An Initial Assessment:

Creating an Arizona Aerospace Institute

Prepared for **Arizona State University**

Prepared by **TheGoldGroup, LLC**
Cherry Hill, NJ & Phoenix, AZ

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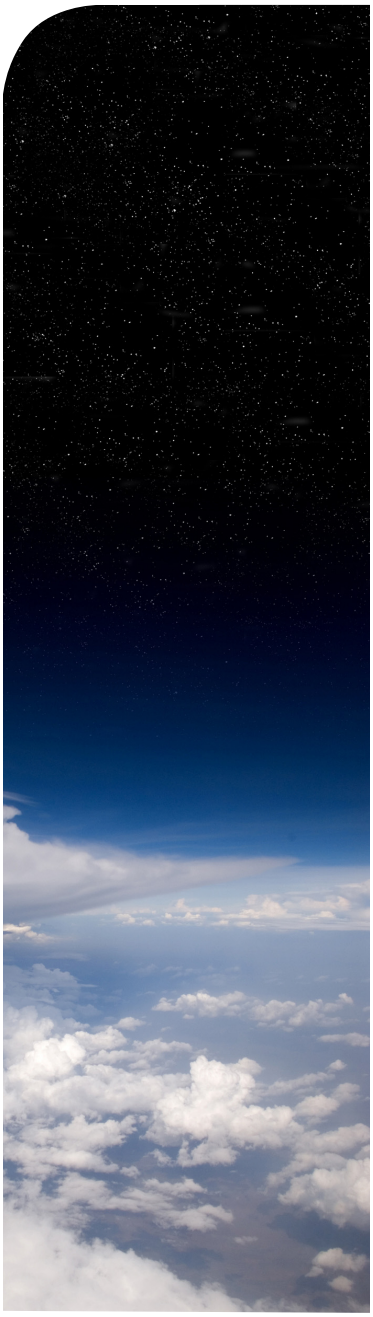

This report was produced by TheGoldGroup, LLC., under contract with Arizona State University, to provide an independent assessment of the interest, need, and viability for creating an Arizona Aerospace Institute. The report was funded by Science Foundation Arizona. Peter Gold, Esq., report author and principal member of TheGoldGroup, LLC., engaged with more than 70 potential stakeholders from industry, government, academia and other sectors to determine enthusiasm for the concept, as well as to help inform the report's outline of a possible operational focus and organizational framework for the Institute. Other efforts included the thorough examination of aerospace industry-related studies and assessments, as well as discussions with individuals in similar or related institutes outside of Arizona. This report reflects the analysis and opinions of the author and should not be construed to be an endorsement of any of the expressed ideas and statements by Arizona State University, Science Foundation Arizona, other organizations, or individuals interviewed by Peter Gold.

Peter A. Gold, Esq.

TheGoldGroup, LLC.

Cherry Hill, N.J. & Phoenix, Az.

856.795.9994
pagold@thegoldgrp.com

CONTENTS

	Executive Summary	**4**
I.	**Why An Aerospace Institute In Arizona? The Imperative**	**6**
	Competitive and Economic Factors Require Greater Collaborative Engagement	6
II.	**Scope of Engagement and Tasks as They Evolved**	**9**
III.	**Methodology and Process: Drivers and Focus Factors**	**11**
	The Drivers of The Institute	11
	Accumulate and Analyze Data and Information	11
	Reports, Publications, and Other Materials Reviewed and Analyzed	12
IV.	**Focus Options for The Institute**	**13**
	A Threshold Choice	14
	Initial Core Competencies of the Arizona Aerospace Institute	14
	Machine to Machine	15
	Machine to Human Interactions	16
	Visioning, Simulation and Modeling	16
	Information Assurance and Management	17
	Value-Added Services and Functions	17
V.	**Unique Opportunities, Partnerships and Strategic Alliances Which Can Be Created by the Institute**	**19**
	Workforce Development Opportunities	19
	Traditional Partners and Interested Persons	20
	Non-Traditional Partners and Interested Persons	20
VI.	**Structure and Governance**	**22**
VII.	**A "Virtual" State-Wide Institute at ASU, Mesa, Arizona**	**23**
VIII.	**Possible Economic Development Impacts of the Institute**	**25**
IX.	**Commitment to the Institute: Sustainability and Public and Private Investment**	**26**
X.	**Next Steps – Beyond this Initial Analysis**	**27**

EXHIBITS

Exhibit A, Statement of Mayo Clinic in Arizona	**28**
Exhibit B, Statement of Embry-Riddle Aeronautical University	**29**
Exhibit C, Statement of Seidman Institute, ASU	**31**

EXECUTIVE SUMMARY

The Need for the Institute: Competitive and Economic Factors Require Greater Collaborative Engagement: According to a recently released report, Arizona is ranked 8th in the United States in aviation and aerospace industry employment and is 4th in the Nation in employment per 1,000 full-time workers.[1] According to the same source, aerospace industry jobs pay 52% higher salaries than Arizona's average wage. Statistics indicate that the aerospace industry is either the 3rd, 4th or 5th largest employing sector in the State (depending how measured).

The availability of a qualified workforce and workforce development is a critical issue facing the aerospace and defense industry in Arizona and elsewhere in the U.S. The industry in the U.S. is exposed to being scissored by the two prong threats of record number of retirements and too few replacements in the "pipeline".

Competition from governments of other countries and companies based abroad as well as economic challenges to the industry are also factors operating on the U.S. based aerospace industry.

The continued vitality of aerospace and aviation in Arizona is critical to the state's economy and affects, directly or indirectly, almost every Arizonan regardless where he or she lives in the state.

State officials, business stakeholders and others with whom we spoke recognize these facts and many recognize the urgency of providing vehicles and infrastructures to:

a) promote retention and expansion of the in-state aerospace industry; and

b) attract into the state other aerospace industry-related economic activity (and the attendant high paying jobs).

An Aerospace Institute that focuses on select high value services, which meet the needs of and build on the vast competence of both in state and out of state aerospace industry stakeholders, would undoubtedly be an important vehicle to protect and grow this critical and diverse industry in Arizona.

An Institute could also have significant economic development impacts. Based on various assumptions, economists from the Arizona State University L. William Seidman Research Institute opine that it is possible that once fully operational the Institute could contribute $72 million in earnings and 1,320 jobs to Arizona's economy.

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[1] *AZ Aerospace, Defense, and Avionics Industries Study*. Charlottesville, VA: ANGLE Technology Group, 2008. p.5.

Initial Core Competencies of the Institute: We accumulated and analyzed data and information from 77 people in 42 different and diverse organizations and located in nine states, Washington, D.C. and England. We reviewed industry trends and concerns as well as the resources and strengths already present in Arizona and listened to the articulated specific needs of stakeholders. From this initial analysis we suggest that the Institute focus in three core competencies:

1) Machine to machine and human to machine interactions and integration;
2) Information management and information assurance; and
3) Visioning, Simulation, and Modeling, both as a core competency of the Institute and as a tool used in 1) and 2) above (the other two core competencies of the Institute).

Value-Added Services of the Institute: The Institute is also envisioned to provide additional value by deploying its expertise in standard setting, policy making, developing curriculum, establishing best practices and providing certification services. It could also provide assistance with preparation of contract proposals, contract management services and be a source of proposal collaborations. As a boost to business development and job creation it can also maintain a business incubator facility and be a facilitator in matching businesses with government in order to optimize utilization of Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs.

Non-Traditional Partners and Interested Persons: In addition to focusing on "traditional" large, medium and small aerospace businesses and university research and education organizations as partners, the Institute's non-traditional partners could include: Out-of-state institutes, aerospace insurers, standard setting organizations and those which certify to standards, economic development interests, trade associations, and venture capital and angel investment interests.

A "Virtual "501 (c) (3) Institute located at ASU, Mesa Arizona: With a footprint in Mesa, the Institute is envisioned as virtual in functions and access. The existence of Phoenix-Mesa Gateway Airport, ASU Polytechnic campus, Mesa's relatively close proximity to Sky Harbor International Airport, the fact that it is equidistance from Prescott and Tucson; the existence of the Air Force Research Lab (AFRL) human talent pool and simulators, the availability of space and the actual and planned development of residences, convention and hotel facilities were all factors considered. in recommending that the Institute be located in Mesa. In our judgment, locating the Institute in Mesa would be tantamount to placing infrastructure around, capitalizing on and leveraging strong aerospace assets already on the ground. The Institute infrastructure would, likewise, bolster and advance these diverse activities.

