take the form of a new state office in support of the space industry that coordinates with state economic and technology agencies to devise business incentives, infrastructure, and workforce strategies. Sections 4 and 5 explore how Colorado can match or exceed the activities of other states by devising a strategic direction for its space industry.

4. Values, Goals, Objectives & Targets

4. Values, Goals, Objectives, and Targets

The Oversight and Technical Committee, along with members of the Space Foundation and the Study Team communicated intensively through May, June, and July of 2000 to articulate the architecture of this Colorado Space Strategic Plan. The highlights of these communications were two in-person meetings of the CSSI committees and the Study Team. On May 18, 2000, the Oversight and Technical Committees met with the Study Team to enunciate a shared value upon which this Plan would rest. At that meeting, the CSSI Team also formulated preliminary goals and objectives to support the value. These goals and objectives were refined and paired with targets and strategies to enable their fulfillment at the June 21 meeting of the Technical Committee and the Study Team [see Section 5 for a discussion of Strategies]. In coordination with the committee members, the Study Team recorded these elements, adding background detail and analysis where appropriate. This section of the Colorado Strategic Plan for Space expresses the consensus value, its underlying goals, the objectives, and the accompanying targets. Section 5 details the implementation strategies.

4.1 Value

Contribute to an increasing standard of living and a high quality of life throughout Colorado with a robust, geographically balanced, and environmentally conscious space economy.

The Colorado Strategic Plan is established upon a shared value among the CSSI participants, State administration officials, industry stakeholders, and the people of Colorado. This value reflects appreciation for Colorado's unique environmental and lifestyle offerings. As noted previously in this plan, the attributes of the space industry are distinctly well-suited to an important role in improving the standard of living and quality of life for all the people of Colorado.

4.2 Goals

The following three goals were identified by the CSSI participants and State Administration officials as supporting the above value statement:

◆ *Retain existing space businesses and strengths*

Colorado's historic strength in the space industry means that it is the fourth largest space economy in the Nation.³⁰ Space jobs comprise highly-skilled and high-income, low-environmental impact employment and constitute a core component of Colorado's high tech economy and standard of living. CSSI has identified a very real and near-term threat to this strength, in the form of increasing activity by competitor states to lure the workforce out of traditional regions and into lower-cost, higher-incentive regions. Without appropriate attention from state and local governments to counter these aggressive efforts, Colorado risks losing this valuable and historical segment of its high tech economy.

◆ *Expand existing lines of space business*

Colorado enjoys strengths in both traditional and relatively new segments of the space industry. For several decades, Colorado has hosted a strong manufacturing base for the Titan, Delta, and Atlas series of space launchers. In addition, the state has placed among the top four states receiving military space dollars during this same time period [see Section 3.5]. More recently, Colorado has become the host for new satellite services such as direct-to-home television and remote sensing. Both new and traditional segments represent key elements of a strong and robust high tech economy. National trends to consolidate space manufacturing in a relatively flat market suggest that states which do not aggressively pursue these businesses will, in fact, lose existing business to other more proactive states.³¹ Conversely, satellite services represent rapidly growing lines of business, and as such promise to employ increasing numbers of highly-skilled service sector workers at high average salaries, have minimal environmental impact, and contribute robustly to the state tax base.³²

◆ *Attract and foster new lines of space and space-related business*

The Milken Institute found that the “the pace of high-tech services’ growth is fastest in small to medium-sized metro areas that have developed a critical mass of concentration.”³³ Achieving, maintaining, and expanding critical clusters of high-tech

³⁰ See Sections 3.4 and 3.5 for a discussion of relative market size.

³¹ See Section 3.6 for a forecast of the Colorado space economy by market segment.

³² The U.S. satellite services sector promises to triple in value between 1999 and 2010, growing from just under \$10 billion to more than \$32 billion. See Sections 3.6 and Appendix F for details on the CSSI Forecast.

³³ Ross C DeVol, *America's High-Tech Economy*, Milken Institute, 1999, p. 77.

services is a continual and highly competitive process . The vitality of the Colorado space economy relies upon the health of related high-tech industries, most notably the information services/software industry. This relationship works both ways. New space-related services such as Internet-over-satellite and satellite Internet multicasting depend upon accessible infrastructure and capabilities in communications, information, and space technologies for their success. These space-related business lines garner strength in turn through the application of their assets to the challenges of the space industry.

4.3 Objectives and Targets

A series of objectives with accompanying, measurable targets underlie the goals of the Colorado Strategic Plan for Space. These targets are aligned with metrics for measuring the degree to which the targets have, or are being, achieved. This is discussed further in Section 5, which also defines strategies for achieving the stated goals and objectives. Many of the identified objectives apply to more than one goal, and vice-versa. Table 4.1 highlights the relationship between the goals, objectives, and targets that have been identified in Colorado's Strategic Plan. Goals, objectives, targets and metrics are discussed further in Section 5, particularly as they relate to the identified strategies.

Table 4.1 Relationship Between Colorado’s Strategic Plan Goals, Objectives, and Targets

	Goals ³⁴			Targets
	Retain Existing Space Businesses and Strengths	Expand Existing Lines of Space Business	Attract and Foster New Lines of Space and Space-Related Business	
Create a favorable and competitive business environment [tax and regulatory] for the space industry	✓	✓	✓	Increase space business growth to 7 percent a year, more than doubling in-state space business base in ten years.
Attract and retain skilled personnel required by Colorado’s space industry	✓	✓	✓	Increase supply of space workers so as to decrease by 50 percent the demand>supply gap in the next 5 years. Achieve a level of employment such that 50 percent of new space jobs are filled by state citizens.
Enhance Colorado’s national and international reputation as a space state		✓	✓	Achieve an increase in media references to space businesses. Integrate space into convergence corridor actions and announcements. Increase the publicized ranking among space states from #4 to #3. Increase inquiries for and movements of out-of-state space businesses into Colorado.
Increase Colorado’s space-related R&D	✓	✓	✓	Increase space R&D expenditures by 10 percent within 5 years, 20 percent within 10 years.
Recognize and exploit convergence with information technology [IT]	[✓]	[✓]	✓	Match growth rate of IT sector.
Increase Colorado’s		✓	✓	Achieve a level of

³⁴ “✓” indicates that the referenced objective supports this goal directly. “[✓]” indicates that the objective supports the goal indirectly.

share of high value added products and services			employment such that 50 percent of new space jobs are filled by state citizens.
Promote industry growth statewide	✓	✓	Achieve growth in each congressional district.

