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Final Report

University – Industry Consortium Development

Made Possible By The
Workforce Innovation in Regional Economic Development (WIRED) Grant

November 2008

1.0 Introduction

In association with the United States Department of Labor (DoL) and the State of California's Labor and Workforce Development Agency, the California Space Authority (CSA) was selected to lead over 60 partners in a 13 county region comprising the "California Innovation Corridor" to promote entrepreneurship, global manufacturing competitiveness and 21st century workforce development. As part of this effort, CSA assigned the California Space Education and Workforce Institute (CSEWI) the responsibility to help accelerate the development of the technical workforce needed to support the nation's innovative leadership in the 21st century. One of the ways CSEWI was addressing this challenge is through the development of an aerospace university-industry consortium.

This report documents the consortium model developed, the results of the project activities, analysis of the results and some recommendations for follow-on work.

2.0 Consortium Model

Consortiums are cooperative arrangements between two or more groups to pursue a common goal, typically intended to improve collaboration between members. The California Aerospace University - Industry Consortium was established to be a mechanism for existing Corridor aerospace-focused university programs, and student organizations, to gain technical and career development by involving them in programs and events sponsored or supported by the aerospace industry. Increased involvement improves the technical workforce's ability to meet the 21st century aerospace needs.

The specific objectives of the California Aerospace University/Industry Consortium were to *increase the technical workforce* capable of meeting California aerospace needs and to *enhance the California academic community's ability to address aerospace industry requirements*. To accomplish these objectives, California Innovation Corridor (CIC) university and industry partners were identified to help identify opportunities to *improve access to space* for student projects. This consortium was intended to actively seek aerospace industry support to improve the value of student involvement in aerospace development efforts. The consortium sought to engage existing university programs and student groups and existing industry programs to help students find the technical resources and support they need to help students develop and launch payloads. It was intended that the industry members of the consortium would inform these university programs and student groups about existing projects they can join or support, and provide

them with access to existing industry contacts to pursue potential activities such as project partnerships, "career seminars", "field trips" and other career development support. It was expected that by improving the value of the university-industry relationship, products and technologies could be developed that would focus on meeting actual requirements, access to space would be improved, and the educational experience would become more realistic.

2.1 Consortium Membership

The initial membership of the consortium was developed from various aerospace companies and universities in the Corridor. Members were engaged based upon their known interest in small space payloads and associated launch capabilities. Four universities and five aerospace companies participated in the consortium kick-off meeting.

Aerospace Industry

- Garvey Spacecraft Corporation
- Northrop Grumman Corporation
- Aerospace Corporation
- Space Exploration Technologies
- SpaceDev

Universities

- Cal Poly San Luis Obispo
- Naval Postgraduate School
- University of Southern California
- California State University, Long Beach

2.2 Collaborative Workspace

A collaborative workspace was created to allow members to communicate and share opportunities and capabilities. The workspace provided a general discussion forum for the group and also areas to post funding opportunities, Research and Development (R&D) areas of interest, challenges, potential projects, and capabilities that could be beneficial for collaboration (see Figure 1). Two universities and three aerospace companies obtained accounts to access the workspace.