Financial Sustainability and Public Commitment: The core competencies of the Institute and the value added services were selected, in part, because they hold the potential for revenue generation to assist in sustaining the Institute. There is no doubt, however, that Phase II of this initiative (e.g. writing an Implementation Study and Roadmap, etc.), and that the initial funding for capital and operational needs will require a commitment of public dollars or creative economic incentives. Other states, including some of Arizona's neighbors, are vigorously competing for aerospace companies and their jobs.

I. WHY AN AEROSPACE INSTITUTE IN ARIZONA? THE IMPERATIVE.

Competitive and Economic Factors Require Greater Collaborative Engagement

Arizona is ranked 8th in the United States in aviation and aerospace industry employment and is 4th in the Nation in employment per 1,000 full-time workers.[2] According to the same Report, aerospace industry jobs pay 52% higher salaries than Arizona's average wage. Statistics indicate that the aerospace industry is either the 3rd, 4th or 5th largest employing sector in the State (depending how measured).

Using Bureau of Labor Statistics, US Census Bureau and NASA data, the 2008 report prepared for the Arizona Aerospace & Defense Commission provides the following "Snapshot" of the Industry in Arizona:[3]

Employment	57,177
Total Wages ($million)	$3,834
Average Wage	$67,065
Avg. AZ wage	$38,154

Thus, aerospace industry employers pay and aerospace industry workers earn substantially more than the average Arizona wage. Some of these employers include: Raytheon, Northrop Grumman, Boeing, Honeywell, Lockheed Martin, General Dynamics, Orbital Sciences Corporation, Bombardier, Sergeant Controls, U.S. Airways, Southwest Airlines, Goodrich, AmSafe, ASIG, MD Helicopters, L-3, Mesa Air Group and others.

According to another report there are approximately 45,000 additional jobs related to the principal military operations in the State, not including military and civilian retirees.[4] Several of these military installations are directly or indirectly related to aerospace, aviation and avionics. The principal military operations located in Arizona have been identified as: Davis-Monthan Air Force Base, Fort Huachuca, Luke Air Force Base, Yuma Proving Ground, Marine Corp. Air Station-Yuma, Air National Guard's 161 Air Refueling Wing and 162nd Fighter Wing, Army National Guard-Papago Park and Western Army National Guard Aviation Training Site-Silverbell.

These aerospace and defense industry stakeholders are geographically dispersed throughout Arizona (see map on page 7) and thus their continued economic well being affects several counties and many communities.

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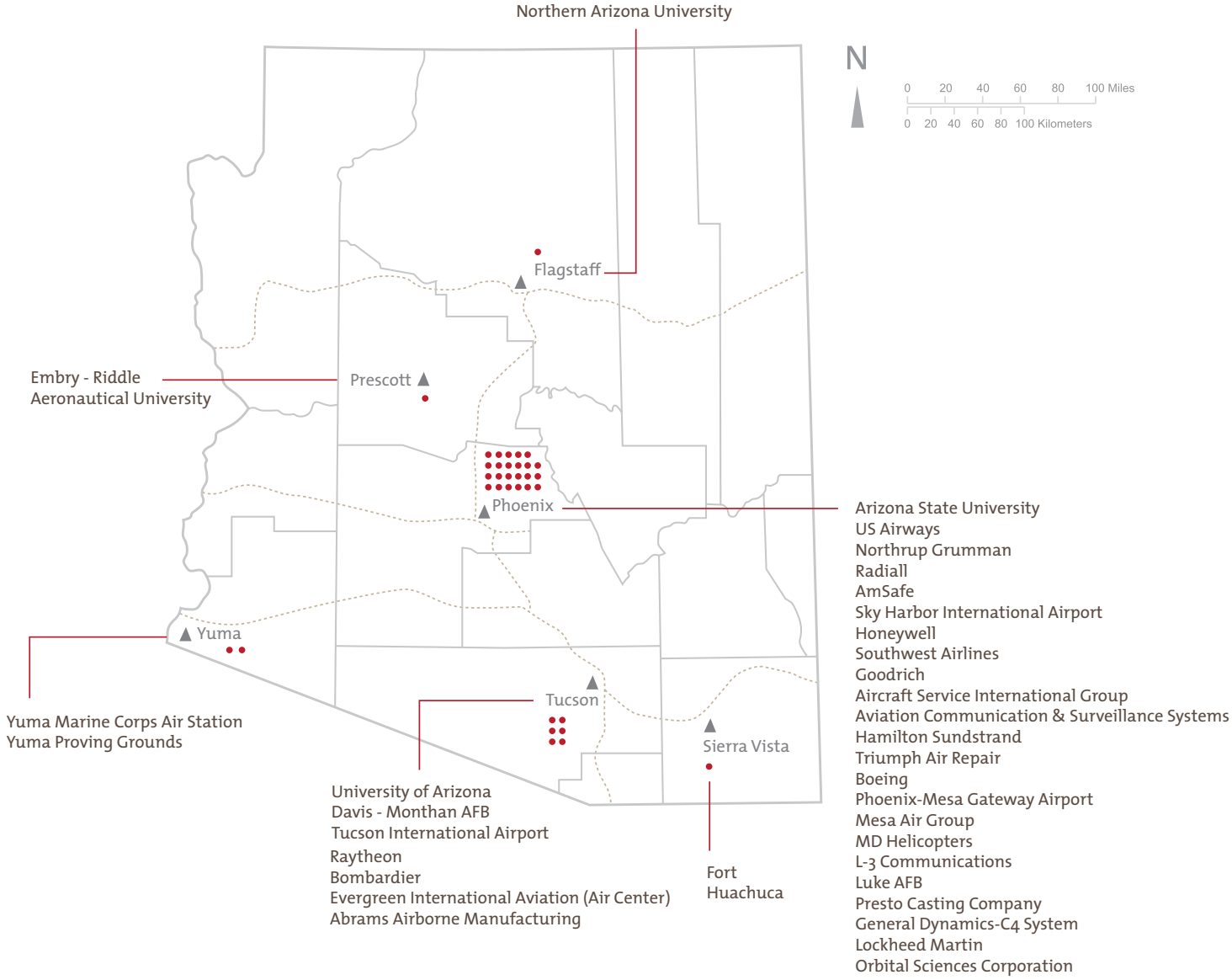
[2] *AZ Aerospace, Defense, and Avionics Industries Study*. Charlottesville, VA: ANGLE Technology Group, 2008. p.5.
[3] Ibid. p.47
[4] *Economic Impact of Arizona's Principal Military Operations*. The Maguire Company, 2008.p.v.

Largest Government, Commercial, Military Aerospace Enterprises in Arizona



Note:

This map includes the top 23 aerospace companies based on employment. Employment figures of companies on this map were referenced from the 2008 Republic 100 (Arizona Republic), 2008 Star 200 (Arizona Daily Star), Greater Phoenix Economic Council, company information and Lexis Nexis company profiles.

Thus, it is clear that the continued vitality of aerospace and aviation in Arizona is critical to the State's economy and affects, directly or indirectly, almost every Arizonan regardless where he or she lives in the State.

State officials, business stakeholders and others with whom we spoke recognize this fact and many recognize the urgency of providing vehicles and infrastructures to:

a) promote retention and expansion of the in-state aerospace industry; and

b) attract into the state other aerospace industry-related economic activity (and the attendant high paying jobs).