5. Strategies for Colorado

5. Strategies for Colorado

5.1 Introduction

Previous sections of this strategic plan have described Colorado’s present and future strategic position in the space industry. This section presents three initiatives for advancing the state’s position to achieve the stated goals and objectives through a number of strategies describing actions necessary to proceed from “where we are” to “where we should be”, and how to measure that progress.

⇒ **SPACE ADVOCATE INITIATIVE:**

ACTION: Create a public/private "Space Advocate Office", housed within the Governor's Office of Business Development and/or the Office of Technology and Innovation, funded for three years at the outset by a strategic partnership including the Colorado Economic Development Commission, Industry and the Governor's office.

RESULT: Led by a respected, bipartisan executive director,³⁵ also known as the Colorado Space Advocate, the Office would be responsible for advocacy, data collection [particularly as required to measure progress] and information dissemination, and overall strategy execution. The Office would be accountable to a seven member Space Strategy Steering Committee, consisting of the Secretary of Technology, Director of the Office of Business Development, the Chair of the Colorado Economic Development Commission, a representative from the Space Foundation and a representative from each of the three largest industry contributors to the effort.

³⁵ Due consideration should be given to the title this “space czar” will hold – Executive Director is used here as a placeholder. Other possibilities might include Special Assistant to the Governor, Deputy Secretary of Technology for Space, and so on.

⇒ **COLORADO TECHNOLOGY WORKFORCE THROUGH SPACE INITIATIVE:**

◆ **ACTION:** Establish a strategic partnership that includes the Colorado Space Advocate, the Space Foundation, the Colorado Department of Education, the Colorado Commission on Higher Education, the space industry, and Colorado colleges, universities and community colleges.

◆ **RESULT:** Using public enthusiasm for space and tools enabled by space activities, continuously increase the percentage of Colorado students graduating from high school or college with credentials appropriate for a technology career.

⇒ **COLORADO SPACE ECONOMY INITIATIVE:**

◆ **ACTION 1:** Establish the "Colorado Space Network" program to retain Colorado's existing space-driven economic base, obtain a growing market share of new space-driven economic opportunities, and create new space-driven enterprises [e.g., a space incubator and space-focused venture capital] in Colorado. The Network shall consist of a strategic partnership including the Colorado Space Advocate, the Colorado Congressional Delegation, the Colorado General Assembly, the Colorado Space Business Roundtable, AEA corporate members, NDIA corporate members, AFCEA corporate members, and interested chambers of commerce and economic development organizations throughout Colorado.

◆ **RESULT 1:** The network would maximize communication and collaboration among all civil, commercial and defense sectors of the Colorado space community, the Colorado state government, and the public and private members of the Colorado education community in support of all initiatives resulting from the Colorado Space Strategy.

◆ **ACTION 2:** Create a "Colorado Soars" program that will rely on space-enabling tools such as GPS, space-based Earth sciences data, and space-based telecommunications and will be driven by a strategic partnership that includes the Colorado Space Advocate, the Colorado Association of Commerce and Industry, the Colorado space industries and all Colorado Chambers of Commerce and Economic Development organizations.

◆ **RESULT 2:** The initiative will continuously improve the competitiveness, efficiency, and effectiveness of all Colorado business, education and government organizations.

Seven intertwined strategies support these initiatives in the integrated approach for implementation that follows. Serving as the basis of the Colorado Strategic Plan, the strategies were developed by the Colorado Space Strategy Initiative's Oversight and Technical Committee members while they met as Business and Workforce Working Groups. A number of the identified strategies support more than one objective, and some objectives are supported by more than one strategy. Interestingly enough, even strategies proposed separately by CSSI's Business Working Group and Workforce Working Group sometimes serve common objectives; this result is not surprising in light of the industry's need to attract a qualified workforce to support its growth. For example, the objective to "increase space-related R&D in the state" is of concern to both business and a key workforce supplier, academia. Likewise, the objective to "increase Colorado's share of high value added products and services" is supported by most strategies listed by either working group [refer to Figure 5.1]. These strategies are summarized in Figure 5.1 and detailed in the sections that follow.

Fundamental to these efforts is the establishment of a Space Advocate Office with a dual purpose: to champion the cause of the space industry in the state and to plan and oversee the implementation of the identified strategies. Florida, California, and Texas, and even states with significantly smaller space presence's than Colorado's, have space-focused agencies filling such roles. The Space Advocate Office appears to be an effective strategy that will require a budgetary outline. Given the state's multi-billion-dollar stake in continuing the robust growth of its space industry, such an initial investment is long overdue. The establishment of the Space Advocate Office should be considered imperative to the continued success and expansion of the state space industry.

In addition, the current data collection activities must be expanded within the state and county economic development offices to ensure that appropriate data exists to support the identified progress metric and to continue to understand the composition of Colorado's space industry.

Figure 5.1 and subsequent pages describe a number of business and workforce strategies that require implementation so as to achieve the CSSI goals and objectives.

5.2 Business Strategies

The four strategies identified in the following paragraphs are aimed primarily at improving the actual and perceived space business environment within Colorado. They are the result of discussions held by CSSI's Business Working Group.

Initiative	Strategy #	Strategy Description	Objective
1. Space Advocate	Business Strategy 1	Establish a Space Advocate Office within Colorado Office of Business Development.	Create a favorable and competitive business environment in Colorado for the space industry.
1. Space Advocate 3. Space Economy	Business Strategy 2	Raise Colorado's profile as a space state.	Enhance Colorado's national and international reputation as a space state.
1. Space Advocate 3. Space Economy	Business Strategy 3	Use broadband to develop statewide telecom infrastructure.	Encourage space industry growth across the state.
1. Space Advocate 3. Space Economy	Business Strategy 4	Offer a broad array of incentives appropriate for retaining and expanding Colorado's space and related industries.	Create a favorable and competitive business environment in Colorado for the space industry. Increase space-related R&D in the state.
1. Space Advocate 2. Tech. Workforce	Workforce Strategy 1	Create a program at the Colorado Institute of Technology to educate new space professionals and support space R&D.	Supply and attract an appropriately skilled personnel pool. Increase space-related R&D in the state.
1. Space Advocate 2. Tech. Workforce	Workforce Strategy 2	Create programs, using IT where possible, to boost primary and secondary space education [K-12] and train future space workers.	Attract and retain an appropriately skilled personnel pool. Recognize and exploit convergence with information technology.
1. Space Advocate 2. Tech. Workforce	Workforce Strategy 3	Establish cooperative education programs in Colorado space companies.	Supply and attract an appropriately skilled personnel pool.

