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Paper Session I-C - The Future of the Space Program is in the Hands of an Unexpected Customer

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**THE FUTURE OF THE SPACE PROGRAM
IS IN THE HANDS OF AN UNEXPECTED CUSTOMER**

ABSTRACT

"The Challenges of the Space Exploration Initiative are great, but so is the quality of American talent and ingenuity, and so is the leadership of the American people. And ... it is America's destiny to lead."

President George Bush

In order for America to maintain its leadership position in space, a technically skilled workforce must be cultivated. Current projections of the American workforce in the year 2000 predict a shortage of scientists and engineers. America's current educational system will not be able to meet the Space Industry's needs for skilled labor. In order to increase tomorrow's supply of talented individuals, it is imperative that the Space Industry and all other industries that use this resource be proactive in all levels of the educational process. Only then will America be able to retain its competitive edge in space.

This paper searches for the root causes of the predicted shortage of scientists and engineers and discusses a potential countermeasure. Emphasis is placed on what Industry can do to augment the traditional educational process.

BOTTOM LINE

THE FUTURE OF THE U.S. SPACE PROGRAM IS IN THE HANDS OF A BUNCH OF SEVENTH GRADERS! That same august group of decision makers is also pondering the future of the American computer industry, automobile industry, hamburger industry, and all other industries in our country.

That's the startling conclusion the three of us reached while researching this paper. We set out to determine the root cause for the decline in engineering, math, and science trained college graduates in the U.S. From an Industry standpoint, this represents a reduction of the key resource on which we depend for a steady supply of people trained in the skills needed to conduct our businesses.

There are several major factors at work here. The first is that the available population of future new workers is simply declining. Between 1983 and 1997, the total population of 22 year olds in the U.S. will go down 26 percent¹. This we can't do anything about. Another major factor is that the demand for employees with at least some math and science skills is increasing as technology continues to permeate our lives. This we also can't do anything about.

As it stands, not enough of today's young people will pursue a technical education to make up for the declining population and the increasing needs for these skills in the future. At the present rates, only three fourths of those 22 year olds will graduate from high school, 44 percent will enter college, and 22 percent will earn a bachelor's degree — but, only 2.2 percent will earn a bachelor's degree in an engineering or scientific field and only 0.1 percent will earn a PhD in engineering or science. At these rates, it is predicted that there will be a shortage of 400,000 scientists and 275,000 engineers in 15 years. This we can do something about.

Industry must take a strong proactive stance and work with the school system to identify students in the seventh grade or earlier and provide specific help to sell these students to take on the extra work and commitment to study math and science. The word, "sell," is used deliberately. We are trying to get these young people to do something which requires their time, their commitment, and their hard work. Unless we can reach them in their own space, and in their own language, then the rest of the loud sellers already in their space (MTV, rock, socializing, etc.) will continue to dominate their decision processes.

1. The statistics that appear in this and the following paragraph are derived from Workforce 2000: Work and Workers for the 21st Century, Indianapolis, IN: Hudson Institute, 1987.

EDUCATORS' PERSPECTIVE

The Instructional Division of the Brevard County, Florida, Board of Education calls seventh grade algebra the gateway course in the students' mathematical curriculum. This is where the students transition from traditional to higher math. We sought insight into this critical age by interviewing teachers at Jefferson Junior High School in Merritt Island, Florida.

A false conclusion is that children this age can't handle the concepts. Case in point: Brevard County had a system of 3 levels of mathematics education and found that the greatest failure rate was in the lower level classes. The lower level courses were dropped and the students from those courses were required to take a higher level course. The result was that the failure rate actually decreased. This, in the words of one educator, is because the expectations had been increased. This clearly illustrates that it is not a lack of talent causing enrollment to decline.

What does appear to be lacking is an interest or desire to learn math and science. The children that are extremely gifted, or those who have parents in technical professions are likely to pursue math and science training. It is the children in the next tier that are at risk. They have the talent, but they don't have the incentive or inclination to follow through. These children must be targeted to fill the ranks of technically trained people for the workforce in the year 2000.

In the seventh grade, students do not understand why they are taking mathematics; they have not yet developed long term goals. At this point in their lives they are more interested in finding out where the party is this weekend. According to teachers, this "weekend vision" is the norm for Junior High School students.

The benefits of enrolling in mathematics and science are intangible to Junior High students. Thus, the students need to have these classes sold to them. The students have to believe that they are getting something special. They need to understand why they are learning the material.

Currently teachers are the only sales people. Today, teachers have to compete with MTV, Madonna, Michael Jordan, etc. Many students have a very narrow view of life; they demand instant gratification. They tend to view the world in economic terms only; and teachers are low on the economic credibility scale. If a teacher suggests that a student enroll in mathematics or science, the student may respond by asking about the teacher's pay scale and what kind of car he/she drives. In this status game teachers have a tough time competing.

INDUSTRY'S CHALLENGE

As consumers of the resource of technically skilled people, it is in our best interest to replenish it. Industry needs to help sell mathematics and science. Industry needs to provide the incentive to students to attain the skills. Industry needs to expose the students to the benefits of mathematics and science training. Industry can help provide the needed role models and help sell long term goals.

