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Apr 23rd, 2:00 PM - 5:00 PM

Paper Session I-C - The Role of the University in Commercial Launch Activities

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THE ROLE OF THE UNIVERSITY IN COMMERCIAL LAUNCH ACTIVITIES

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ABSTRACT

Success of the U.S. in the international space arena depends largely on our ability to reduce the cost-to-orbit of payloads. To reduce costs, significant effort must be expended to upgrade commercial launch vehicles, processing facilities and operational procedures.

The universities have much to contribute to such an effort. This paper discusses the positive role that universities can play in helping industry and government be more successful in commercial space. Activities include needs assessments, problem definition, research, test and evaluation, business assistance, and education. Emphasis is placed on establishing a permanent capability to continuously advance launch systems technology, and on developing education and research programs that are complementary to each other.

INTRODUCTION

For several reasons, U.S. commercial launch operators are at a disadvantage compared to those from other space faring countries of the world. This fact raises the following questions: How can the U.S. establish a clear leadership in commercial launch capability? How can we maintain such leadership in the future?

This paper stresses the need for strong industry, government, and university teams to accurately assess needs, develop new technology, and effectively convert research results into better hardware, improved processes and lower costs.

NEEDS OF THE U.S. COMMERCIAL SPACE PROGRAM

Over the past several decades, U.S. leadership in technologies such as automobiles, shipping, televisions, consumer electronics and others has been lost to other nations, or seriously eroded. One field in which the U.S. has consistently been recognized for its leadership and overall technical prowess is aerospace technology. It is important not only to maintain this leadership, but also to enhance it through productive research and development efforts.

Despite many aerospace successes, the future of the commercial space program is much in doubt. With the Challenger tragedy, it became apparent that a more diversified launch capability was necessary, including a heavier reliance on Atlas, Delta and Titan vehicles. A visit to these launch facilities dramatically demonstrates the need for modernization and technology infusion. Many of the facilities are over 30 years old and use technology from the 1950s and 60s. As a consequence of this and increased use of the Eastern Test Range, launch processing is slow and expensive and must be improved for long term success in the increasingly competitive commercial space arena.

The president of one of the U.S. commercial launch operators recently stated that it is not easy for the U.S. commercial launch industry to be optimistic about its future. He expressed concern that economic conditions may force U.S. companies to quit the business, leaving our commercial satellite industry completely dependent on foreign transportation to space.

International competition in commercial space presently comes from four sources: the Europeans, Japan, the Soviets and the Chinese. They have all benefited from U.S. advances in aerospace technology. In particular, much of their launch facilities and hardware is newer and has been developed specifically for commercial applications. In addition, the Soviets and the Chinese operate in non-market economies (i.e., heavily subsidized by their governments). Consequently, their launch prices are relatively low. U.S. companies can counter this by offering better launch services, but it is important to reduce costs from present levels.

A tremendous improvement in our competitive stature can be achieved through the use of advanced automation, intelligent launch processing, robotics, data management and other launch system technologies. However, this is not enough. It is important to establish a permanent capability to continuously improve launch systems technology, and to continuously and effectively transfer research results to the commercial launch industry. It is important also that the research effort not be limited to just applied research. Basic, fundamental, generic research is critical to long term success. A good balance between fundamental and applied research needs to be established.

In summary, a most important need of the U.S. commercial space program is lower costs-to-orbit. Lowering these costs requires a significant modernization of the commercial launch infrastructure. This modernization can be accomplished in part using existing technology. However, to achieve a competitive edge, a continuous advancement of commercial launch capability is necessary. This can best be done through an effective research and development program that successfully focuses university expertise on industry and government needs. A proper mix of basic and applied research is necessary for continued long term success.

VALUE OF COOPERATIVE RESEARCH RELATIONSHIPS BETWEEN INDUSTRY, GOVERNMENT AND UNIVERSITIES

In studying seven cases involving cooperative research programs, McDonald and Gieser (Research Management, 1987) concluded the following:

- All projects gave excellent technical results which met or exceeded the expectations of the project leaders.
- Cooperative projects are an effective means for enhancing student education, training and employment opportunities.
- Involvement in cooperative research can lead to increased academic and private sector cooperation, and subsequent participation in future projects.
- Close geographic proximity of the participants can greatly enhance the productivity of cooperative R & D projects.

The authors go on to recommend the following for success in cooperative research agreements: open communication, mutual dedication and interdependence, respect and trust, an effective program management system, and a willingness on the part of all participants to compromise.