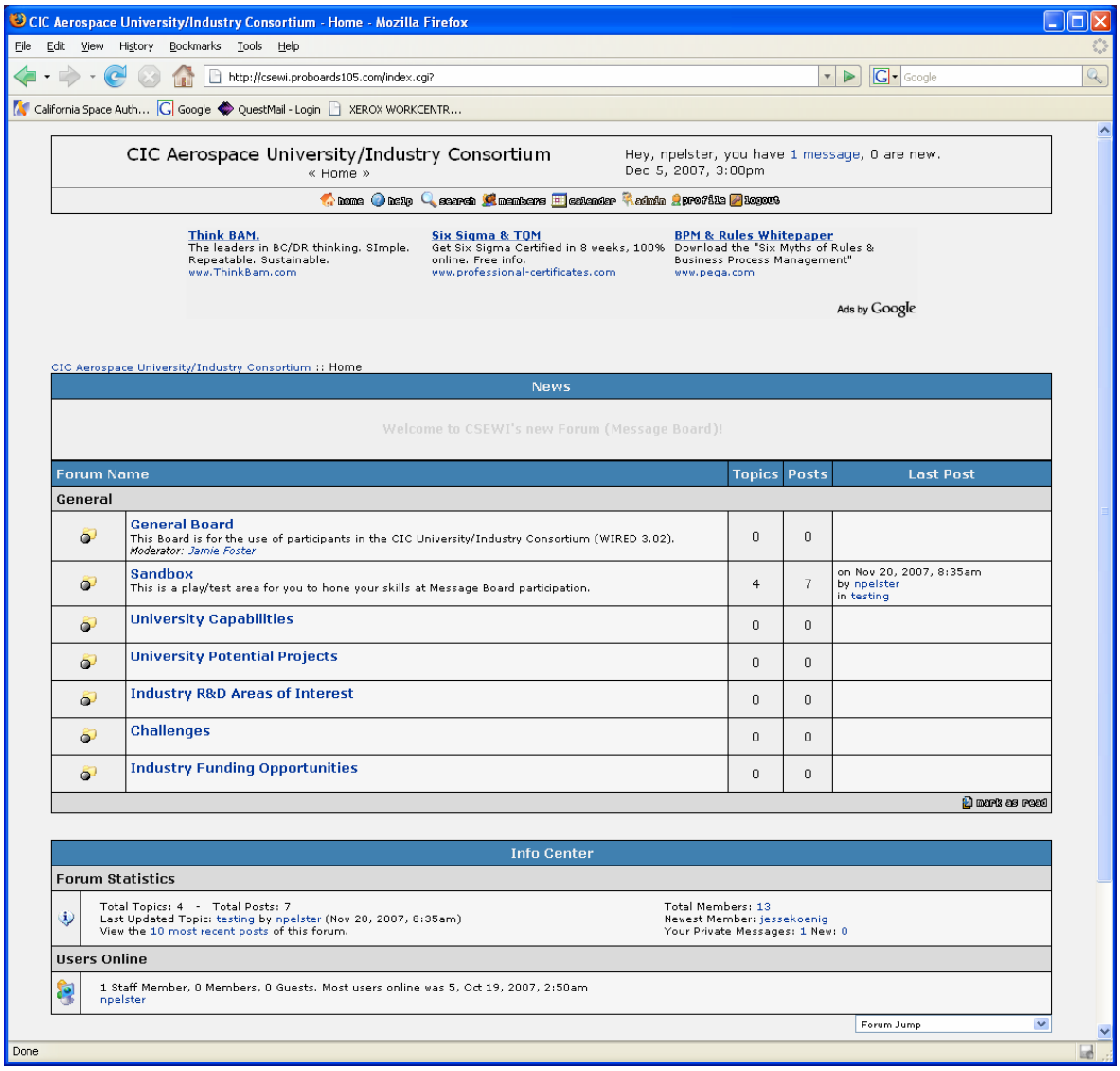

Figure 1 – Collaborative Workspace Home Page

2.3 Collaboration Process

Meetings, workshops and conferences are very affective ways for people to collaborate. For small payloads and associated student aerospace projects, there are a few forums that focus on the subject (CubeSat Workshop, Small Payload Rideshare Workshop, Small Satellite Conference, etc.). Members were highly encouraged to engage in those forums. During other times, the collaborative workspace would provide a tool to facilitate communication and develop relationships.

In the workspace, the university members could list their capabilities to support small payloads and launches. Universities could also propose potential projects that they suggest would be beneficial to industry while providing educational opportunities for students.

Similarly, aerospace companies could list their R&D areas of interest and also potential funding opportunities. These funding opportunities were intended to be potential projects that could be funded and conducted by students. These could also be prize competitions for students.

The idea of the workspace was to initiate an on-line dialog that is similar to what normally happens at the workshops and conferences. With active participation by both groups (aerospace companies and universities), the workspace could be an effective and responsive tool that facilitates development of relationships and provides opportunities to improve education of the future workforce while obtaining assistance in addressing technical challenges.

In addition to getting together at various workshops and conferences, consortium meetings (telecons, webinars or face-to-face) would be held twice a year to discuss topics specific to the membership of this consortium. One of the key items addressed at each of these meetings would be recommendations on process and consortium model improvements. Process improvements agreed upon by the membership would be documented in the collaborative workspace.