Figure 5.1 Relationship of Strategies to Objectives

- **Business Strategy #1: Establish a Space Advocate Office within the Colorado Office of Business Development.**

A favorable business environment supports goals of business attraction, retention, and growth. As shown in Section 3, growth trends in space industry revenues indicate that Colorado could exceed 6 percent annual growth [8 percent in revenues from commercial customers] in 1999 dollars if state efforts result in maintaining or improving its competitive position. Using the state's unique

Summary of Strategy	
Objective	Create a favorable and competitive business environment [tax and regulatory] in Colorado for the space industry.
Target	Achieve space business growth at a real rate of 7 percent per year, doubling in-state base in ten years. Increase supply of space workers to decrease the demand-supply gap by 50 percent in the next 5 years.
Sample Actions	Implement strategic plan. Advocate and coordinate state space initiatives. Develop incubator plan with universities for new firms.
Cooperating Organizations	Governor's office Space Foundation, Colorado Space Business Roundtable, and other space organizations Universities [e.g., Colorado State University, University of Colorado, Colorado Institute of Technology] Space businesses [e.g., Lockheed, Boeing, Hughes] New state Space Advocate Office Colorado Association of Commerce and Industry Colorado Chambers of Commerce Office of Business Development Colorado Space Network Colorado Soars initiative Economic Development Commission Economic Development organizations

Figure 5.2 Overview of Business Strategy #1

strengths, weaknesses, opportunities, and threats, actions must be developed to address aggressive actions being taken by other states to increase their shares of the space economy. CSSI recommends an aggressive *real* [constant dollar] target growth rate of 7 percent that, if attained, would produce a doubling in revenues from approximately \$4 - 5 billion in 2000 to \$8 - 10 billion by 2010.

One major step in achieving such growth is to emulate the most effective strategies of other states in support of their own space industries. Several state governments already have full-time space business entities. For example, Florida has established the Spaceport Florida Authority; moreover, its development agency [Enterprise Florida] has a Director of Space Programs. Other state agencies or chartered organizations include the Texas Aerospace Commission, the New Mexico Office of Space, the Virginia Space Flight Authority, and the Alaska Aerospace Development Corporation. [See Appendix I for more detail on these organizations.] Such organizations provide long-term focus on public and private initiatives, resources, and monitoring on an industry deemed critical to their states' economic health. The amount of state investment required could well be on the order of one-hundredth of one percent of the billions of dollars in new business targeted.

The Space Advocate Office could be funded by industry, the Governor's office, and the Colorado Economic Development Commission. Led by its executive director—the Space Advocate—the Office would be responsible for advocacy, coordination, data collection and information dissemination, and overall strategy execution. The Office would be accountable to a seven-member Space Strategy Steering Committee consisting of the Executive Director of the Office of Business Development, the Chair of the Colorado Economic Development Commission, a representative from the Space Foundation, and a representative from each of the two largest industry contributors to the effort.

Creating and filling the Space Advocate position is the most important strategic action that Colorado takes to meet its space goals. The head of the Space Advocate Office should be widely respected by participants across the political spectrum and have a track record of persuading diverse groups to cooperate for the common good. Specifically, the Space Advocate will be assigned to:

- Implement the strategic plan and update it as needed [at least annually],
- Improve the space profile of Colorado worldwide while reaching out to in-state stakeholders ,
- Recommend competitive incentive packages to attract and retain business,
- Streamline regulations to ease the burden on organizations that are considered to be part of the space industry,
- Coordinate with government offices planning public infrastructure investments and establishing policies that will impact the space industry,
- Work closely with Congressional offices so as to ensure the presence of policies and programs that will support Colorado's space industry goals and objectives, and
- Develop an incubator plan with universities to encourage space related start-up business ventures.

Some of these responsibilities are detailed in other implementation strategies in this plan. If the position is created and filled in the Fall of 2000, more detailed actions should be planned by early 2001. In this age of rapidly transforming information and perspectives, every six months can see significant developments and necessitate decisive, timely actions.

The success of this strategy requires the cooperation of numerous organizations, including the Governor's Office and public space organizations in-state, as well as

Summary of Strategy	
Objective	Enhance Colorado's national and international reputation as a space state.
Target	<p>Increase media references to Colorado's space industry.</p> <p>Integrate space into convergence corridor actions and announcements.</p> <p>Raise perceived ranking among space states from #4 to #3.</p> <p>Increase the number of inquiries and movements from out-of-state companies interested in relocating to Colorado.</p>
Sample Actions	<p>Assemble a state Space Commission to mobilize resources.</p> <p>Develop and implement a marketing plan.</p> <p>Use elected officials to raise state share of federal awards.</p>
Cooperating Organizations	<p>New state Space Advocate Office</p> <p>Colorado Office of Technology, Office of Economic Development, and Public Affairs Office</p> <p>Colorado Association of Commerce and Industry</p> <p>Colorado Chambers of Commerce</p> <p>Office of Business Development</p> <p>Economic Development Commission</p> <p>Colorado Space Network</p> <p>Colorado Soars initiative</p> <p>Economic Development organizations</p> <p>Space Foundation</p> <p>Participating space businesses</p>

Figure 5.3 Overview of Business Strategy #2

space firms. While state funding would be required to maintain the office, private funding and public grants could also contribute to incubators and other initiatives facilitated by the state's Space Advocate Office. [Federal funding might be possible for projects with a perceived national benefit: federal funding has been crucial to the two-year California Space Infrastructure Program', which has led the development of a space infrastructure master plan that will also nurture that state's industry.] Additionally, universities ranging from existing state institutions to the envisioned Colorado Institute of Technology [see Workforce Strategy #1] might become key partners in incubating space business start-ups.

- ***Business Strategy #2: Raise Colorado's profile as a space state.***

As noted in previously, space is a critical infrastructure element for telecommunications services. Space activities constitute a large, growing sector already employing over 30,000 Colorado residents and indirectly account for the employment of over 100,000 personnel altogether. One of the first steps taken by Colorado's new Space Advocate Office [introduced in Business Strategy #1] must be the integration of "space" into state convergence corridor actions and announcements. Ideally, space should be recognized as another converging sector in the corridor. Generally with recognition comes government prioritization and support, not only at the state level but also the federal level.