An Aerospace Institute that focuses on select high value services which meet the needs of and build on the vast competence of both in-state and out-of-state aerospace industry stakeholders could be an important vehicle to protect and grow this critical and diverse industry in Arizona. A properly structured and governed Institute accomplishes this mission by providing the following value points:

- The Institute would be a recognized "One-Stop" concentration of expertise and knowledge leaders.
- The Institute would provide a "pre-packaged" set of relationships and structures in place, which is important in the bidding for and performance of contracts and grants.
- The Institute could be agile, unbureaucratic, speedy and flexible in responding to various needs.
- There would be a knowledgeable and professional Institute staff in place. Their knowledge would be easily accessible to members of the Institute.
- The Institute could facilitate workforce development by providing practical training and recruiting, by engaging engineering and other students, by attracting and engaging faculty, by making available educational certifications, and by conducting seminars and other industry-specific educational programs within its core competencies.
- The commercialization of advanced technologies would be accelerated by an Institute. The innovation-to-market timeline could be shortened.
- The Institute would provide an environment for the collaboration of business with business and business with government, military and academic stakeholders.
- The Institute could be a liability shield for spin-off and start-up activities.
- The Institute could generate revenue for the Institute and for its members.
- The Institute would be a tangible, visible and demonstrative commitment of the state to the industry and the industry to the state and industry stakeholders to each other.

II. SCOPE OF ENGAGEMENT AND TASKS AS THEY EVOLVED

TheGoldGroup, LLC and its principal member, Peter A. Gold, Esq., was engaged under contract with Arizona State University dated July 28, 2008 to prepare an initial assessment scoping report on creating and sustaining a high value aerospace "Institute" to serve the needs of existing and future stakeholders and interested parties.

The Stakeholders:

These stakeholders include:

- The commercial and defense aviation and aerospace industry in Arizona and the Nation, including; prime contractors, subcontractors, and others which provide services to them;
- Government: Civil and Military;
- Arizona's people and their employers;
- Research and Educational Institutions; and
- Other aerospace industry related persons and institutions.

The "Industries and Stakeholders" in the aerospace and defense cluster have been depicted by the following diagram in a report prepared by the Arizona Aerospace and Defense Commission (2005 Progress Report for the State of AZ Strategic Plan for the Aerospace and Defense Industry, December 30, 2005, pg. 8) This chart reveals the diversity of the industry.

Specific Tasks Undertaken:

Some of the specific tasks contemplated under this engagement include:

- Identifying potential stakeholders and other interested persons(referred to herein as "SIPs"),
- Identifying needs or gaps which exist, as articulated by the SIPs, that the Institute could meet, or address,
- Assessing assets and resources in Arizona and elsewhere which could be leveraged and enhanced through the Institute,
- Identifying potential strategic and other partners,
- Determining if there is enthusiasm for the Institute,
- Identifying the core competencies, expertise (technical and otherwise) that could be provided by the Institute,
- Identifying value added services that could be provided by the Institute
- Identifying structure and governance options (type of entity, governed by whom, etc.) for the Institute;
- Identifying possible economic impacts of the Institute, such as job creation, higher wage levels and a multiplier effect; and
- Identifying some possible funding options.

Briefly stated, the scope of the engagement was to assist in focusing a broad vision into specific objectives which could have high value results for the SIPs. This Report principally assists decision makers to more specifically define the Institute's focal point(s) and its parameters.

We note, albeit briefly, that the written deliverable of this engagement was required to be submitted in a very compressed period of time. Thus, the conclusions set out herein should be read giving due consideration for the time frame set out for completion of the engagement. Notwithstanding the foregoing, we believe that the matter and conclusions setout herein are accurate and can be relied on by decision makers in considering next steps.

III. METHODOLOGY AND PROCESS: THE DRIVERS

The Drivers of The Institute

A first step in determining the specific focus of the Institute is to identify the specific drivers or factors, which are motivating the creation and maintenance of the Institute in the first place. These are:

- Meet the needs and enhance the strengths of identified SIPs - the Institute must fill a practical gap,
- Leverage existing assets and resources already "on the ground" in Arizona,
- Create options which will deliver value for the aerospace businesses in Arizona,
- Create options which will draw additional aerospace employers, employees and related resources into Arizona,
- Long term (post start-up) sustainability for the Institute; sustainability is defined not only as financial sustainability but also sustainability of the purpose and expertise of the Institute,
- Ascertain the competitive landscape - What are existing aerospace Institutes doing? What niche(s) to stake out for Arizona?
- Create Economic Development Benefits. Keep high wage jobs in the state, attract additional jobs into the state, create businesses and commercialize technologies which will bring value to Arizona.

Accumulate and Analyze Data and Information

Another step in determining the specific focus of the Institute is to accumulate and analyze data and information points from the SIPs relating to each of the seven drivers listed above. We believe that the methodology and process deployed resulted in our meeting with a diverse and representative group. Some of the specifics regarding the SIP we spoke with are as follows:

- **77 people**
    - **42 different organizations**
        - **Located in:** Arizona, Ohio, Florida, North Dakota, New Jersey, Illinois, Florida, Washington, Massachusetts, Washington, DC and England

The organizations include:

- Aerospace manufacturers
- Aerospace vendors and contractors – small to large
- Educational institutions
- Centers of excellence
- Research and technology parks
- Business incubators
- Not for profits
- Government entities
- Elected officials – Federal, State and Local
- Airport operators
- Active and retired military – General rank and enlisted
- Trade associations
- Trade publications
- Real estate developers
- Federal supported research laboratories
- Economic development organizations
- Aviation medicine and health care providers
- Human performance and athletic firms
- AZ Aerospace and Defense Commission (representative)

Reports, Publications and Other Materials Reviewed and Analyzed

We also reviewed various reports, publications, websites, press accounts and other materials. The following are just some of the materials reviewed.

The Nations Guardian: America's 21st Century Air force, Chief of Staff USAF, 2007;

Arizona Aerospace, Defense, and Avionics Industries Study, Angle Technology, 2008 ("Angle Report");

Economic Impact of Arizona's Principal Military Operations, The Maguire Company, 2008 ("Maguire Report");

Tucson Economic Blueprint (TREO Report), KMK Consulting, 2006;

MITRE Corp and FFRDC Center for Advanced Aviation System Development (various materials);

Characteristics and Trends in North American Research Parks, 21st Century Directions; Battelle Memorial Institute and Association of University Research Parks, 2007;

U.S. Defense Modernization, Today's Choices for Tomorrow's Readiness, Aerospace Industries Association, 2008;

Sematech, 20th Anniversary Report, 2006;

Aerospace Industry, Firms, Wages and Labor Data in Greater Phoenix, GPEC, 2007

IV. FOCUS OPTIONS FOR THE INSTITUTE

A Threshold Choice

With few exceptions, the era of "If we build it they will come" is over. To attract activity and sustainably accomplish the objectives of the Institute, the Institute must provide an environment which supports the creation of services which are meaningful to and immediately consumable by stakeholders and others.

We believe it is imperative to define the focal point of the Institute based on a service and market needs analysis model. The competencies and functions of the Institute should be customized to meet the articulated needs.

In defining the Institute's focus or core competencies there is a threshold and fundamental choice. That is:

> *Should Arizona Institute focus on a set of specific technologies, sciences, or problems (e.g. jet propulsion, bio- fuels, vibration and shock in space, airframe design)?*
>
> - OR -
>
> *Should the Institute's expertise, skill sets and infrastructure span several advancing (but related) aerospace technologies and be utilized in deploying or commercializing these technologies and resolving aerospace challenges?*

Our work suggests that the second option is the stronger. After having analyzed and filtered the data collected from our extensive interviews, document reviews and independent industry and market knowledge through the prism of the drivers for creating an Institute, we believe the second option has a greater possibility of success in meeting the prerequisites of and meshing with the Institute's drivers.

We recommend that the Arizona Aerospace Institute have both bricks and mortar and a virtual structure whose focus, expertise and resources would span and be utilized in developing and deploying several advancing technologies to resolve aerospace industry challenges.

In other words, the specific and related skill sets, resources, and expertise which reside in the Institute should be those which advance many aerospace technologies and address a wide range of related aerospace challenges. We are not suggesting an Institute which focuses on a specific technical challenge or problem (e.g. propulsion, biofuels, vibration, and airframe design, nor are we recommending a broad "everything to everyone" approach. Rather, we are proposing an Institute that has specific, practical and well-defined skills, expertise and resources which can be used by the diverse aerospace industry, government, military and academic stakeholders to advance their technologies and meet their challenges.

