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University - Industry Interaction

Daniel E. Hastings  
Program Director, MIT Space Grant Program  
Massachusetts Institute of Technology  
Cambridge, Massachusetts 02139

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## University Industry Interaction

### Abstract

It is posited that university industry interaction is highly desirable from the viewpoint of the long term economic development of the country as well as being desirable for the Space Grant Programs. The present and future possible interactions are reviewed for the three university levels namely, undergraduate, graduate and faculty research.

### Introduction

It is a truism that the long term health of high technology industry depends on access to and employment of creative, knowledgeable people. It is critical, therefore, that the industry be able to attract and retain such people. One of the prime examples of high technology industry is the aerospace industry which historically has progressed by fits and starts. Many of the leaps forward have come through the inspired leadership of creative individuals as well as through the determined efforts of legions of dedicated scientists and engineers. Some examples that arise are Robert Goddard, Werhner Von Braun and Kelly Johnson.

While there have been many recent critiques of the secondary school education in the US, education in the US at the university level is clearly first rate. This is a fact recognized by students from all over the world who clamor to get into American universities. This includes in particular, students from countries which are our main economic competitors. Students from these countries, particularly Japan, mainly come to the US in order to participate in the research experience at the universities as well as to gain an appreciation of American culture.

After the Second World War, the US had the dominant economy in the world with essentially no competitors and for that period of time US universities did a good job of filling the needs of US industry. In recent years it has been recognized that the paradigm that worked right after the war is no longer valid in light of the changed and changing world order. From the university point of view, the enormous amount of federal money which built and sustained the growth of research in universities is now shrinking. This demands attention to be paid as to other possible sources of support.

In addition the desire of many states to use the universities as seed beds for industrial development also means that the universities have to be more proactively involved in the business world. From the industrial point of view, the increasingly competitive world market and the growth of the economic powerhouses in Asia and Europe means that industry must scramble to stay ahead or to catch up. The universities provide a possible means for doing this. Additionally, as the number of young people entering technical fields in the country continues to drop, industry will face a shortfall of about half a million scientists and engineers by the end of the century. Unhappily, this shortfall comes at time when the overall educational standards in the US are low as compared to our major competitors. All these arguments point to the fact that the time is ripe for a new, close and cooperative relationship between US industry and US universities.

In this new climate exist the NASA Space Grant Programs which have as their avowed aims the encouragement of cooperative programs among universities, aerospace industry and government as well as the recruitment and training of professionals, especially women and underrepresented minorities, for careers in aerospace science and engineering. This paper will address the mechanisms by which universities and industry can interact with particular reference as to how the Space Grant Programs can interact with aerospace industry. The discussion is framed in terms of the three levels in universities, namely undergraduate, graduates and faculty/staff research.

#### Interaction at Undergraduate Levels

The undergraduate levels are traditionally the levels which supply most of the people in industry. For example, 60% of the undergraduate class at MIT in aeronautics and astronautics goes on to work in the aerospace industry after graduation with the Bachelors degree. This is clearly a level at which industry has a great incentive to participate with universities to ensure that it gets the engineers it needs.

Many recent studies have called attention to the fact that while the US has a large and creative basic research establishment, our competitors often end up beating us in terms of bringing cost effective goods to market.

One of the explanations for this is the lack of any systematic study of design and manufacturing engineering at either the university or the industry level. It is often suggested that researchers, design engineers and manufacturing engineers do not communicate with each other, with the attendant loss of synergetic interactions. This situation did not always exist in US industry. After the war in many aerospace industries, engineers were required to undertake apprenticeships in several areas of a company before starting on their main job. This was so they appreciate and communicate with other engineers. This is a practice still adopted in Japanese aerospace companies. In US companies it has fallen out of favor as the increased mobility of American society has meant that the average time an engineer stays with a company has decreased relative to what it was. This makes it uneconomic for US companies to employ an engineer and not get a return from his work. In parallel with this trend is the rise of engineering science at universities. Since it is much easier to judge faculty in this area rather than in basic engineering the universities are now filled with faculty who are mainly engineering scientists rather than engineers. These two trends and their consequences are now recognized and both universities and industry are moving to correct them. One major way to do this at the undergraduate level is to teach courses in the design and manufacturing of products by practicing engineers from industry. For the aerospace industry, the Space Grant Programs could make a major contribution to this process by sponsoring such courses in their universities. In order for this to be successful, industry would have to be willing to release an engineer for a semester to teach such a course as well as allow that engineer to speak on the details of the manufacturing process. This may raise some questions of a proprietary nature. The universities would have to recognize the importance of such a course by making it a requirement for graduation with a degree in aerospace engineering. An excellent example of this was noted in the Soviet Union, where at the Moscow Aviation Institute they have an aircraft design course taught by the lead designer for the Sukhoi design bureau. He works part time at the Institute and part time at Sukhoi.