2.4 Benefits

Partnering universities with industry would allow universities to pursue technologies and capabilities that meet an immediate need, improving the launch opportunity potential. Also, students could potentially work on projects and research opportunities that prepare them for the technical workforce. Developing applicable value-added space hardware and software, and launching the systems into space would provide valuable "real-world" experience.

Partnering industry with universities would allow industry to obtain additional resources to support focused space-related research and systems developed under university projects and programs. Industry has a need to develop advanced space technologies and capabilities to address customer requirements and market demands. Research and demonstration of advanced space systems reduces risk in delivering products to the market.

Providing students resources for exciting, valuable projects will motivate them to become trained as scientists and engineers via hands-on activities and increases the chance they will choose aerospace industry employment. Providing students career development support, will give them the tools and knowledge to become successfully employed, and make the transition from school to work with an aerospace company.

Ultimately, the California Aerospace University-Industry Consortium was intended to answer the critical need for an increased technical workforce that is highly-trained for 21st century aerospace needs.

2.5 Initial Risks and Issues

Several risks were identified early in the project that had the potential to impact the success of the consortium model:

Lack of Use – This risk was identified as high due primarily to the workload of potential members of the consortium. Adding another meeting, activity or process requires more time which is already a scarce resource. Due to the additional effort, the chance exists that the consortium would not be supported by a strong enough membership to be successful.

Competition – This risk was identified as moderate due to the potential reluctance of members to share information. Information on capabilities and potential projects could be construed as sensitive from a competitive standpoint. This could result in some industry members not contributing, avoiding the visibility among the consortium.

Funding – This risk was identified as high due to the fact that after 2008, there exists no known source of funds to sustain the consortium effort. Due to the minimal cost of the infrastructure and maintenance, it would take very little for a small group to take ownership, but somebody would need to take the responsibility.

3.0 Results

The collaborative workspace was created in October, 2007 and a consortium kick-off meeting was held in December, 2007. All four universities and five companies attended the meeting and provided enthusiastic support. The attendees all agreed that the intent of the consortium was good and any increased collaboration between universities and industry would be beneficial. One concern expressed by some attendees was that Government entities were not part of the consortium. They indicated that if the Government attended and supported the consortium, there may be funding that could be provided to support collaboration opportunities.

Two universities and three companies established a presence on the collaborative workspace. Only one company and one university posted messages, and none of the entities populated the workspace with capability information or opportunities.

Approximately three forums held annually address the topic student payloads and access to space for those payloads annually. The 2008 forums were attended by almost all of the consortium members.

Apr08 – CubeSat Workshop – Cal Poly SLO
May08 – Small Payload Rideshare – Wallops Island, Virginia
Aug08 – Small Satellite Conference & CubeSat Workshop – Logan, Utah

Significant effort was expended to communicate the availability of the consortium to other CIC entities during the first two forums (CubeSat Workshop and Small Payload

Rideshare) and also solicit feedback from existing consortium members on enhancements to the consortium model to improve collaboration. Feedback from conversations during these forums indicated that the main reason for the lack of activity was work schedules had not allowed the members to input the information requested. Most of the members indicated they would re-look at the collaborative workspace, input their information, and also provide suggestions on improvements to the consortium.

Prior to the Small Satellite conference, no updates were made on the collaborative workspace and no suggestions were provided. Due to the apparent lack collaboration as a direct result of the consortium, the consortium members were queried at the conference to solicit suggestions for changes to the consortium model or approach that could increase the collaboration. Some of the university members indicated that they believed the collaboration was occurring and the consortium was not necessarily needed to facilitate the process. Several examples of specific university-industry projects were used to illustrate the point. It was indicated that forums such as the conference provide them sufficient opportunity to develop new one-to-one relationships that could develop into projects.

Some of the industry members indicated there was some concern about release of proprietary or competition sensitive information in an open collaboration environment. They stated that identifying R&D areas of interest and publicly releasing specific funding opportunities could increase insight to their competitors, which is a risk they were not inclined to take. The industry members indicated that most of the existing university-industry collaboration was a result of one-to-one relationships. Some of these relationships were established at forums, but most were a result of long standing relationships primarily alumni-based.