Initial Core Competencies of the Arizona Aerospace Institute

Our scoping process has confirmed a number of aerospace industry trends and concerns:

- Most aviation technologies are deployed in systems where they must interact with other technologies (machines and/or human beings) for them to be of full utility. They are tools to accomplish human-determined objectives;

- Aerospace technology is changing, advancing, and becoming even more complex and complicated;

- The degree and frequency of several stakeholders (or SIP's as they are referred to in this report) collaborating in the same product or working under the same general contract (e.g. integrated cockpit, heads up display) is increasing; and

- Machine to machine and machine to human interaction (and the reverse) and communications and data transfer between and among them are increasing and becoming more complex.

These trends and concerns coupled with both the resources already present in Arizona and with the articulated specific needs of stakeholders suggest that the initial focus, expertise and core competencies of the Institute be in three related areas:

1) Machine to machine and human to machine interactions and integration;

2) Information management and information assurance; and

3) Visioning, Simulation, and Modeling, both as a core competency of the Institute and as a tool used in 1) and 2) above (the other two core competencies of the Institute).

Machine to Machine Interactions

In networks or systems often comprised of different and diverse hardware and software, this competency would address whether particular machines, devices or technologies are optimally communicating and interacting with each other. Possible descriptors and activities might include: systems communication, systems surveillance, systems integration, software and hardware integration, testing, developing standards and policy; certifying technologies to those standards, etc.

Machine to Human Interactions

Under this competency (related to Machine2 Machine) Institute activities might, for example, focus on integrating human factors earlier in the design process, determining the optimal human use of a technology, determining the physical/psychological effect of technologies on humans, determining, setting and testing the efficacy of aerospace policies and regulations, determining and advancing best training methods, setting standards and providing certification regarding Human2Machine interactions. It could also utilize the simulation process and could ascertain the effectiveness of particular simulators.

Other descriptors encompassed in the machine to human core competency are: Usability analysis, human-systems design, training effectiveness, human factors engineering and cognitive engineering, physiology, applied psychology, and kinesiology.

The Aerospace Life Sciences Unit at the Mayo Clinic in Arizona is a logical stakeholder and potential strategic partner. Some of what Mayo Arizona currently does appears to be within the scope of this core competency. We believe that Mayo as a member the Institute would be a unique, high-value entity in the aerospace machine to human interaction field and marketplace.

According to Mayo:

> *"Mayo Clinic's services and programs include active clinical aerospace programs (suborbital, orbital spaceflight) and research programs focused on special orientation/ disorientation, acceleration induced threats and high altitude environments".*

Further, in referring to the contemplated Arizona Aerospace Institute, Mayo leadership states:

> *"The collocation of special environment simulation systems (altitude chamber, novel centrifuge, flight simulation systems) will create a facility that will be a unique resource for civilian, military and government customers at the national and international level."* (See Mayo statement attached as Exhibit A).

As noted, our methodology and process included reaching out to several educational institutions. In response to our inquiries about this initiative Embry-Riddle Aeronautical University writes:

> *"With any aerospace system's development, now or in the future, the human-machine interface cannot be ignored. Designing systems keeping human needs and capabilities is of utmost importance* [sic]. *At our Prescott Campus, we have a graduate level faculty in our Safety Science program designed to conduct research in human factors and ergonomics with particular emphasis on how human-centered design can be enhanced in aviation and aerospace systems."*

Embry-Riddle also writes:

> *"Embry-Riddle is pleased to begin a discussion within the State of Arizona about how we can assist in the enhancement of aerospace &D".* (Embry-Riddle statement attached as Exhibit B).

Similarly most of Arizona's undergraduate and graduate degree granting universities have unique strengths and capabilities which can be an important part of Arizona's Aerospace Institute. For instance, ASU's Polytechnic Campus has state of the art flight simulators and a high altitude chamber. The Computer Science Department in ASU's engineering school has the Center on Information Assurance and Management. U of A also has rich resources and is at the forefront of sensor development and other areas which stakeholders could utilize.

Visioning, Simulation and Modeling (VSM)

It is important to underscore that we view VSM as a core competency of the Institute and also as a tool used in the other two competencies. Regarding VSM as a tool, the Institute's services could include: technology integration and systems management, b) design and beta testing of products, c) setting and testing policies and regulations, d) cost effective and state of the art training; and e) determining human performance erosion and optimalization.

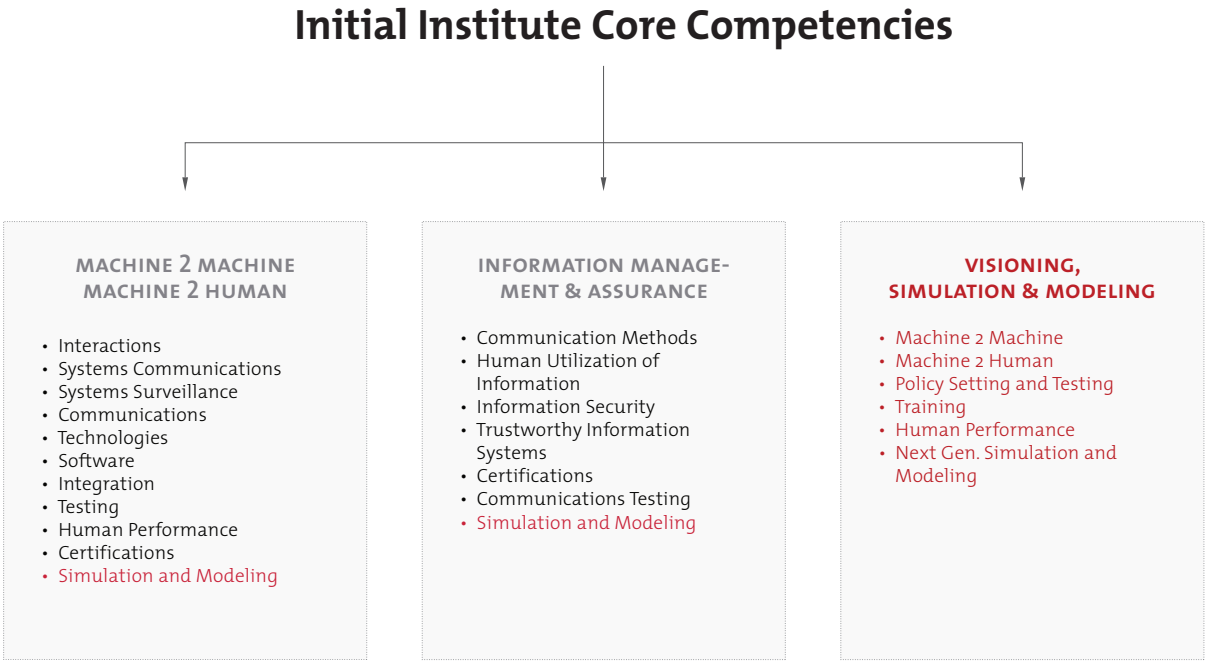
As a core competency the Institute's VSM expertise could be applied to a) designing VSM technology or customized training to meet specific aerospace stakeholder needs and purposes, b) advancing and establishing the forefront of VSM technology, research and development; and c) using VSM in workforce training and workforce development not only through specific training applications but also by exposing engineers and engineering students, industry member employees and others to state of the art VSM research and practical applications.

VSM also appears to align seamlessly with several of the drivers, which have been identified in this report for establishing the Arizona Aerospace Institute. Significantly, it leverages important assets and state of the art resources already residing in Arizona. Specifically, we note the human talent and technology resources of the Warfighter Training Research Division, Human Effectiveness Directorate, Air Force Research Laboratory (AFRL), Mesa, Arizona. This AFRL simulation and modeling laboratory has been "BRACed" and is scheduled to be closed and relocated to Ohio in 2010/ 2011. It is possible, even likely, that there will be a "stranded" pool of expertise, talent, and hardware in Mesa which might be available to an Institute. In addition, in Mesa there are several not insignificant businesses, applied researchers and others performing services related to the AFRL who may have excess capacity as a result of the closure and relocation. Many of these businesses also work in the fields of machine to machine and human to machine interactions.

Information Assurance and Information Management

As the interactions and inter-dependence of machine to machine and human to machine increase in volume, complexity and frequency, our interviewees have expressed the need to assure a) the proper information is being communicated or transferred, b) the information communication method is optimal; c) the information communicated can be effectively utilized by humans, d) the information, code, and other message media are secure and have not been subject to tampering. Our data suggests that another core competency of the Institute be Information Assurance and Management. The Institute could, for instance, provide specialized aerospace-related services in the fields of identity assurance, data management, trustworthy information systems, and modeling, simulating, testing, and certifying systems and communications.