Extremely important areas affecting autonomous and intelligent launch processing are artificial intelligence and expert systems. The close relationship between Carnegie-Mellon University and Digital Equipment Corporation is a good example of university and industry cooperation in these areas of research. Feigenbaum, McCorduck and Nil in their book The Rise of the Expert Company (Times Books, 1988) note that nearly every industry organization that was early in getting into expert systems has had strong ties with the university research community. The book also notes that Japanese industrial firms systematically send their brightest young researchers to graduate school in the United States. The Japanese have concluded that the universities have much to contribute to their industries' success and are in the process of establishing several joint research centers (Research Management, 1987). Each center will concentrate on different specialized research areas.

Roland Schmitt, president of Rensselaer Polytechnic Institute and former head of General Electric Company's corporate research and development, states that the partnership between academia and industry produces the preeminent pioneering basic research for which the United States is renowned (Spectrum, 1990). The emphasis in the article is that basic research is a key ingredient to long term corporate success and we need to restrain the push toward faster commercialization.

In a companion article (Spectrum, 1990), Toshiaki Ikoma of the University of Tokyo states that "the infrastructure for fundamental research in Japanese universities is very weak..." In many ways, Japanese industries

have been more effective in utilizing basic research results from U.S. universities than have American companies.

THE REWARD SYSTEM WITHIN THE UNIVERSITY

University faculty are evaluated for performance in three main areas: teaching, research, and service. Of the three, success in research is an important distinguishing characteristic among faculty. Research grants benefit the entire university community. New knowledge is added to the classroom; thesis and dissertation topics are generated; knowledge is synthesized and transferred through publications; marketable research skills are improved; and funds are released for laboratory improvements and other purposes.

In summary, faculty need research to be successful and graduate students, particularly doctoral candidates, need research to graduate. It makes good sense, therefore, to establish the connection between those who have the expertise and the need to do research with industry and government organizations that can benefit from such research.

Despite the desirability and the benefits of cooperative research between government, industry and academia, much work needs to be done to make it happen and to more fully take advantage of opportunities that present themselves.

GOALS AND OBJECTIVES

The University of Central Florida (UCF) has two primary goals for space related pursuits:

1. To establish strong and enduring synergistic relationships with the space industry, government, and other educational institutions.
2. To establish a permanent research capability to continuously advance space science and technology, and to address the most pressing needs of the space community.

More specifically, the University desires to assist the space industry and government in establishing the most modern and advanced spaceport in the world within ten years. To achieve this latter objective requires a strong concentration of effort in launch systems research, a critical mass of faculty and student researchers in relevant technologies, and appropriate laboratories and facilities in which to conduct the research.

SPACE RESEARCH CAPABILITIES AT UCF

Basic factors which limit research capability include the size of the university, number and quality of researchers, and disciplines represented. The University of Central Florida presently has approximately 22,000 students distributed among five colleges: Arts and Sciences, Business Administration, Education, Engineering, and Health and Professional Studies. The relevant areas in which doctoral programs are offered include computer science, human factors psychology, civil engineering, computer engineering, electrical engineering, environmental engineering, industrial engineering, and mechanical engineering. A much larger number of master's degree programs are also offered, including the M.B.A. program in the College of Business Administration. All of this information is indicative of the fact that the University has both the breadth and depth of capability to perform research which can significantly affect commercial launch activities.

A challenge within universities is to marshal the talent and resources available, and to concentrate efforts so as to maximize their impact in advancing technology and solving problems. Reasons why this is sometimes difficult within a university include the emphases on individuality and on independent research, in contrast to the team approach more prevalent in industry and government. In truth, many major scientific breakthroughs result from individual faculty researchers pursuing basic research with their students in the laboratory. However, launch systems research cuts across many disciplines and requires a coordinated team approach. A principal role of UCF's Space Education and Research Center (SERC) is to bring together the diverse talents necessary to address serious launch system problems.

The Space Education and Research Center has developed a document entitled "Space Research at the University of Central Florida: Capabilities." The document identifies three major areas of research strength: launch systems, space optics and communications, and educational technology.

Within universities, research project implementation typically involves faculty members in lead roles, followed by doctoral candidates, and possibly master's degree students. Highly qualified faculty are required both to perform research and to direct graduate students. Because of the high standards for doctoral dissertations, doctoral candidates add greatly to overall research capability. Approximately 45 UCF faculty members with expertise relevant to launch systems research are listed in the capabilities document, together with biographical information (SERC, 1991). Of these faculty, over 35 supervise doctoral candidates. In addition, over 30 laboratories appropriate for conducting various aspects of launch systems research have been identified.