To mobilize space resources, the Space Advocate Office should assemble an industry-government-education commission, perhaps modeled on CSSI. Here California offers a number of precedents. For example, this commission could present findings during a Colorado Space Day resembling the Governor's Aerospace Day in California. Part of this commission could be a space-related collaboration of economic development offices very much like that of California. Additionally, a series of stakeholder conferences around the state could be arranged to target investors, educators, and the general public. In the case of educators, a standing body or Space University Network could be established along the lines of the Florida Space Institute [refer to Appendix I].

In anticipation of these actions, the Space Advocate Office should draft a marketing plan that will attract space businesses to Colorado. Incentives that might be included in the plan are presented in Business Strategy #4. Improved recognition of Colorado as a space state could be measured in terms of media metrics—e.g., number of published references, or ranking of revenues among states—or number of inquiries from outside space companies interested in moving to the state. A consulting firm could work with the Space Advocate Office in creating a marketing plan. Assuming the Space Advocate position has been created and filled during Fall 2000, this marketing plan should be announced by January 1, 2001 with implementation begun by June 1.

Additionally, the marketing plan should address how state businesses can receive awards for more federal space programs. Recently Colorado has lost key opportunities—such as the Space-Based Laser to Mississippi, and Boeing’s EELV plant to Alabama—in which the State should have competitive advantages. Another key opportunity may soon arise in the consolidation of the Space and Missile Center [Los Angeles Air Force Base] with the Space Command in Colorado Springs. At the same time, command and control facilities for the Army-led National Missile Defense could also be consolidated in Colorado Springs. A close working relationship must be nurtured with the Space Command by Colorado’s elected officials, including the Governor.

The following committees, caucuses, and members of the U.S. Congress have a significant influence on the space industry and policy, and should be considered for assistance in mounting award campaigns. Names listed below the specific committees or subcommittees are of congressional representatives from Colorado serving on those entities.

Senate

Committees

1. Appropriations
Senator Ben Nighthorse Campbell
+Defense Subcommittee
+Commerce Subcommittee
Sen. Campbell
2. Armed Services
Senator Wayne Allard
+Strategic Subcommittee
Sen. Allard, Chairman
3. Banking
Sen. Allard
+International Trade Subcommittee [export issues]
4. Commerce, Science, and Transportation
+Science, Technology and Space Subcommittee
5. Intelligence [DOD, NRO programs]
Sen. Allard

Caucuses

- Senate Information Technology Caucus

House

Committees

1. Appropriations
+Defense Subcommittee
+Commerce Subcommittee
2. Armed Services
Representative Joel Hefley

- +Military Research and Development Subcommittee
Rep. Hefley
- +Military Procure Subcommittee
- 3. Commerce
Representative Diana DeGette
- 4. Science
Representative Mark Udall
 - +Subcommittee on Space and Aeronautics
Rep. Udall
 - +Subcommittee on Technology
Rep. Udall
- 5. Permanent Select Committee on Intelligence

Summary of Strategy	
Objective	Encourage space industry growth across the state.
Target	Achieve an increase in bandwidth and space business utilization off-corridor with the aid of satellite broadband. Achieve real growth in the space industry in each congressional district.
Sample Actions	Coordinate with state in dispersing enhanced bandwidth. Demonstrate satellite broadband in remote areas. Improve access to broadband via schools and libraries.
Cooperating Organizations	New state Space Advocate Office Colorado Association of Commerce and Industry Colorado Chambers of Commerce Office of Business Development Economic Development Commission Space Foundation Economic development organizations Colorado Space Network Colorado Soars initiative Proponents of managed growth Satellite and terrestrial broadband companies [e.g., Echostar, Lockheed, Qwest]

Figure 5.4 Overview of Business Strategy #3

- ***Business Strategy #3: Use broadband to develop statewide telecom infrastructure.***

Colorado's value statement asserts the importance of a balanced quality of life. Inherent to such a balance is bringing more economic opportunity to areas that are less developed and alleviating the infrastructure, environmental, and quality of life problems—like traffic congestion, rising cost of living, and crowded schools—that accompany the development now focused on the I-25 corridor. Geographic dispersion of emerging or relocating space businesses can be enabled by improved telecommunications, especially more Internet points-of-presence [POPs] and more bandwidth off of that corridor.

The state's new Space Advocate Office introduced in Business Strategy #1 should encourage this development by:

- Coordinating with the state's telecommunications planners in dispersing enhanced bandwidth through the state's Multi-Use Network initiative running fiber to county seats [see Workforce Strategy #2],
- Promoting the use of satellite broadband, starting with demonstration in a remote area
- Improving public access to high-end computer processing [e.g., at public libraries and schools],
- Stimulating new business incubators [see Business Strategy #1] leveraging dispersed broadband communications.

Private partners should include not only space entities but also information technology and telecommunications companies.

Given the fast pace of development seen in broadband communications and the hiring of a Space Advocate in Fall 2000, CSSI recommends that on January 1, 2001 a target date of June 1 be announced for demonstration of prototypes of a POP, an incubator, etc. Roll-out dates in 2002 could be set if the prototypes prove useful to space business. State and even federal [e.g., FCC] incentives should be considered for promoting broadband investment in remote POPs and last-mile access, just as rural telephone access has historically been supported by government subsidies.

- ***Business Strategy #4: Offer a broad array of incentives appropriate for retaining and expanding Colorado's space and related industries.***

Whether specific to space and related businesses or more broadly applicable, state incentives such as tax credits and other financial incentives must be available to

encourage the retention and expansion of Colorado’s space industry base. As noted in Business Strategy #1, the Space Advocate Office must plan how and when to apply these tools to needs ranging from general business growth to R&D stimulation. Other space states offer benchmarks for consideration: foreign trade zones and sales tax exemptions, for example. These are also being considered or implemented by states from New Mexico to Virginia with current or envisioned spaceports.

The most complete package of space-focused incentives has been identified in Florida. Florida’s list of financial incentives found in Figure 5.6 should be considered a menu of items for implementation by Colorado.

Incentive prerequisites can include private investment and job creation. Florida’s investment tax credit, for instance, requires a minimum investment of \$25 million and the creation of 100 jobs. Not only recipient candidates considering relocation

Summary of Strategy	
Objectives	Create a favorable and competitive business environment [tax and regulatory] in Colorado for the space and related industries. Increase space-related R&D in the state.
Target	Achieve space business growth at a real rate of 7 percent per year, resulting in the doubling of the in-state space business base in ten years. Increase space R&D by 10 percent within 5 years, 20 percent within 10 years.
Sample Actions	Evaluate potential incentives offered by other space states. Create incentives that would make a competitive impact.
Cooperating Organizations	New state Space Advocate Office Colorado Association of Commerce and Industry Colorado Chambers of Commerce Office of Business Development Economic Development Commission Space Foundation Economic Development organizations Colorado Space Network Colorado Soars initiative Participating space businesses

Figure 5.5 Overview of Business Strategy #4

but also the offering state should consider whether the incentive and investment conditions are balanced. The Space Advocate Office would need to evaluate the cost-benefit perspectives of both corporate candidates and other states competing for these candidates. Such an evaluation would require tools measure the economic impact of incentives.

