NASA-TM-108593

SPACE EDUCATION SESSION

Space Education: Deriving Benefits from Industrial Consortia

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(NASA-TM-108593) SPACE EDUCATION: DERIVING BENEFITS FROM INDUSTRIAL CONSORTIA (NASA) 8 p

N93-18358

Unclas

G3/80 0146068

THIRTIETH SPACE CONGRESS
COCOA BEACH, FLORIDA
APRIL 27 - 30, 1993

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INTRODUCTION

As the number of spacefaring nations of the world increases, so does the difficulty of competing in a global economy. The development of high technology products and services for space programs, and the economic exploitation of these technologies for national economic growth, requires professionals versed in both technical and commercial aspects of space. Meeting this requirement academically presents two challenges. On the technical side, enrollment in science and engineering is decreasing in some of the spacefaring nations. From the commerce perspective, very few colleges and universities offer specific courses in space business.

The United States and Australia have each established programs targeted towards developing strong linkages between their universities, businesses, and space programs. The U.S. Centers for the Commercial Development of Space and the Australian Space Industry Development Centres are consortia composed primarily of universities and companies seeking to identify and exploit potentially commercially significant space-based technologies. Australia's Cooperative Research Centres, which are not limited to space research, include Centre's with a space interest. This paper describes each country's industry consortia program and discusses the resulting benefits to space education.

CENTERS FOR THE COMMERCIAL DEVELOPMENT OF SPACE (CCDS)

The National Aeronautics and Space Administration (NASA) initiated a program called Centers for the Commercial Development of Space (CCDS) in 1985 to stimulate interest and expand private sector investment in commercial space activities. The CCDS's are competitively-selected non-profit consortia of university, industry, and government entities working together to conduct space-based, high technology research with commercial potential. There are currently 17 CCDS's participating in the program, one having dropped out.[1] The CCDS's are listed in Table 1.

Funding is provided to the CCDS's through the NASA grants program at a base level of about one million dollars per year each. NASA provides some additional funding to support specific flight hardware and commercial transportation programs on a case-by-case basis. The CCDS's are expected to leverage the NASA funding with additional funds or in-kind support from their private sector and university affiliates.

The CCDS's serve as incubators for future space-related products and services and offer U.S. organizations excellent opportunities to perform low cost, space-based commercial research and development. CCDS's and their affiliates are actively developing commercial space hardware, infrastructure, and transportation resources. Through flight experiments they are building commercial data bases characterizing the environment of space in the development of such things as new materials, pharmaceuticals, diagnostics, robotics, and uses for remotely sensed data. As of late 1992, 248 companies and 88 universities were participating in the program.

The CCDS's provide significant benefits to space education in the United States. An estimated 163 professors, 116 undergraduate students, and 260 postgraduate students worked on space application projects during 1992. Over 100 degrees have already been awarded to students involved in CCDS-related projects.[2]

SPACE INDUSTRY DEVELOPMENT CENTRES (SIDC)

The Australian Space Office initiated the Australian Space Industry Development Centres (SIDC) program to help Australian industry develop products and services which can compete for identified opportunities in the international space marketplace. The SIDC's are competitively-selected collaborative research and

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[1] The Center for Space Processing of Engineering Materials, Vanderbilt University, in Nashville, Tennessee, announced that it would discontinue its operations in October 1991.

[2] There were 122 degrees awarded through 1991. Statistics for 1992 have not yet been compiled.

development centres established with public and private sector partners and funding. Selection of the first SIDC's was announced in 1990. A total of six SDIC's have been formed; four are still participating in the program. The current SIDC's are listed in Table 2.

The SIDC's receive public funding to a maximum of A$500,000[3] per year per Centre for approved specific research and product development projects. Funding is provided for up to 5 years, and industry partners are required to match government funding. The Centres receive an additional A$25,000[4] for administrative and marketing costs.

The SIDC's are a major infrastructure element of the Australian Space Industry Development Strategy. Like their CCDS counterparts, the SIDC's are a means of encouraging commercially-targeted research and product development in space-related technologies. All of the SIDC's are headquartered at universities.

COOPERATIVE RESEARCH CENTRES (CRC)

A second Australian program which provides benefits to space education is the Cooperative Research Centres (CRC). The CRC initiative was introduced in 1991 by the Prime Minister's Office, through his special scientific adviser. CRC construction is similar, but not identical, to the SIDC's. The process involves a consortium composed of industry, universities, and government research establishments submitting a proposal of support (on a dollar-for-dollar matching basis) of up to A$5,000,000[5] per annum for 7 years. Legally, CRC's are limited-liability Australian companies. The CRC decides the direction of the research, and all partners (including the universities) contribute financially. Fifty CRC's either have been or are in the processes of being established. CRC's are not limited to space research--they have been established in a wide variety of technical areas.