The following diagram is a visual representation of the initial core competencies of the Institute as we have identified them.



Value-Added Services and Functions of the Institute

As envisioned, the Institute would also deploy and utilize its core competencies to accomplish other tasks and perform other value-added services as articulated by the SIPs. These could include:

Standard Setting, Policy Making, Curriculum Development, Best Practices and Certifications within Core Competencies. The Institute could also answer the articulated call to create a collaborative environment and infrastructure to further develop standards and best practices which fall within its Core Competencies and expertise.

The Institute could assist policy makers, regulators and regulation enforcers in setting, interpreting and enforcing policy. For instance, through its VSM expertise it may be able to determine human performance erosion associated with the use of particular advancing technologies, such as an air traffic controller's new NextGen radar screen. Policies regarding the use of and environment required for advancing technologies (perhaps such as shift length, visual acuity, number of breaks, room lighting, etc.) could be determined and beta-tested by the Institute.

The Institute might not only assist in the development of best practices and standards but could also develop and provide a certification service for aerospace members needs. For example, the Institute could certify whether specific technologies and /or machines interact with each other, whether humans can effectively interface with them, or if a particular simulation is sufficiently realistic enough for the intended project purposes.

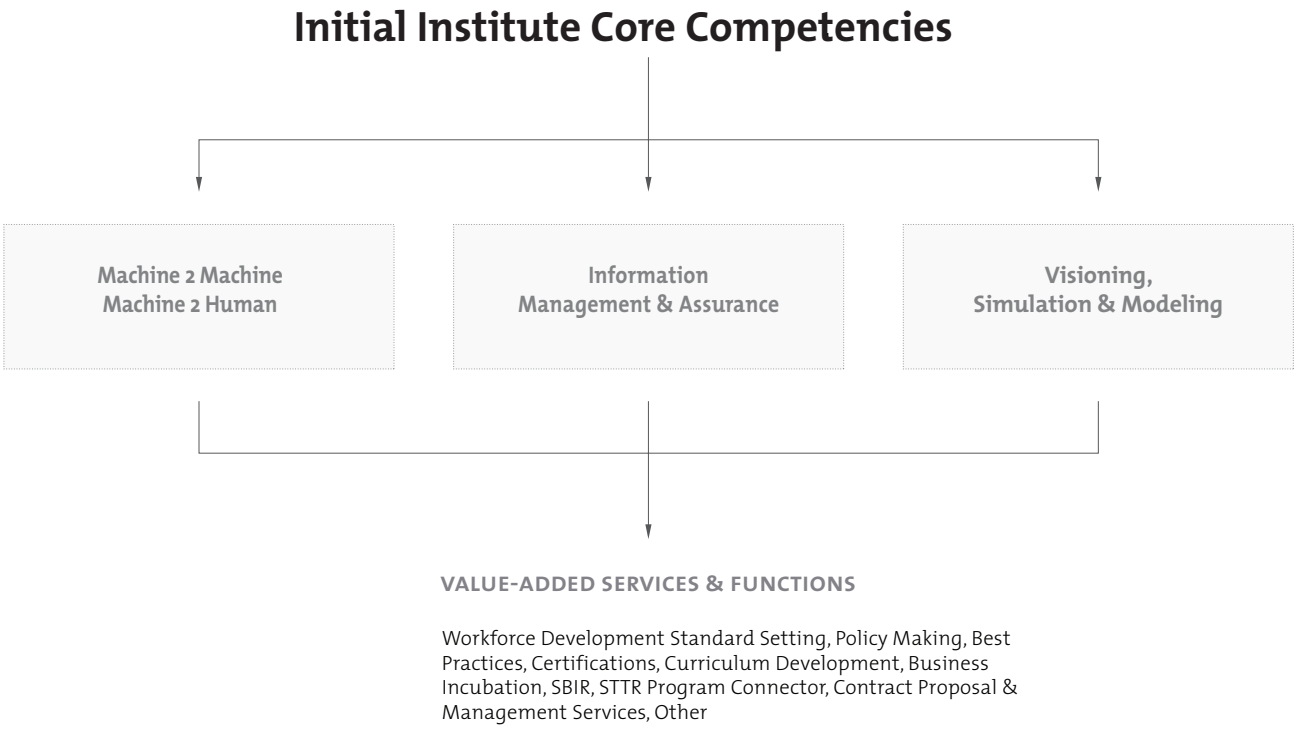
Aerospace Business Incubation Facilities and Services. Various SIPs in our interview group noted that the Institute should support entrepreneurship through creation and maintenance of a collaborative business incubation environment. This makes sense from a variety of perspectives.

A properly administered business incubator program can shorten the timeline between innovation and market sales. It does so by concentrating technical expertise, business expertise and other multi-disciplinary business resources and matching those resources with businesses and/ or entrepreneurs with commercializable technologies, products or services.

An Institute could add value to start-up businesses by focusing its many resources, including but not limited to, its member institutions (both business and academic), technical experts, and financial contacts with venture capital firms and angels active in the aerospace sector. It can also provide physical facilities (for business suites, laboratories, common areas) in or around the Institute facility.

SBIRs and STTRs: The Small Business Innovation Research ("SBIR") and Small Business Technology Transfer ("STTR") programs are two significant federal government programs designed to assist growth of small business. One of the top five employers of aerospace workers in Arizona suggests that Arizona's small businesses are underutilizing the federal SBIR and STTR programs. Through the Institute, small businesses could team with larger businesses, prime contractors, and universities to increase the number and dollar value of SBIRs and STTRs awarded to Arizona companies. Within its core competencies, the Institute can help identify and match large businesses with developing businesses and match those with government/ military needs to optimize utilization of SBIR and STTR programs.

Contract Proposal Collaborations, Proposal Preparation and Contract Management Services. The Arizona Aerospace Institute will recruit and maintain a cadre of partners who would be available for teaming in contract or funding proposals The Institute will facilitate the building of teams from among its members to pursue contract opportunities. The Institute could also assist with the actual preparation of proposals and subsequent contracts. It could also assist in the management of contracts.



The above diagram is a visualization of some of the added-value services that the Institute might offer.

V. UNIQUE OPPORTUNITIES, PARTNERSHIPS AND STRATEGIC ALLIANCES CAN BE CREATED BY THE INSTITUTE

Workforce Development Opportunities

Almost every business and most every person in the aerospace industry with whom we spoke indicated that there is a shortage of US Citizen Engineers and other aerospace workers who can work in environments where certain security clearances are required. The clear consensus message and challenge to Arizona is to attract more science and mathematics- inclined students into engineering and aerospace programs. The aerospace companies cannot be sustained in Arizona, or anywhere, without a competent workforce.

The Institute can be a magnet which attracts students and faculty into the aerospace field and act as a vehicle to upgrade the skills of engineering and non-engineer aerospace workers. Under the Institute's umbrella, businesses could collaboratively work with each other, with government, and with undergraduate and graduate degree-granting member universities to develop curricula, offer on-line and other courses, and provide other workforce enhancements to aerospace workers and their employers.

Some of the potential partners and stakeholders interviewed also suggested that the Institute implement programs to attract high school students who may be interested in aerospace careers. Such programs could include: a) coordination by the Institute of member company, government and other member internship programs b) creation of scholarships, job fairs, competitions, and other long term recruitment activities, c) partnerships with Arizona high schools to create and run Arizona aerospace high schools or high school programs; and d) developing an aerospace preparatory curriculum for Arizona's high schools.

Potential Participants / Partners / Members

Traditional Partners and Interested Persons

Large, medium and small aerospace, aviation, avionics and air transportation businesses. These are the obvious Institute members and participants. Arizona's corps of such companies includes, but is certainly not limited to, Raytheon, Northrop Grumman. Boeing, Honeywell, Lockheed Martin, General Dynamics, Orbital Sciences, U.S. Airways and many others.

Research and education partners. Research and educational undergraduate and graduate degree-granting universities and colleges are another set of important traditional stakeholders and interested persons.