If the Space Advocate position is established and filled in Fall 2000, then an initial package of incentives should be modified or created by the legislature in 2001. To develop this package the Space Advocate should work with members of the proposed Colorado Space Network and Colorado Soars initiatives.

Incentives for Space Companies	Florida
Sales Tax Full or Partial Exemption	Satellites Launch vehicles (with components and fuels) Leases of property used for space flight business Machinery & equipment used for space technology products and R&D Electricity used in aerospace manufacturing
Fuels Excise Tax Exemption	Fuel in satellites + launch vehicles
Ad Valorem Tax Exemption	Space flight hardware used for research
Investment Tax Credit	Up to 20 years equal to 5% of capital costs for facility growth
Foreign Trade Zones	Import of foreign payloads + components for test & integration
Industry Grants	Up to \$12 million for growing R&D firms or manufacturers
Infrastructure Grants	Up to \$2 million to improve access to transportation
Job Credits	Up to \$5000 per new job created, \$7500 in an Enterprise Zone
Training Grants	Workforce grants for growth companies

Figure 5.6 Florida's Financial Incentives for Space Business Development

5.3 Workforce, Education, and Training Strategies

Three workforce, education, and training strategies are identified in the following paragraphs. These strategies are aimed primarily at improving workforce skill, availability, and competitiveness for the Colorado space industry.

Workforce Strategy #1: Create a program at the Colorado Institute of Technology (CIT) to educate new space professionals and support space R&D.

Attracting and retaining a high technology workforce supports the goals of maintaining current space businesses, growing existing business lines and expanding the Colorado commercial space industry. These goals *will not* be reached without the support of a highly educated and technologically skilled workforce—preferably to be developed from in-state as well as out-of-state. As Colorado improves the quality of space education, it will also improve its reputation as a “space state.” National and international commercial space

Summary of Strategy	
Objective	Attract and develop an appropriately skilled personnel pool to satisfy the needs of the space industry. Increase space-related R&D in the state.
Target	50 percent of new space jobs filled by Colorado citizens. Increase supply of space workers so as to decrease by 50 percent the state’s shortage in the next 5 years. Increase space R&D by 10 percent within 5 years, 20 percent within 10 years.
Sample Actions	Emphasize space education in CIT curriculum. Establish a research center to attract federal space grants. Attract great faculty with distance learning technology.
Cooperating Organizations	New state Space Advocate Office Colorado Department of Education Colorado Commission on Higher Education CIT and other Colorado institutions of higher learning Space businesses [e.g., Raytheon, CSC, TRW] Governor's office

Figure 5.7 Overview of Workforce Strategy #1

businesses will increasingly recognize Colorado as a center of technologically skilled workers. This will encourage space businesses to remain in or to relocate to Colorado.

A critical step in attracting and retaining an appropriately skilled workforce is to establish a space focus at the planned Colorado Institute of Technology [CIT]. Once the CIT is created, it also may become a key partner in incubating space business start-ups [see Business Strategy #1]. The following actions should be taken to create a space focus at the CIT and to generate technologically skilled personnel:

- Emphasize space education in overall CIT curriculum, adding bachelors and advanced degrees in space studies.
- Set up a research center that will attract federal grant funds for space-related R&D. Six Colorado universities received a total of \$44.4 million from NASA in 1999 for space research, education, and graduate student finding. CIT could attract additional NASA investments in Colorado for space research.
- Seek funding and other support from firms inside and outside Colorado.
- Attract a faculty pool with a world-class reputation using distance learning technology [see also workforce strategy #2 for K-12 distance learning].
- Establish relationships with other university space programs—eventually institute a space university network [S.U.N.] for universities to share space information and resources similar to the Space Grant Consortium.

Other state governments have founded such consortiums for supporting space education. For example, the Florida Space Institute [FSI], a partnership of five Florida academic institutions, supports undergraduate, graduate, and continuing education, in partnership with the agencies and companies at Cape Canaveral. The FSI has long-distance learning programs that support existing space industry operations and link universities across the country to its programs.

Over the next five to 10 years, Colorado may measure its progress with regard to CIT by evaluating improvement in the following metrics:

- Increase enrollment by 50 percent each year for the first five years to rapidly increase the number of qualified candidates for jobs requiring high tech skills.
- Increase the percentage growth in enrollment of students in CIT engineering programs so that it is greater than the percentage of growth of enrollment in all higher education programs.

- Reduce outflow and increase inflow of high tech workers from and to Colorado, so that more personnel are coming into Colorado than leaving it.

The CIT is being created as an initiative of the Governor’s office. Ideally, the kick-off of the CIT will be announced at the Governor’s State-of-the-State address in January 2001. Colorado should strive to have targeted endowment for the CIT programs by June 2001 and should begin marketing and recruitment for students and faculty campaigns by January 2002.

Currently, some CIT funding exists, but much more is needed. Cooperating organizations could comprise Colorado commercial space firms, the Colorado Economic Development Commission, and state universities. The Space Foundation will support this effort and assist in promoting space education at the CIT. In order to maximize the potential of the CIT, business-university partnerships are fundamental from both a financial stand-point and from the perspective of educational content for future students.

Summary of Strategy	
Objectives	Supply and attract an appropriately skilled personnel pool. Recognize and exploit convergence with the information technology industry.
Targets	50 percent of new space jobs filled by Colorado citizens. Increase supply of space workers so as to decrease by 50 percent the demand>supply gap in next 5 years. Match growth rate of information technology sector.
Sample Actions	Increase K-12 space curriculum requirements. Obtain funding to develop site-selected Challenger centers. Improve distance learning, information kiosks, etc.
Cooperating Organizations	New state Space Advocate Office Colorado Department of Education Colorado Commission on Higher Education CIT and other Colorado institutions of higher learning Economic Development Commission Challenger Middle School

Denver Middle School
Hughes DirecTV
Echostar

Figure 5.8 Overview of Workforce Strategy #2

- ***Workforce Strategy #2: Create programs to boost primary and secondary space education and train future space workers.***

Supplying a high technology workforce and exploiting the convergence of space with information technology support the goals of the CSSI plan. To meet the targets identified in Figure 5.8, an aggressive K-12 space education program must be implemented to provide an education base for the Colorado workforce. Drawing on a more diverse population, the high technology workforce needs to be created from the bottom up. That is, Colorado must focus on the education of the children in the state so that they grow up to be the future workforce.