Many students who decide to go in for aerospace science and technology do so because they find the whole enterprise of space research and exploration very exciting. For these students, one of the best ways to attract, motivate and retain them in the aerospace field is to show them how exciting the field can be. One way to do this is for industry to support research projects at the universities specifically designed so that undergraduates can make vital contributions to the project. By this means the students can see and feel the excitement of a research project which previously was something that only graduate researchers could know. Specific recent examples at MIT are the Deadalus project which built a man powered aircraft and set a world record. This project involved many undergraduates in the design and manufacturing of the aircraft.

Interestingly, this project was underwritten by Annhauser-Busch which is a well known beer company. Another example is the EASE project which involved a shuttle experiment on the ease of constructing structures in space. While the shuttle astronauts ultimately performed the experiment, many student participated in the design and testing at the MIT swimming pool and the NASA Marshall neutral buoyancy facility.

This project was underwritten by NASA. For this to be a successful industry we would have to be willing to commit money and suggest creative ideas for undergraduates. The universities must be willing to allow faculty to spend their time on these projects and judge it as an important part of the educational process. That is, faculty must be rewarded for participating in these projects.

Finally, there are the traditional ways in which universities and industry have interacted. These include industry offering summer positions to students as well as co-op arrangements whereby students go to school part time and work part-time. The Space Grant Programs could create such arrangements and administer with aerospace industry. This is one of the approaches taken at the MIT Space Grant Program which has put together a consortium of nine companies involved in the aerospace business. These companies have all committed to provide summer employment for students recruited by the Space Grant Program. The program and companies are particularly geared to recruiting students early in their careers as well as minority and women students. The response so far at MIT indicates that this approach has been well received by the students.

#### Interaction at the Graduate Level

In the aerospace industry, in many ways the optimal degree to possess presently is a Masters degree. This is because the management track is much easier to get into with this degree. Additionally, the amount of knowledge required for modern aerospace engineering is such that many in the educational field question whether it can be encapsulated only in a Bachelors program. For work in any field of space science, a Doctor's degree is essential in order to get a meaningful job. In light of these trends a major level of interaction between industry and universities can be by industry supporting it's employees to get graduate degrees. While many of the aerospace companies have such programs, the employees are often only allowed to go part-time or at night to local universities. This is driven by economic considerations since the company does not wish to lose services of a valuable employee either temporarily or permanently if he leaves for a better job right after getting the graduate degree.

In contrast, Japanese companies are sending many employees to US universities to get graduate degrees. The students come full time, take courses, engage in state-of-the-art research and then return to their companies after a period of two to four years. The Japanese companies can afford to do this because of the tradition of lifetime employment both in terms of the company and of the employee. Interestingly, many career Air Force officers come full time for graduate degrees and they are encouraged to do so by the Air Force since it is recognized that the officer will be staying in the military. The Space Grant Programs can sponsor and arrange faculty support for industry employees taking graduate degrees through them.

The other traditional ways for universities and industry to interact at the graduate level are for industry to support graduate fellowships, graduate research projects and offer summer employment for graduate students. The role of graduate fellowships is becoming increasingly important as the character of the undergraduate population changes. The number of underrepresented minorities going into graduate school has been dropping at precisely the time that it needs to rise to supply the needs of the country. This in part can be traced to the decline of federal support for undergraduate loans and grants through the eighties. Minority students are much more likely than majority students to end undergraduate years with crippling loans and the lack of graduate fellowships acts as a disincentive to go on for graduate school. Graduate research projects leading to a S.M. or Ph.D. can be very useful to a company if the project coincides with the research interests of the company. The Space Grant Programs have graduate fellowships from NASA and can and should obtain additional fellowships from industry.

#### Interaction at the Faculty/Staff Levels

The US is widely recognized as having the premier research and educational establishment in the world. This is largely due to the fact that for several decades the universities have benefited from federal largesse and that in the research based universities the teaching loads on the faculty are deliberately kept low. This has enabled many faculty in universities to establish research groups at which first rate research is undertaken. Many universities have established formal industrial liaison programs whereby companies pay a fee to participate and are given facilitated access to university faculty as well as invited to university symposia. These programs have been moderately successful in bringing together industry and universities. Space Grant Programs can support or create such programs where they do not exist.

A major way that industry can learn of university work is by sending research staff to spend some time in university labs.

At MIT Japanese companies have sent many researchers to laboratories in electrical engineering and in material science. Typically such researchers come for two years and periodically report to the companies on the work that is going on in the labs. Space Grant Programs can organize and sponsor exchanges like this with the aerospace companies. The Space Grant Programs can use their contacts in industry to help arrange sabbaticals for faculty in companies. These sabbaticals would help the university by bringing in industrial experience and help industry by giving access to highly qualified faculty.

Finally, companies can support research projects with faculty directly or perhaps better, support endowed chairs for faculty. These enable faculty to be free to pursue their research as they see fit. If their company also sent along research staff then the faculty member and the staff could interact and mutually benefit from each other. Space Grant Programs can be active in encouraging the donation of such chairs.

### Conclusions

Industry and universities need each other especially in the future and for the well being of the country. The Space Grant Programs can play a significant role in bringing together universities and companies in the aerospace field.