Organizations with the core competencies. For-profit businesses and not-for- profit organizations that specialize in one or more of the identified core competencies of the Institute are also potential stakeholders. For example, a cognitive engineering concern in Boston, Massachusetts or a human factors firm in San Diego, California or a non-profit applied psychology firm in Mesa, Arizona are just a few of this class of potential stakeholders, members and interested persons.

Non-Traditional Partners and Interested Persons

In our judgment the Drivers for establishing the Institute necessitate a search for what we have called *non-traditional* but important stakeholders, partners, and interested persons to participate in Institute activities. These could include:

Out of State Not-For-Profits/ Other Institutes. In determining the core competencies of the Institute we considered the specialties, expertise and bundle of relationship and services of other

institutes and centers of excellence. We looked at these from both a market/competition perspective and, just as important, from the perspective of identifying key potential strategic partners. We have identified several *out- of-state* potential strategic partners or Institute members. For example, some of these are:

- Institute for Simulation and Training, University of Central Florida
- The MITRE Corporation, Center for Advanced Aviation Systems Development
- The Ohio Aerospace Institute coupled with Human Effectiveness Directorate, USAF
- The University of North Dakota, Unmanned Aircraft Systems
  School of Aerospace Sciences

In interviews with the leadership of some of these institutions they have expressed great enthusiasm to partner or otherwise team with an Arizona Aerospace Institute. They recognize that Arizona has a robust aerospace community and we surmise that they would like to participate in a vehicle that provides greater access to Arizona's aerospace community.

Insurance Industry Interests. Important stakeholders and virtually invisible partners in most, if not all, commercial aerospace activity (flight, space, airport operations, ground operations, product design) are those who participate in and "own" the risk of such activities. Safety as a factor in insurance underwriting and premium setting suggests that the insurance industry companies and their international and national trade associations may be logical participants in supporting an Institute whose expertise can directly affect aerospace safety and how safety is impacted by advancing technologies.

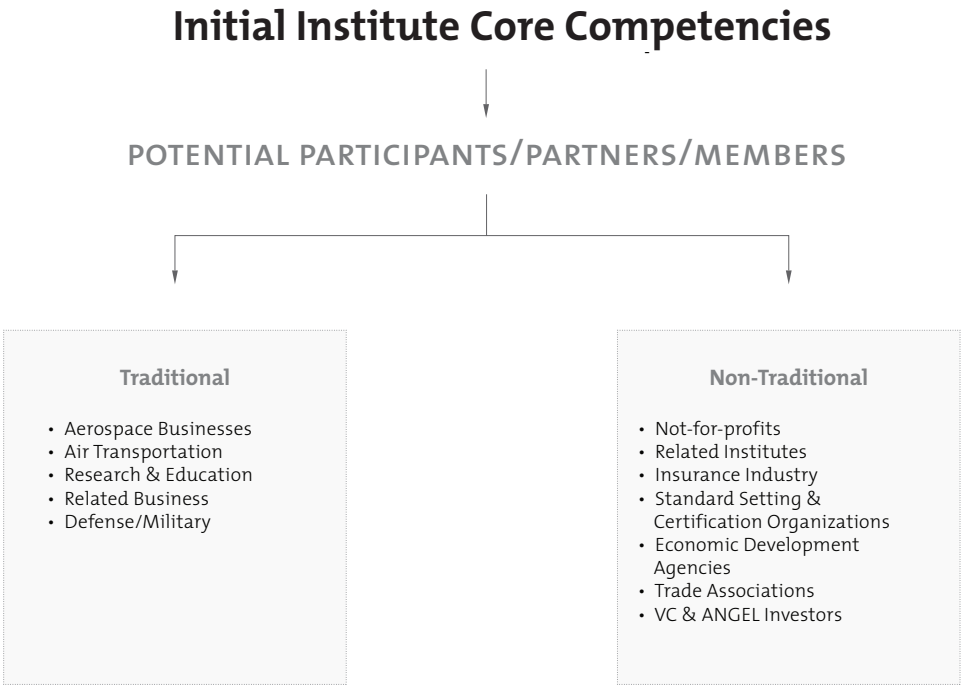
Standard Setting and Certification Interests. Government, for-profit and not-for- profit organizations which participate in setting standards and certifying to those and other standards may also be logical participants.

Economic Development Interests. There is little question that an Institute and its constellation of activities including job creation and other positive economic impacts can dramatically influence and affect Arizona's, and perhaps the nation's, economy. Thus, State and Federal economic development interests such as the US Economic Development Administration, US Housing and Urban Development Administration, Office of Economic Adjustment, Department of Defense could also be potential supporters or participants in
the Institute.

Statewide Aerospace Trade Association. The presence of an Institute may also be a vehicle to assist those who are trying to form a statewide aerospace association. The Institute may be able to accelerate such efforts because it can be a collaboration center for business, academia, government and the military.

Venture Capital and Angel investments. Perhaps the Institute, especially with a small business / start up business incubator component, could be an inducement to draw greater aerospace venture capital and angel investment into Arizona. Some sources report that the venture and angel communities in Arizona are not robust, with Arizona deals receiving only approximately one-half of one percent of venture dollars. If the Institute advances and accelerates the commercialization of high value technologies perhaps it can become a source of "deal flow" and this statistic can be improved.

The following diagram depicts the potential participants/partners/members:



VI. STRUCTURE AND GOVERNANCE

Identifying the Institute's most efficient and most effective service delivery model, structure and, governance is just as important as identifying the areas of expertise and core competencies. The Institute, as articulated, is poised to create immense value. However, this value must reside in a proper "infrastructure" in order to be delivered. By analogy, putting an immensely powerful jet engine on a wooden 1930's airframe cannot maximize the value of the engine and may actually be detrimental to vehicle flight.

Flexibility, agility, and freedom from the counterproductive aspects of bureaucracies are important factors in canvassing models for structure and governance. Financial sustainability and accountability are also key considerations. Buy-in, confidence of its members, and the absence of the perception that the Institute will be driven by a single stakeholder's agenda are also, in our judgment, ideal characteristics.

There are many possible options, including, but not limited to:

a. An operating unit of a university
b. An operating unit within a potential stakeholder business
c. A state "public corporation"
d. A Federal "public corporation"
e. A for profit business model
f. A wholly owned operating unit within an existing "public corporation"
g. A joint venture or other combination with a strategic partner;
h. An operating unit within, or subsidiary of, an existing State 501(c)(3) organization, or
i. An independent 501(c)(3) not for profit member-controlled collaborative consortium.

Balancing the above possibilities with Arizona's somewhat unique landscape and that of its institutions, we recommend that the initial governance and structure of the Institute is a collaborative member-based consortium organized as an independent" 501(c) (3) corporation initially with a small founding Board of Directors.

We envision the service delivery model of the Institute to feature a distinguished professional staff identified by and coming from Institute member sectors (e.g. business, academia, government, military, not-for-profits). We also recommend that top quality founding participants be "incentivized", in appropriate ways, to participate in and bring their unique values to the Institute. While identification and implementation of such incentives are beyond the scope of this engagement, one incentive could be that the Institute offer "fellowships" to such persons and/or their organizations.

VII. A "*VIRTUAL*" STATE-WIDE INSTITUTE AT ASU, MESA, ARIZONA

Stakeholders and other interested persons have underscored the importance of emphasizing that the Institute be a VIRTUAL Institute, regardless of the location of the initial physical footprint. SIPs have repeatedly stated that the Institute must be accessible to members, clients and other interested parties regardless where they are located in the state, the nation and perhaps the world.

However, to accomplish its goals the Institute would undoubtedly require an initial first stage physical infrastructure. We believe that its location will effect and can contribute to its "success." For the reasons set out below, we believe that the Institute would be on a strong foundation if co-situated at or near the Phoenix-Mesa Gateway Airport ("PMG Airport") and Arizona State University's 600 acre Polytechnic Campus (abutting the PMG Airport) in Mesa, Arizona.

The Institute should be located at or near an airport capable of being a major transportation center (with expansive runways and access to a modern highway system). Not only is this important for the work of the Institute and its members, but it is also important for ease of access to the Institute. PMG Airport has three runways (10,400, 10,200, and 9,300 feet). It is attracting businesses and educational assets. Further, the PMG Airport area supports several tax and business incentive programs. These include: Military Reuse Zone; Foreign Trade Zone; and a Work Force Development Program.