Other states, such as California, have implementation strategies that develop K-12 educational programs to ensure that students will have the necessary interest in and skills for space jobs. These programs include: a one-day space orientation conference to include space education lessons provided to teachers through in-services; support/coordination program ensuring that 100 California educators per year experience the Space Foundation's "Teaching with Space" in-services; space education and enrichment forums; and incorporation of space education into the performance guidelines in California education. Examples of space education programs available include Journey into Space, NASA Classroom of the Future, Space Educator's Handbook, and the Virtual Astronaut.

Therefore, an important step toward educating the Colorado workforce is boosting the primary and secondary space education. Taxpayers want to invest in their children, particularly when the children can later compete for Colorado's higher-paying jobs that require high tech skills. Space education must begin at an early age to develop an interest in space and to nurture the development of technical skills. Increasingly, technology is woven into American classrooms, with today's children learning high tech skills at a very young age. Colorado should take advantage of existing resources to bring technology into the classrooms. The state should make the most of its opportunity to elevate the level and intensity of space education in Colorado.

The following actions should be taken to improve K-12 space education in Colorado:

- Increase requirements of the overall K-12 space curriculum to focus on the development of quantitative skills; create educational programs that focus on producing information engineers, scientists, and technicians.
- Ensure that the two Challenger centers that have been site-approved are implemented.
- Persuade NASA to back creation in Colorado a Space Camp similar to those in Alabama, California, and Florida.
- Develop the distance learning programming initiative to enhance space education; use CIT as a hub and as a product warehouse.
- Promote the distance learning initiative by establishing related requirements in space education.
- Create information kiosks in schools and libraries for greater public access with greater bandwidth, to benefit from the increased information flow [see Business Strategy #3].

For many of these items, coordination will be required with the state's Multi-Use Network initiative that will extend fiber links to county seats.

The "Information Science and Engineering" curriculum should be added to the state's Educational Strategy by year-end 2001 and implemented in the 2002 school year. The remainder of this strategy should have the same timing goals as those

Summary of Strategy	
Objective	Attract and provide an appropriately skilled personnel pool for employment by the space industry.
Targets	50 percent of new space jobs filled by Colorado citizens. Increase supply of space workers so as to decrease by 50 percent the demand > supply gap in next 5 years.
Strategies	Solicit support from firms and schools for co-op program. Establish guidelines. Execute a pilot program.
Co-operating Organizations	New state Space Advocate Office Colorado Department of Education Colorado Commission on Higher Education CIT and other Colorado institutions of higher learning Colorado space firms [e.g., Lockheed, Boeing, Ball]

Figure 5.9 Overview of Workforce Strategy #3

for CIT, since much of the content for distance learning is dependent on the creation of that institution, discussed in Workforce Strategy #1.

The state government should provide each Challenger center with \$1 million. Other funding [each center requires an additional \$19 million] will have to be culled from other cooperating organizations, such as Colorado commercial space firms and the Colorado Economic Development Commission. The Challenger Foundation has been created to support major fundraising efforts. For the distance learning initiative, Colorado should offer tax incentives in exchange for bandwidth [see Business Strategy #4]. As such, programming would be free for in-state customers and out-of-state customers would receive programming for pay-per-view. This incentive could potentially generate significant revenue for the state as distance learning can reach from coast-to-coast and internationally.

- ***Workforce Strategy #3: Establish cooperative education programs at major Colorado space firms.***

Establishing a co-op program supports Colorado's goals of maintaining current space businesses and expanding the commercial space industry by building an educated and technologically skilled workforce. The success of the Colorado strategic plan for industry relies heavily on the creation of mutually beneficial partnerships with state universities and vocational schools. All of the organizations involved in the co-op program will benefit from the resources of the other partners. [See Business Strategy #1.]

Some states have established organizations to foster relationships between the space industry and educational institutions. For example, the Florida Space Research Institute [FSRI] is designated as an industry-driven center for research and education. FSRI offers universities the opportunity to work with industry to further develop their expertise and commercialize their findings through industry channels.

A co-op program is a low-cost strategy for cultivating partnerships with significant benefits to both universities and vocational schools on the one hand, and businesses on the other. It reduces hiring and training costs for businesses and it may reduce the rate of turnover of new employees. A co-op program also allows students to acquire hands-on experience, in which they apply what they have learned in the classroom. Practical experience will make graduates more employable. [Additionally, Colorado may wish to extend this program to junior and senior high school students.] Colorado should take the following steps to institute a co-op program:

- Form a working group with representatives from commercial space firms, space organizations, vocational schools, and universities.

- Solicit participating firms, vocational schools, and universities [both undergraduate and graduate programs].
- Establish guidelines for co-op program [e.g. duration and schedule of student co-ops, course requirements, and type of work to be performed by co-op students].
- Execute a pilot co-op program to gain experience at a university and a vocational school, and eventually grow the program to all universities and vocational schools.

If the baseline working groups are formed by December 2000, Colorado could plan to initiate the pilot co-op program in the 2001 school year and rollout in subsequent years.

Over the next five to 10 years, Colorado may measure its progress in instituting a co-op program based upon the following metrics:

- Existence of co-op programs at all major Colorado universities.
- Twenty-five percent of university students graduate with co-op experience.
- One-third of Colorado space organizations participate in co-op program [50 percent of industry value].
- Retention of co-op students in Colorado workforce greater than retention of graduates that did not co-op.

The primary incentive for space firms to sponsor students is to reduce employee turnover as well as hiring and training costs. For this reason, firms might cover not only student wages but also a significant portion of co-op administrative costs

6. Summary

6. Summary

The **high tech space industry** is, and can continue to be, an important part of Colorado's knowledge-based industry. **In Colorado, the space industry currently provides directly for nearly 38,000 jobs and indirectly for an additional 75,000 jobs.** The "space industry" includes the manufacture, assembly, test and operation of launch vehicles and satellites and related infrastructure, and makes possible an ever increasing range of consumer and business services including telecommunications management, fishing, transportation, environmental and land use management, telemedicine, and many more. . Indeed the "new" information economy itself depends upon space-based infrastructure and value added space-based or space derived technologies where Colorado companies are well positioned.