The Centre for Aerospace Structures was among the first 15 CRC's established. The consortium consists of the two main aerospace manufactures of Australia, Hawker de Havilland and Aerospace Technologies, Australia. Three universities--Sydney, the University of New South Wales, and the Royal Melbourne Institute of Technology--participate in the CRC by teaching and researching aerospace engineering. Also participating are Monash University and the Government's Aeronautical Research Laboratory. Other CRC's have a space interest, mainly in the usage of space technology for such purposes as remote sensing.

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3 Approximately US$386,5000.

4 Approximately US$19,325.

5 Approximately US$3,865,000.

BENEFITS TO SPACE EDUCATION

The CCDS, SIDC, and CRC programs were not established primarily to further space education. The consortia have the potential to provide a significant benefit to each nation's space education infrastructure, which can be a valuable dividend on the national investment. It is beyond the scope of this paper to attempt a cost benefit analysis of the public and private investment versus the educational benefits (many of which may be intangible).

The formation of partnerships such as CCDS's, SIDC's and CRC's implies that to a certain extent government, industry, and academia together guide the technological direction of the Nation. Each party enters the relationship with slightly different motives, expectations, and agendas. Simply put, the Government seeks to promote the national interest while industry wants to demonstrate a profit to its shareholders. For universities, the "profit" may be academic prestige--which increases the value of the product (education) that they provide to their customers (the students). Only where there is a careful balance of these needs and expectations can the potential synergistic benefits of the relationship be realized.

Potential benefits to space education can include, but are certainly not limited to, the following:

o Participating universities can gain an improved base of knowledge concerning the commercial world's needs. Such knowledge can assist the university in making informed judgements on what research efforts to support. However, if a university already has a strong industry relationship, participation in a consortium may not provide significant value-added.

o The programs present opportunities for the development of relationships between universities and industry which are based on mutual concerns and interests, the sharing of intellectual knowledge, and the effective transfer of new knowledge to the commercial marketplace.

o From a business standpoint, membership in a consortium can provide opportunities for faculty and students to gain valuable space business experience. Since few, if any, universities have courses in space business, involvement in a consortium may be the only way for students to get exposure to this field.

o From a technical standpoint, the consortia can open up new opportunities for universities to participate in space-related activities. If the work of the consortium is challenging it can provide a motivational force for students and faculty alike.

TABLE 1.

CENTERS FOR THE COMMERCIAL DEVELOPMENT OF SPACE

1. Battelle Advanced Materials Center
   - Electronics, polymer, and catalysts applications

2. Consortium for Materials Development in Space (University of Alabama in Huntsville)
   - Superconductors
   - Electro-optical materials

3. NASA Center for Crystal Growth (Clarkson University)
   - Crystal growth

4. Space Vacuum Epitaxy Center (University of Houston)
   - Thin film growth
   - Materials purification

5. Center for Materials for Space Structures (Case Western Reserve University)
   - Materials exposure

6. ITD Space Remote Sensing Center (Stennis Space Center)
   - Satellite and airborne remote sensing
   - Image processing
   - Geographic information

7. Center for Mapping (The Ohio State University)
   - Remote sensing geographic information systems and global positioning system applications

8. Center for Cell Research (Pennsylvania State University)
   - Understanding of cell functions for disease treatment

TABLE 1. (Con't)

CENTERS FOR THE COMMERCIAL DEVELOPMENT OF SPACE

9. BioServe Space Technologies (University of Colorado-Boulder)

   - Space-based biomedical and agricultural research

10. Center for Macromolecular Crystallography (University of Alabama at Birmingham)

    - Crystal growth for use in new pharmaceuticals or biotechnology

11. Wisconsin Center for Space Automation and Robotics (University of Wisconsin-Madison)

    - Automation and robotics

12. Space Automation and Robotics Center (Environmental Research Institute of Michigan)

    - Machine vision and sensing systems
    - Robotics and automated manufacturing systems
    - Biological technology for life-support systems

13. Center for the Commercial Development of Space Power and Advanced Electronics (Auburn University)

    - Alternate commercial space power

14. Center for Space Power (Texas A&M University)

    - Commercial space power systems

15. Center for Space Transportation and Applied Research (University of Tennessee-Calspan Center for Space Transportation and Aerospace Research)

    - Advanced aerospace propulsion technologies

16. Center for Satellite and Hybrid Communication Networks (University of Maryland Systems Research Center)

    - Space-based communications

17. Center for Space Communications Technology (Florida Atlantic University)

    - Digital transmission techniques for video, audio, and data

TABLE 2.

SPACE INDUSTRY DEVELOPMENT CENTRES

1. Australian Space Centre for Signal Processing (University of South Australia)

   - Research and development on signal-processing hardware for satellite communications
   - Image processing
   - Launch and re-entry vehicle systems
   - Tracking operation

2. Space Microwave Centre (Griffith University/University of Queensland)

   - Microwave flight system hardware

3. Space Center for Satellite Information Systems (Queensland University of Technology/University of New South Wales)

   - Advanced Australian satellite navigation and positioning systems

4. Space Industry Development Centre for Space Engineering (Universities of Adelaide/South Australia/New South Wales)

   - Regional focus in space industry-related space engineering research and applications
   - Key strategic engineering capability for companies developing products or systems for spacecraft