ASU's 600 acre Polytechnic Campus is located directly across the street from the PMG Airport. ASU Polytechnic and other ASU campuses support various aerospace initiatives and programs.

This location is also fairly close and convenient to Sky Harbor International Airport (and its constellation of businesses, services, technology, government, and other interests). This is important not only for ease of access to the Institute by in-state and out-of-state members and interested persons, but also for the work of the Institute.

Major aerospace educational and research interests such as Embry-Riddle Aeronautical University (ERAU), University of Arizona (U of A), and Arizona State University are geographically dispersed throughout Arizona, with ERAU in Prescott and U of A in Tucson. *Mesa, Arizona is an equidistant two (2) hour drive from Tucson and from Prescott*.

This proposed location for the Institute is also the current home to the Warfighter Training Research Division, Human Effectiveness Directorate Air Force Research Laboratory (AFRL). The AFRL facility is scheduled to close and be moved by 2010/2011. It is altogether possible that these assets --- human, physical and intellectual --- can leverage the Institute and also be leveraged by it. Many of the functions performed by the AFRL's talented and comparatively highly paid workforce are a "fit" for the core competencies of the Institute. The services, products, or workforces of several entities which do business with, are dependent on, or are symbiotic with the AFRL Lab, also fit within the core competencies of the Institute. These businesses and those on PMG Airport property could also utilize the Institute's value added services such as its business incubator facilities. Finally, the AFRL is a high-level security facility (Tempest certified) which cannot be easily or cost-effectively replaced.

This proposed location also has physical space available not only for the Institute but also for the businesses, their employees, and related and necessary services that will hopefully be drawn to the area, not only by the Institute but also as a result of the planned use and expansion of PMG Airport, and the anticipated enhancements and growth of ASU's Polytechnic Campus. Private interests, most notably Arizona's DMB Associates and the City of Mesa, have targeted the former GM Mesa Proving Ground site as a destination desert urban lifestyle area that will include housing, hotels, conference facilities, commercial activities, education, entertainment, transportation and recreation.

The success of the Institute will be dependent on the availability of conference space, hotel accommodations and related services. In this regard the September 5, 2008 Phoenix Business Journal reported:

> *"A $1 billion private development-including a 1,500-room resort, a retail complex, a convention center and a championship golf course-is slated for the soon-to-be-vacated General Motors Proving Grounds, next to Phoenix-Mesa Gateway Airport.*
>
> ***
>
> *Gaylord signed an agreement with DMB to purchase 100 acres for a large resort and convention center. The Mesa resort is expected to have 1,200 to 1,500 rooms. DMB also signed shopping center developer Westcor for* the *project's retail component."*

The combination of these factors point to the conclusion that locating the Institute at the recommended location would be, in reality, placing infrastructure around, capitalizing on and leveraging strong aerospace assets already on the ground. The Institute infrastructure would also bolster and advance these activities.

VIII. POSSIBLE ECONOMIC DEVELOPMENT IMPACTS OF THE ARIZONA AEROSPACE INSTITUTE

Economic development impact is a Driver for creation of the Institute. Some of the desired positive economic effects of an Institute could include: protecting in-state high wage jobs, attracting additional jobs into the state, having a platform for creating businesses, commercializing technologies, growing the venture capital and angel investor communities and increasing economic activities which can increase state and local tax revenue.

Based on various assumptions provided to them, economists at the L. William Seidman Research Institute, W.P. Carey School of Business, ASU, reviewed the possible "Economic Impact of an Aerospace R&D Operation in Maricopa County." (The Seidman economists' statement is attached as Exhibit "C"). The statement reports the average annual wage for all people in the Phoenix-Mesa-Scottsdale metro area is around $38,000. Based on the assumptions provided, it is predicted that the average annual wages of Institute workers would be around $65K. Including benefits and other items, they further estimate that the average payroll per employee in the proposed Institute would be $80K for a total payroll of $48 million per year.

Referring to the indirect economic impacts and the multiplier effects, the Seidman economists' state:

> *"A science research and development facility with a payroll of this size would be expected to contribute a total of $101million per year to the Arizona gross state product, $72 millions in earnings, and 1,320 Arizona jobs. The State and local taxes which could be expected from impacts of this size are around $8 million per year."*

A note of caution is in order at this juncture: the above economic development impacts are based on various assumptions regarding the Institute, which may or may not be accurate and/or come to fruition (e.g. when fully operational it will employ 600 people, like the ASU Biodesign Institute). Further, the launch of the Institute will be accelerated by and may require some form of infusion of public sector funds or other types of commitments. This initial and any subsequent outlay of public funds would be both a cost to the public and an investment. (Please see Part IX, below).

IX. COMMITMENT TO THE INSTITUTE: SUSTAINABILITY AND PUBLIC AND PRIVATE INVESTMENT

We anticipate that preliminary budgets for the capital, operational and other costs and revenue of the Institute will be developed and tested in a comprehensive "Implementation Plan" (a subsequent phase of this Project). Financial sustainability however is a driver and is a consideration in identifying the initial core competencies of the Institute and in the proposed structure and governance model which we have identified. Once operational, there will be opportunities for revenue from various activities, including, but not limited to: membership and other fees, commercialization activities, standard setting, certification activities, private sector contract activities, sales of services, grants, revenue from government contracts, military contracts, economic development agency stipends and private foundation grants.

We recommend that the state and its institutions view the Institute as an opportunity to solidify and augment the footprint of aerospace industry companies in Arizona, enhance relationships with leadership of those companies, and as a vehicle to attract additional high-value aerospace constituents and activities into the state and develop its workforce.

As noted in some of the reports and studies by others cited in Part II above, Arizona's aerospace industry is subject to competitive pressures and uncertainty. In this environment the state's contribution to the success of the Institute, and thereby the aerospace industry, is exceptionally important. Contribution can take the form of not only an initial investment in the development and start-up stage but also by fine tuning or adopting programs that reward and incentivize those private sector industry stakeholders which associate with the Arizona Aerospace Institute. *While not the subject of this Scoping Report, and as an example only, an Institute administered Virtual "Aerospace Innovation Zone" (in which various economic benefits, incentives, and industry obligations are concentrated and available) might be considered.*

Arizona is and must continue to be mindful of and monitor what other states are doing to secure and expand their relationships with aerospace industry stakeholders, many of whom are also significant to Arizona's economy. New Mexico has an aerospace research and development tax deduction, an aircraft manufacturing tax deduction, an aircraft refurbishing or remodeling tax deduction, and a spaceport gross receipts tax deduction.

In this connection, Oklahoma's Governor recently signed into law the "Aerospace Industry Engineer Work Force Bill." The law incentivizes, through the use of tax credits, Oklahoma aerospace engineers and their aerospace employers to remain in Oklahoma. In signing the bill into law Governor Henry stated:

> *"More important than this particular legislation is the symbolism to the aerospace and aviation industries that we value your industries, and to send a message to the country."*

Sound and appropriate economic and other incentives *coupled* with private sector industry commitments and obligations can not only fuel and power the Institute but may also directly and indirectly kick start and accelerate expansion of aerospace interests in Arizona.

X. NEXT STEPS – BEYOND THIS INITIAL ANALYSIS

Some possible next steps to undertake as Phase II of this Project include:

a) assemble an advisory/working group of potential stakeholders and interested persons to further vet, modify, and/or endorse the concepts in this Report

b) engage in additional "buy-in" activities (e.g. presentation of this report to interest groups, SIPs, press, industry leaders, government/military leaders, others)

c) formulate and draft a comprehensive Implementation Plan which would include:(i) matching SIPs with specific core competencies; (ii) obtaining preliminary commitments from "founder" SIPs; (iii) preparing an initial start-up budget; (iv) scoping of potential funding sources; (v) identifying potential candidates for members of a "founding" board of directors (vi) identify initial staff requirements;

d) identify other steps.

We estimate an implementation study and the other activities identified above as Phase II may take approximately six to nine months to complete and the cost would, of course , vary depending on the scope of the activity.

EXHIBIT A

Mayo Clinic Aerospace Life Sciences Unit

Mayo Clinic has always been guided by a philosophy of "the needs of the patient come first". Mayo has a rich legacy in Aerospace Life Sciences that dates back to before World War II with the development of the first high altitude oxygen mask, G-suit, anti G straining maneuver and many other contributions that remain critical to safety in flight and improving clinical care to this very day.