The Colorado Space Strategy Initiative [CSSI] was implemented as authorized by Executive Order of the Governor to develop a strategy for the State's space economy that would "retain and expand Colorado's preeminence in space activities within the next decade." The objective of this Initiative has been accomplished with the delivery of this *Colorado Strategic Plan for Space*, the successful completion of which required and embraced statewide participation of public and private organizations and individuals. *The Strategic Plan treats space as an all-Colorado opportunity.*

Why Focus on Space?

The space industry, because it provides the basic infrastructure upon which many services are built, and because of its high technology content which creates the opportunity for new business development, has become an important component in global economics and provides a significant number of jobs in the U.S. and in Colorado. **In 1999, the space industry generated direct [world] revenues of approximately \$68 billion. This is expected to increase to \$199 billion by 2010, nearly tripling over the next 10 years – an average annual growth rate in excess of 10 percent per year. Current Colorado space industry revenue and government expenditures are expected to increase from \$3.3 billion to nearly \$7 billion by the year 2010.** This corresponds to an average **growth rate in excess of 6 percent per year.** This forecast is based upon Colorado taking the necessary actions to counter the aggressive actions of a number of states including California, Florida, Texas, and Alaska. Aggressive actions by Colorado could lead to increased market share which would result in even greater growth than forecast for Colorado's space industry.

Colorado's space industry currently generates approximately 38,000 jobs which indirectly create an additional 75,000 jobs in the State; this total of 113,000 jobs can be expected to increase to a total of 232,000 jobs by 2010. Colorado's space activities are intellectually rich, software and services intensive, environmentally friendly and comprise skills and workers synergistic with other high-tech industries and initiatives within the State. Colorado is also home to a significant DoD space infrastructure which provides a stable employment base and acts as a magnet for industry.

The State of Colorado and various economic development initiatives and organizations have not yet focused on the vast importance of Colorado's space industry.³⁶ For example, the recently released Convergence Corridor Report³⁷ omitted the space industry from its "high technology" industry group; singled out for consideration were high tech manufacturing; communication services, and software and computer services; biomedical products and devices; computer storage and peripherals, software for telecommunications infrastructure, and equipment for telecommunications infrastructure. These four "convergent" industries combined could provide "as many as 117,000 jobs...by 2020;" the space industry alone is expected to provide 76,000 [direct] jobs by 2010 [a decade sooner] and is likely to continue its significant growth into the following decade.

Colorado in Space

Colorado is rich in space technology, research and applications. Within its borders are many of the leading laboratories, installations and companies that use space for national security, probing the mysteries of the universe and taking advantage of the space infrastructure for applications that benefit all peoples of the world. Many of the most outstanding space scientists and engineers have selected Colorado as their home state. Research facilities have been established in Boulder, Denver, Fort Collins, and Colorado Springs to carry out leading edge projects in astronomy, astrophysics, atmospheric physics, propulsion and remote sensing. Technology centers are located in Denver, Boulder, Pueblo and Colorado Springs. Colorado is one of the leading states for the production and assembly of launch vehicles, with manufacturing facilities located in Denver and Pueblo. The three largest U.S. and most capable expendable launch systems are all manufactured or assembled in the State: Titan, Atlas and Delta.

There are more than 100 companies in the state of Colorado which provide materials, equipment, software and services for the space infrastructure and to

³⁶ As of this writing, neither the Colorado Institute of Technology [CIT] nor the "convergence corridor" initiatives discuss or address the space industry.

³⁷ **The Convergence Corridor**, prepared by Development Research Partners for InterMountain/RKH in support of Metro Denver Network Tech Vision, Denver Metro Chamber of Commerce, January 2000.

end users of space applications. There are also several military organizations in the state of Colorado which provide national security functions using space assets and the space infrastructure. Several universities are involved in space related research and technology projects.

Colorado is well positioned to maintain and increase its market share of space related activities and investments. The space industry is high-tech and its magnitude is large in the context of the Convergence Corridor – including and integrating the space segment within this initiative could bear significant economic fruit for the State.

Colorado's Strategic Initiatives

Colorado's economy is increasingly knowledge and idea-based, driven by the ability of firms to innovate and develop new products and processes. Colorado's space industry plays a major role in this type of economy by providing both a strong base for continued expansion as well as providing an infrastructure and knowledge base upon which new industry can build.

This strategic plan was developed to maintain and expand Colorado's space industry, thereby continuing the expansion of the State's economy while maintaining the highly valued quality of life. As an essential means of safeguarding this highly valued quality of life, Colorado must **retain and grow** its space and related industries. This strategic plan provides the strategies, tactics and baseline information about the space industry and space economy to enable the State to do so.

The Colorado Strategic Plan is premised upon a shared value amongst the individual members of the CSSI Oversight Committee, Technical Committee, State Administration officials, and the people of Colorado. This value, to *contribute to an increasing standard of living and a high quality of life throughout Colorado with a robust, geographically balanced, and environmentally conscious space economy*, is the extension to the space industry of a widely articulated appreciation for Colorado's unique environmental and lifestyle offerings. The goals of the plan are to:

- ⇒ *Retain existing space business and government activities,*
- ⇒ *Expand existing space business lines and government activities,*
- ⇒ *Attract and foster new space and space-related business and government activities.*

A number of strategies for achieving these goals were developed by the Colorado Space Strategy Initiative's Oversight and Technical Committee members and serve as

the basis of this Strategic Plan,. The identified strategies, including the metrics for measuring the degree to which the goals have been achieved, are intertwined and require an integrated approach for their implementation. As a result, the following three specific initiatives, which encompass the developed strategies, have been identified and appropriate actions should be taken to ensure their implementation:

⇒ **SPACE ADVOCATE INITIATIVE:**

ACTION: Create a public/private "Space Advocate Office", housed within the Governor's Office of Business Development and/or the Office of Technology and Innovation, funded for three years at the outset by a strategic partnership including the Colorado Economic Development Commission, Industry and the Governor's office.

RESULT: Led by a respected, bipartisan executive director,³⁸ also known as the Colorado Space Advocate, the Office would be responsible for advocacy, data collection [particularly as required to measure progress] and information dissemination, and overall strategy execution. The Office would be accountable to a seven member Space Strategy Steering Committee, consisting of the Secretary of Technology, Director of the Office of Business Development, the Chair of the Colorado Economic Development Commission, a representative from the Space Foundation and a representative from each of the three largest industry contributors to the effort.