UCF has been actively involved in launch systems research since 1968, the year students were first admitted, when its first grant was received from NASA in the area of optical tracking. Presently, the University receives approximately \$2 million per year in space-related contracts and grants. About half of this amount is with NASA Kennedy Space Center and involves

launch systems research. The capabilities document presents information on nine separate launch system research projects currently in progress (SERC, 1991).

PROPOSED RESEARCH PROJECTS

In January 1991, the University of Central Florida, in cooperation with the Spaceport Florida Authority and key members of the U.S. commercial launch industry, submitted a proposal to the National Science Foundation for an *Automation and Intelligent Launch Systems Research Center*. The proposal was in response to NSF's initiative for cooperative research between state government, industry and universities.

NSF, NASA and other federal agencies have long recognized the importance of government, industry and university cooperative research, and have actively pursued a variety of programs to encourage such cooperation. The proposal cited above identifies the emerging U.S. commercial space program as a prime target for focusing university research capabilities.

UCF has attempted to identify a balanced research approach for the greater benefit of the commercial launch industry. Projects recently proposed to NSF (Johnson, 1991) include the following:

1. Object-oriented analysis, design, modeling and simulation. The focus of this activity will be on intelligent launch control and the associated software and data structure.
2. Real time computer control of dynamic systems: multi-rate sampling, measuring and data processing. The objective is to enhance launch flexibility, introduce options not presently available, and reduce manpower requirements for launch processing.
3. Robust control theory research for non-linear uncertain dynamic systems. This research will help satisfy operational checking, maintenance and repair of the launch vehicle and ground support equipment, including hazardous operations.
4. Development of a generic simulation model using artificial intelligence and expert systems to analyze launch vehicle processing. The generic simulation will be capable of modeling ground processing at any launch site in the world.
5. Process analysis and control to enable automation and expert systems implementation. This effort will provide the process analysis capability and the statistical control capability needed by the other proposed research projects.

6. An intelligent simulation training system. Such a system will provide augmented training capability.
7. Automated docking mechanisms and control algorithms. This research will reduce processing time, improve the overall capacity to launch vehicles and lower costs.
8. Vibration control of a robotic arm using a piezoelectric actuator. This work will allow for more precise remote control.
9. Computer and communications network design of intelligent launch command and control, automated vehicle check-out and monitoring system. This project has the potential to significantly increase the current launch rate of expendable vehicles.
10. Systems analysis and development of a strategic plan for commercialization of space launch services. This project will include a commercial environment assessment, recommendations and implementation assistance.

CONCLUSIONS AND RECOMMENDATIONS

- The university community has both the expertise and the incentives to advance launch systems research.
- The opportunity exists for a mutually beneficial cooperative research relationship between the commercial launch industry, NASA, Spaceport Florida Authority, the Air Force and educational institutions in the region.
- A comprehensive commercial environment assessment and a needs assessment should be given high priority. Although industry will be the primary source in defining problems and needs, the assessments should be the responsibility of an industry, government, university task force.
- A research agenda should be developed based on the needs assessment. A strong basic research component should be included.
- Funding sources for research should be identified and vigorously pursued.
- A permanent capability to continuously advance launch systems technology should be established.
- Education, training and development programs should be complementary to the research programs and should contribute to enhancing research capability.

REFERENCES

1. McDonald, D. W. and Gleser, S. M., "Making Cooperative Research Relationships Work," Research Management, Vol. 30, No. 4, pp. 38-42, July-August 1987.
2. Feigenbaum, E., McCorduck, P. and Nil, H. P., The Rise of the Expert Company, Times Books, New York, p. 132, 1988.
3. "Japan to Establish Joint Research Centers," Research Management, Vol. 30, No. 4, p. 4, July-August 1987.
4. Schmitt, R., "We have to relearn what we once knew better than anyone," IEEE Spectrum, Special Issue on R & D, Vol. 27, No. 10, pp. 81-82, October 1990.
5. Ikoma, T., "The infrastructure for fundamental research in Japanese universities is very weak and will not be improved rapidly," IEEE Spectrum, Special Issue on R & D, Vol. 27, No. 10, pp. 80-81, October 1990.
6. Space Education and Research Center, Space Research at the University of Central Florida: Capabilities, Spring 1991.
7. Johnson, R. W., "Automation and Intelligent Launch System Research Center," a proposal submitted to the National Science Foundation, State/Industry, University Cooperative Research Initiative, January 1991.