Following the discussions at the forums with the consortium members, it was concluded that the established consortium model will not be productive, at least not with the "student access to space" community. In summary, the following challenges greatly impeded the success of the consortium model:

- Busy schedules of the consortium members
- Concerns about public release of proprietary or sensitive information
- Lack of funds provided for specific projects
- Existing forums provided sufficient collaboration opportunities
- Preference toward one-to-one relationships for specific opportunities.

It was evident that all of the predicted risks became legitimate issues for the project, and some unanticipated risks also became issues. As a result, the project refocused efforts to analyze other consortium models and provide recommendations on attributes of successful consortia as might be applied to the goal of improving access to space for student projects

4.0 Analysis of Results and Alternatives

The analysis conducted consisted of research on other consortia and their attributes, how the attributes apply to what was attempted under this project, and what additional unanticipated risks were realized.

4.1 Consortia Research

In order to better understand the potential roles a consortium might play within the student access to space community, a survey was conducted of existing space and non-space related consortia and the roles they play within their respective communities. In addition to space related organizations and consortia, a number of high tech focused consortia were included. Many of these are focused on sectors such as Information Technology and Bio Technology. A list of the consortia and their roles is included below:

- Space Related Consortia and Organizations:
  - CANEUS, http://caneus.org
  - California Launch Vehicle Education Initiative (CALVEIN), http://csulb.edu/rockets
  - Universities Space Research Association (USRA), http://usra.edu
  - CubeSat Project, http://cubesat.org
  - Florida Spacegrant Consortium, http://fsgc.engr.ucf.edu/programs/precollege/preparing-schools.html
  - California Spacegrant Consortium, http://casgc.ucsd.edu
  - Colorado Spacegrant Consortium, http://spacegrant.colorado.edu
  - X PRIZE Foundation, http://space.xprize.org
- Other Technology Related Consortia
  - World Wide Web Consortium (W3C), http://w3.org
  - The Open Group, http://opengroup.org
  - Organization for the Advancement of Structured Information Standards, http://oasis-open.org
  - SUPERGEN Biomass and Bioenergy Consortium, http://supergen-bioenergy.net
  - IMS Global Learning Consortium, http://imsglobal.org

- Consortium on Green Design and Manufacturing, http://cgdm.berkeley.edu
- San Diego Biotechnology Education Consortium (SDBEC), http://sdbiotechcareers.org
- North Carolina Biotechnology Center, http://ncbiotech.org
- Consortium for Plant Biotechnology Research, http://cpbr.org
- PharmaSTART, http://pharmastart.org
- University of Missouri Bioinformatics Consortium, http://umbc.rnet.missouri.edu

Study of the consortia on the list yielded the following roles and attributes. Because the consortia studied play differing roles in differing communities, the list includes a very broad set of potential consortia attributes and activities. This list of attributes and activities were considered in the development of the recommendations described below.

- Consortium Attributes:
  - Membership
    - Paid membership
    - Enterprise association (corporate members)
    - Professional association (individual members)
  - Events
    - Conferences
    - Workshops
    - Symposia
  - Processes for Community Benefit
    - Knowledge management/sharing best practices
    - Community building/Community management
    - Share results of non-recurring work
    - Vendor-neutral interactions
    - Facilitate interoperability
    - Standards development
    - Develop and issue certifications
  - Funding Related
    - Arrange for financing
    - Proposal leading, organizing, partnering
    - Customer identification
  - Generate Knowledge

- Provide information that builds credibility with potential investors
- Funded research (science and technology development)
- Assemble experts, users and advisory groups
- Strategic studies and research
- Thought leadership / characterization and direction of industry

- Fee for service
  - Evaluate and endorse technologies
  - Strategic planning
  - Commercialization services
  - Regulatory interface
- Facilitation
  - Technical collaboration
  - Community communication
  - Articulation among career paths
  - Publishing services
  - Infrastructure
    - Facilities
    - Computing infrastructure

4.2 Aerospace Consortium Model Attributes

The attributes of the model as executed, based on the attributes in the list above include the following: Proposal organizing and partnering, customer identification, providing information that builds credibility with potential customers, assemble experts, community communications, and articulation among career paths. These attributes were provided through the process of identifying appropriate participants in the consortium, inviting potential customers to meetings, promoting the consortium within the California space enterprise community, and providing an online tool for collaboration and communication between the consortium members. Articulation across career paths is one of the perceived needs that was identified through the strategic planning process that resulted in the initiation of the consortium initiative. It is therefore not evident in any single element of the program but a high level metric of success for these efforts.