Today, Mayo Clinic in Arizona is uniquely positioned to address the current and future challenges in Aerospace Life Sciences. Mayo Clinic's services and programs include active clinical aerospace programs (suborbital, orbital spaceflight), research programs focused on spatial orientation / disorientation, acceleration induced threats and high altitude environments. Mayo's programs have been federally funded in each of the above areas of focus. Close collaborations and ties exist to NASA, FAA, USN, USAF, US Army and commercial aerospace companies.

No other current aerospace life sciences program in the US has the clinical expertise to deliver the services in the context of a multidisciplinary, fully integrated group medical practice. The collocation of special environment simulation systems (altitude chamber, novel centrifuge, flight simulation systems) will create a facility that will be a unique resource for civilian, military and government customers at the national and international level.

Collaboration with key stakeholders at the state level will be critically important in achieving our vision to create a destination Aerospace Life Sciences Center that will feature novel facilities and tools.

Prepared by the Mayo Clinic in Arizona, August 8, 2008.

EXHIBIT B

ERAU Contributions to Arizona Aerospace Research Institute

Embry-Riddle Aeronautical University is the world's oldest and largest University dedicated to aviation and aerospace education and research. Created in 1926, the University has two residential campuses in Daytona Beach, Florida and Prescott, Arizona. The largest majors on both campuses are aerospace engineering and aeronautical science. Embry-Riddle also has a large distance learning campus – Embry-Riddle Worldwide with 130 centers located across the world focused on providing aerospace education to non-traditional students. Arizona is home to several Worldwide Center locations.

The Prescott campus has several research areas that may be of interest to an Arizona Aerospace Research Center. Our premier research area at Prescott is led by Professor Tarek el Dokor in the Aerospace Engineering Department. This lab focuses on machone vision and hands-free computing. Professor el Dokor in collaboration with several private entities has been able to create a human-computer environment that allows a user to use hand and body gestures to control actions in a computer system. This technology has applications across numerous domains including adaptive technologies, gaming, transportation interfaces and the development of the next generation of computer interfaces. Professor el Dokor currently has a grant from Honda Corporation to examine transportation applications of his technology and is negotiating projects with several prominent technology companies.

In the College of Aviation, Professor Ray Bedard has developed a low-cost, state of the art Air Traffic Management and Aeronautical Science training system using Flight Simulator X (FSX). His system has so innovatively expanded the use of FSX to develop training systems that could provide nationwide education in areas of need that his work has been recognized by Microsoft Corporation. The technical team behind FSX and Professor Bedard have developed a working relationship in order to move Professor Bedard's project forward. Professor Bedard and Embry-Riddle have also developed a patented scoring system for training scenarios in FSX, so that performance using this simulated environment can be automatically and correctly scored for accuracy. This innovation allows FSX and programs to follow to be used legitimately as training tools in simulated aviation environments.

With any aerospace system's development, now or in the future, the human-machine interface can not be ignored. Designing systems keeping human needs and capabilities is of utmost importance. At our Prescott Campus, we have a graduate level faculty in our Safety Science program designed to conduct research in human factors and ergonomics with particular emphasis on how human-centered design can be enhanced in aviation and aerospace systems.

Last, Embry-Riddle recently signed a contract with the FAA to provide NextGen testing and implementation work at our NectGen Test Facility located at our Daytona Beach Campus.

This project is mentioned because the project is a University-wide program that will involve faculty from both residential campuses, as well as 13 private corporate partners including but not limited to: Lockheed Martin, CSC, Mosaic ATM, Boeing, Frequentis, Harris and Jeppesen. This ongoing consortium will focus on testing near term NextGen solutions for air traffic management, system-wide information sharing, surface management and weather.

Embry-Riddle is pleased to begin a discussion within the State of Arizona about how we can assist in the enhancement of aerospace R&D. This brief overview focused on 4 substantive aerospace research areas that are focal to our efforts at our Prescott Arizona campus.

Prepared by Embry-Riddle Aeronautical University, September 1, 2008.

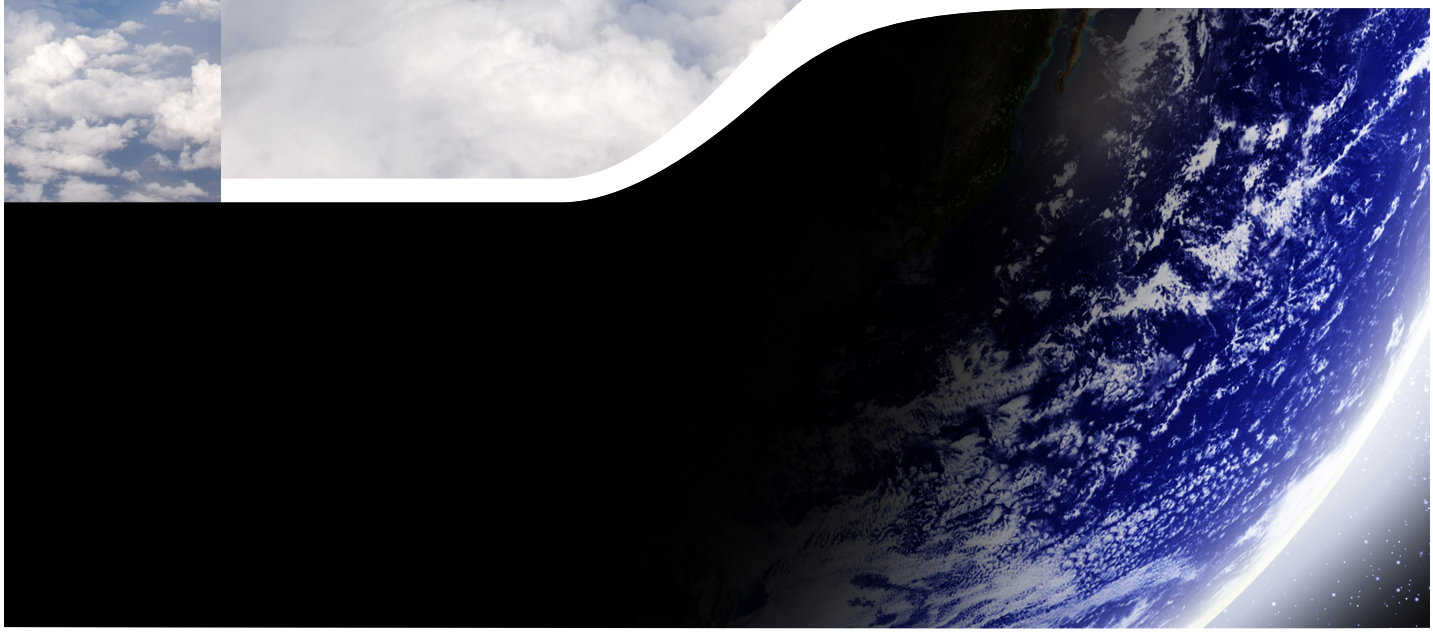
EXHIBIT C

Economic Impact of an Aerospace R&D Operation
in Maricopa County

The proposed facility would employ approximately 600 people, including 300 research scientists. Annual wages and salaries of aerospace engineers in Maricopa County range from $60K to $110K, with an average of $82K. In addition to the research scientists, the facility would employ operations technicians, computer specialists, and a variety of administrative support personnel. Average annual wages across all employees would be around $65K. This compares with an average for all people employed in the Phoenix-Mesa-Scottsdale metro area of around $38K. Including benefits and other employee-related expenses, the average payroll cost per employee in the proposed facility would be around $80K, for a total payroll cost of $48 million per year.

The R&D facility would generate indirect economic impacts associated with the purchases of supplies and services from other local companies and, even more importantly, when employees spend a portion of their incomes in the local economy. When multiplier effects are included, a science research and development facility with a payroll of this size would be expected to contribute a total of $101 million per year to the Arizona gross state product, $72 million in earnings, and 1,320 Arizona jobs. The state and local taxes that could be expected from impacts of this size are around $8 million per year.

Prepared by L.William Seidman Research Institute, W.P. Carey School of Business, ASU, August 7, 2008.

An Initial Assessment:

Creating an Arizona Aerospace Institute