⇒ **COLORADO TECHNOLOGY WORKFORCE THROUGH SPACE INITIATIVE:**

◆ **ACTION:** Establish a strategic partnership that includes the Colorado Space Advocate, the Space Foundation, the Colorado Department of Education, the Colorado Commission on Higher Education, the space industry, and Colorado colleges, universities and community colleges.

◆ **RESULT:** Using public enthusiasm for space and tools enabled by space activities, continuously increase the percentage of Colorado students graduating from high school or college with credentials appropriate for a technology career.

⇒ **COLORADO SPACE ECONOMY INITIATIVE:**

³⁸ Due consideration should be given to the title this "space czar" will hold – Executive Director is used here as a placeholder. Other possibilities might include Special Assistant to the Governor, Deputy Secretary of Technology for Space, and so on.

- ◆ **ACTION 1:** Establish the "Colorado Space Network" program to retain Colorado's existing space-driven economic base, obtain a growing market share of new space-driven economic opportunities, and create new space-driven enterprises [e.g., a space incubator and space-focused venture capital] in Colorado. The Network shall consist of a strategic partnership including the Colorado Space Advocate, the Colorado Congressional Delegation, the Colorado General Assembly, the Colorado Space Business Roundtable, AEA corporate members, NDIA corporate members, AFCEA corporate members, and interested chambers of commerce and economic development organizations throughout Colorado.
- ◆ **RESULT 1:** The network would maximize communication and collaboration among all civil, commercial and defense sectors of the Colorado space community, the Colorado state government, and the public and private members of the Colorado education community in support of all initiatives resulting from the Colorado Space Strategy.
- ◆ **ACTION 2:** Create a "Colorado Soars" program that will rely on space-enabling tools such as GPS, space-based Earth sciences data, and space-based telecommunications and will be driven by a strategic partnership that includes the Colorado Space Advocate, the Colorado Association of Commerce and Industry, the Colorado space industries and all Colorado Chambers of Commerce and Economic Development organizations.
- ◆ **RESULT 2:** The initiative will continuously improve the competitiveness, efficiency, and effectiveness of all Colorado business, education and government organizations.

A number of specific strategies have been identified in support of these initiatives. They include:

⇒ **Establishment of a Space Advocate Office within the Colorado Office of Business Development** funded by industry, the Governor's office, and the Colorado Economic Development Commission. The objective is to create a favorable and competitive business environment in Colorado for the space industry. This would be accomplished by initiating a number of actions including overseeing the implementation of the strategic plan, advocating and coordinating State space initiatives, improving the space profile of Colorado worldwide, recommending a competitive incentive package to attract and retain business, coordinating with government offices planning public infrastructure investments and establishing policies that will impact the space industry, working closely with Congressional offices so as to ensure the presence of policies and programs that will support

Colorado's space industry goals and objectives, and developing an incubator plan with universities to encourage space related start-up business ventures.

- ⇒ **Raising Colorado's profile as a space state.** The objective is to enhance Colorado's national and international reputation as a space state thereby increasing government and business awareness of the attractiveness of Colorado for space infrastructure and business location. This would be accomplished by initiating a number of actions including assembling a state Space Commission to mobilize and coordinate resources, developing and implementing a marketing plan, and utilizing elected officials to raise the State's share of federal awards and to interact with industry executives so as to increase the likelihood of business retention and new business location.
- ⇒ **Utilizing broadband communications to develop statewide telecom infrastructure.** The objective is to encourage space industry growth across the state by providing and promoting the use of satellite broadband communications. This would be accomplished by initiating a number of actions including providing a demonstration in a remote area of the use of satellite broadband communications, improving public access to high-end computer processing, and stimulating new business incubators by leveraging dispersed broadband communications.
- ⇒ **Offering a broad array of incentives appropriate for retaining and expanding Colorado's space and related industries.** The objective is to create a favorable and competitive business environment in Colorado for the space and related industries and to increase space-related R&D in the state. This would be accomplished by evaluating incentives offered by other space states and recommending the creation of incentives for Colorado that would maintain and enhance the competitiveness of Colorado's space and related industries.
- ⇒ **Creating a program at the Colorado Institute of Technology [CIT] to educate new space professionals and support space R&D.** The objective is to attract and develop an appropriately skilled personnel pool to satisfy the needs of the space industry. This would be accomplished primarily by creating a space focus at the Colorado Institute of Technology, and setting up a research center that will attract federal grant funds for space-related R&D.
- ⇒ **Creating programs to boost primary and secondary school space education and training future space workers.** The objective is to supply and attract an appropriately skilled personnel pool for the space and related industries. This would be accomplished by placing an increased emphasis on space curriculum requirements in K-12, obtaining funding to develop site-selected Challenger centers, and improving distance learning.
- ⇒ **Establishing cooperative education programs at major Colorado space firms.** The objective is attract and provide an appropriately skilled personnel pool for employment by the space industry. This would be accomplished by establishing co-op program guidelines, soliciting support from firms and schools for co-op programs, and executing a pilot program.

Conclusions

The space and related industries are an important and desirable part of the expanding Colorado economy.

Recognition of the importance of Colorado's space sector, coupled with a statewide commitment of policy and economic support, can maintain and attract new jobs and revenues for Colorado communities. However, Colorado is in competition with other states that have already initiated aggressive actions to attract the space industry. As a result, Colorado will see an erosion of its space industry base and consequent adverse impacts on the State's economy, unless it undertakes appropriate proactive and responsive measures.

Colorado houses the infrastructure, technology, skill, university and research base upon which it can build to expand its current space industry and attract new industry and government establishments.

Workforce availability, financial competitiveness, and infrastructure availability are key factors in industry decisions concerned with business location. The Colorado Strategic Plan identifies a set of initiatives and supporting strategies that are aimed specifically at these key factors.

In addition, the Colorado Strategic Plan recognizes the importance of federal government [DoD, NASA, and others] organizations and facilities to Colorado's economy and presents an initiative that aims to maintain and expand federal government expenditures in Colorado.

Fundamental to the Strategic Plan is the establishment of a space advocate position, if not an authority, to champion the cause of the space industry in the State as well as plan and oversee the implementation of the identified initiatives and strategies. Not only Florida, California, and Texas, but also states with significantly smaller space presence than Colorado's have space-supported entities filling such roles. Given the multi-billion-dollar stakes the state has in continuing its space industry's robust growth, such a starting investment is overdue.

Not taking the actions identified in this Strategic Plan will most likely have a significant adverse impact on Colorado's space and related industries and, consequently, the overall economy of Colorado.