4.3 Additional Risks and Issues

In addition to the risks included in the *Initial Risks and Issues* section, some additional risks have been identified and activities for mitigation of these has been included in these recommendations.

One risk is the current and future status of the credibility assigned to student projects by potential industry partners. Currently, industry partners experience a lack of motivation by their customers (primarily DoD and NASA) to include student elements into existing

projects. In addition, the industry partners are unlikely to advocate for it due to valid concern for the reliability of student projects as compared to their industry counterparts.

In addition, there is some risk associated with the barrier to entry for new university and industry partners joining the consortium. For the university partners, there needs to be significant incentives to join the consortium, and for industry partners, there needs to be a clear business case for participation. Some of this risk can be associated with a lack of public information about student project successes, and a focused repository for accessing it. It can also be associated with a need for a shared vision of what the expansion of student access to space can provide to the space enterprise community and society as a whole. Several of these recommendations are communications focused on some level, and would seek to obviate the benefits of industry and university collaboration for enhanced student access to space.

5.0 Recommendations

Based on the list of attributes and services provided by other consortia, the following project elements are recommended as being specifically applicable to the goal of providing more access to space for student projects: Knowledge management, community management, publish standards, provide regulatory interface, develop and issue certifications, interface to customers and investors, and establish a community of practice. These recommendations do not follow the assumptions included at the initial development of the WIRED 3.2 Industry University Consortium project, and reflect an expansion of scope to a more general consortium model while remaining focused on the goal of improving student access to space. While some of these recommendations would require resources in order to be implemented, they have been chosen for their direct application to the risks and feedback associated with the project. If funding was identified in the future, these recommendations could serve as candidates for project elements.

5.1 Knowledge Management

There are several project elements that would fit under a broader category of knowledge management. In most of these cases, this function could be served by way of an Internet based repository of specific types of data ordered by a taxonomy in order to lend some level of context as well as to make retrieval convenient. The proposed elements for a knowledge management system include a repository for best practices and lessons learned, template process documents, success stories, and a technical paper repository,

In order to enhance the reliability of student projects, and to bolster industry confidence in their success, sharing of knowledge and best practices and lessons learned is recommended. By sharing pitfalls, common mistakes can be avoided. This can help to improve the reliability and to instill confidence of industry partners in student built hardware.

Efforts to share pitfalls have been investigated by the Air Force to facilitate better mission success in commercial launch services, but significant resistance to sharing of this information was encountered. This was attributed largely to the highly competitive nature of commercial launch services, but would likely receive much better reception in an academic environment. Through papers and other academic interactions, many universities are already sharing lessons learned, however a centralized repository for accessing those does not exist. This creates a barrier to entry for universities newly joining the community. Providing a knowledge management service to consortium members would be an incentive to universities, and its use would also inspire increased confidence among industry partners that despite a rate of student turnover, knowledge can be retained.

In addition to best practices, acting as a one-stop shop for information on processes to manifest university payloads onto government launches would be beneficial for any new university groups seeking these opportunities. This would lower the barrier to entry for universities seeking to start a space program, and could act as a significant incentive for them to join the consortium. Multiple studies and reports have already been generated with significant information about accessing government launch opportunities, and having these in a central location for newcomers would be a logical progression of these efforts. Having easy access to these resources would help universities interact more efficiently with industry partners.

Another more specific element that could be included in a knowledge management system is the collection of the knowledge base of best practices for university launch providers. As universities continue to expand launch operations, having a community reviewed document of best practices for launch providers would help to provide continuity of experience for university payload providers. For example, template procedures or other operational information. This could improve the efficiency of the the payload integration process especially when both the launch provider and payload developer are university based and may be new to the process and pitfalls. A shared, well defined process, would also be an opportunity for industry to provide input and again bolster confidence in the reliability of student projects.