It's hard to glamorize mathematics and science, but the intent is really to open the students' eyes to the realities of the future and to sell a message to them. These students are our CUSTOMERS! We must treat them as such. The customer must be sold on the product before he/she will buy it. We did some market analysis and compiled a customer profile:

The Junior High Mathematics and Science Education Customer:

1. They have a sixth grade education.
2. They are capable but not particularly interested in the product.
3. Their primary role models appear on MTV and in beer, soda, and sports shoe commercials.
4. They are 12 years old and they are being asked to make a 10 year commitment (an eternity!).
5. They are not yet equipped to make complex decisions.
6. They are not yet equipped for long term planning.
7. They are interested mainly in creature comforts (pizza, soda, etc.).
8. They demand instant gratification.
9. They are subject to intense peer pressure.
10. For the first time in their lives, math classes are optional.
11. They have had everything dictated to them all of their lives and now they are beginning to make some decisions which will affect them for the rest of their lives.

In order to sell the benefits of math and science training, the seller must remember that the CUSTOMER IS ALWAYS RIGHT. And this is one tough customer!

What is being asked of the average (not gifted) student to study mathematics and science? If the average student spends one hour per evening studying for a mathematics and science class, he/she would be committing almost 20 percent of his/her discretionary time! An analysis of the time commitment is shown below:

TYPICAL ADOLESCENT WEEK			
<i>Activity</i>	<i>Hours/Day</i>	<i>Days/Week</i>	<i>Total Hours</i>
<i>Hrs per day</i>	24	7	168
<i>Sleep</i>	8	7	-56
<i>School (+travel, etc.)</i>	9	5	-45
<i>Non-School Meals</i>	2	7	-14
<i>Discretionary Time</i>			53
<i>Study Math/Science</i>	2	5	10
<i>Time Commitment</i>			18.9%

Although adolescents clearly have enough discretionary time, will they be willing to part with such a significant portion? It is definitely a BIG impact. Imagine asking them what four TV shows they would prefer to give up! To them it may seem like an incredible waste of time.

Are typical 12 year olds mature enough to analyze the options and consequences to make a commitment? The payoff is intangible to them; it is 10 years (2 in Jr. High, 4 in Sr. High, 4 in College) away!

EXISTING COUNTERMEASURES

One consumer of engineering resources, NASA, has had experience with this level of customer through its NURTURE (NASA's Unique Resident Tutoring for Up-and-coming Replacement Engineers) program. This program has the specific objective of identifying and nurturing Junior High students who may have an interest in technical fields. NASA works with the schools to select students in the ninth grade for a series of one-day mentoring experiences at KSC and other centers. This is a planned four-year program, rotating the stu-

dents through each of the major departments at the Space Center. The students are treated to a curriculum which includes:

- Hearing about NASA's research and development programs
- Learning about future space programs
- Observing demonstrations and working laboratories
- Visiting operational work areas
- Working on projects that interest them
- Meeting NASA engineers at work
- Learning about qualifications for jobs at NASA

The students are assigned mentors who stay with them for the whole year, providing a person-to-person communication. In many cases this extends beyond the program to helping with science fair projects and similar experiences. NASA has found that continuity and follow-up are critical for these customers. Students who stay in the program are eligible for summer jobs at NASA through the SHARP (Summer High school Apprenticeship Research Program) program.

There is a follow up with each student to identify lessons learned and to continually improve the program. Sixty-three of the eighty customers in the program in the 1990-91 school year rated it as "excellent." Some typical comments from the customers about the NURTURE program follow:

- The "on-hands" [sic] experiences I received while in the NURTURE program helped me to pinpoint my career goal.
- Through NURTURE I was able to find out more about the different engineering fields and narrow it down to the one that best suited me.
- NURTURE allowed me to expand my career choices to see what NASA has to offer.
- Before entering the NURTURE program I wasn't sure of what I wanted to do, but NURTURE has given me an interest in engineering that I wish to pursue.

Last year, a survey of students who had completed the NURTURE program and are now in their first year of college showed that 78 percent of them were enrolled in a technical curriculum. NASA is proud of this high degree of customer satisfaction.

Another countermeasure which is commonly employed with college students, and which could be extended to include younger students, is the co-op program. At Harris, we have

hired engineering and computer science students from college co-op programs. We have found that this is an excellent way for the student to get first hand job experience, and in fact many of these students come back to work at Harris after graduation. These people are ready to work immediately, and don't require long periods of orientation and start-up. There is an immediate payoff for both Harris and the new full time employee.

CONCLUSION

Some programs have been implemented that do work. While these programs are merely a drop in the bucket, they offer hope. NASA's NURTURE is one such program. Co-oping is another.

In view of the situation with the Junior and Senior High students, it is now time to extend these ideas back earlier in time to reach young people as they are making pivotal career decisions. These seventh graders represent a renewable resource for our technical and scientific future, not only for our companies, but also for our nation.

Industry can and must implement programs like NURTURE. Schools need our help. At Harris Space Systems, we are working with Jefferson Junior High School in Merritt Island, Florida to begin this dialogue and support. Other companies are already working with Jefferson and other schools in the area. It takes the commitment of top management to make these programs work, and the willingness of employees to volunteer as mentors. The alternative is to do nothing, letting this valuable resource continue to decline.