The publishing of papers about activities conducted through collaboration to improve student access to space would have the benefit of documenting the accomplishments in a medium that is useful to the technical community. Each published report will help to communicate the benefits of collaboration between industry and university. While other organizations already provide the service of publishing technical documents, a consortium could serve as a coordinating entity so the common thread through these technical publications is documented. When combined with the success stories, a collection of technical documents can build credibility within the technical community.

5.2 Community Management

Community building and community management activities of several types could have widespread benefit. By creating a network of shared contact information, newcomers to

the consortium can more quickly become integrated into ongoing activities and would serve as another incentive for universities to join. In addition, by highlighting the number of organizations working together, the consortium would gain credibility as a standard practice and which in turn could instill confidence in the activities organized through it. Community management can often best be conducted by way of a dynamic and interactive web based platform. Many social networks already exist for niche interest groups, including space entrepreneurship. Applying a similar paradigm of features to a consortium community could facilitate communication across temporal and geographical boundaries. In the interest of promoting articulation of students from their university studies into the space industry, effective community management could be a valuable asset for making connections where appropriate to facilitate that process on an informal basis while retaining the ability to track successes.

5.3 Publish Standards

While some organizations such as the CubeSat Project are already accomplishing this for orbital satellite systems, facilitating interoperability by way of published standards for common interfaces, two things can be gained. One is an assurance of technical rigor in the integration process, and another is again to help support industry confidence in the reliability of student built hardware. This can also reduce cost of hardware development by causing more design work to be non-recurring. In addition, improvements made over time based on flight data can benefit several projects simultaneously. In order to implement an expansion of standardized interfaces, consortium leadership would need to choose system interfaces which could benefit most by standardization. As an example, if several projects evolve in which subsystems are being integrated from several different organizations, some of the subsystem interfaces with the spacecraft bus may benefit from some level of standardization.

5.4 Provide Regulatory Interface

Providing a regulatory interface could be useful in the event that a new standard is being developed. Possibly for the interface between satellite payloads and the satellite bus which could facilitate projects where an industry payload is integrated with a university built spacecraft bus. A consortium would have the ability to speak for the community as a whole on issues relating to student access to space and industry university partnership.

5.5 Develop and Issue Certifications

Developing and issuing certifications for certain processes associated with building hardware could be beneficial by supporting increased confidence by industry and government in hardware built by students. As an example, certain technician level tasks such as space rated soldering or facilities used for storage or testing could be certified to meet specific standards. Processes or documents (i.e. an interface control document) could also be certified to address specific industry concerns. One downside of this approach, however, is that while certifications of equipment, processes or documents

could have significant education value, it could also have the effect of driving up the cost of projects.

5.6 Interface to Customers and Investors

Providing significant information to potential investors (likely represented by either industry or government stakeholders) about the benefits of collaboration across industry and university lines as well as success stories would help to instill confidence and demystify the participation model. Without strong evidence of success, widespread adoption of industry and university collaboration for improved student access to space is unlikely. By making information about multi-faceted (technology as well as workforce development) successes reached through industry university collaboration could result in an increase in demand for these activities by industry.

By bringing these stories together under one consortium, a more cohesive message can be carried. Due to the systemic nature of these successes, an "objective" organization such as a consortium would be best suited to highlight the "big picture" and long term benefits of successful industry university collaboration. In addition, demystification of the collaboration model could help to deflate common detracting arguments that may have been addressed by way of process or practice.

5.7 Establish a Community of Practice

To establish a community of practice around the improved student access to space would serve to ensure the lessons learned, best practices, success stories, processes and other knowledge generated would continue to be updated and have relevance to emerging challenges. This could be accomplished through the assembly of experts and users into panels or advisory groups. By documenting the accounts from the industry perspective, further participation from a broader set of industry partners is encouraged. In addition, a high level panel could be a tool to be used in raising policy maker awareness which in turn could provide an increase in government support and widespread adoption. Community of practice activities could also be a significant value added activity for universities newly entering the consortium as a technical and networking activity.