10 Over the Horizon
Raymond P. Whitten

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I'll begin with a review of what NASA is do ing in Technology Utilization; and then discuss some of the complications of technology transfer. The infusion of technology into our society is very difficult, and I will give some examples of the impediments. Nothing happens through serendipity. The process is "people intensive."

Even though NASA technologies may be useful to the building industries, it's going to take work to couple that technology with industry needs. Our program works with industry and the user community. We do not unilaterally develop prototypes and certainly do not do commercialization or marketing.

NASA can learn a lot from the progressive building industry's thinking in terrestrial applications. This will be evolving as we move into Space Station and Lunar Exploration. NASA has a system in place that is both a paperwork and a 'hands-on' people-to-people process. We have developed ways to disseminate technology as it is documented through a Scientific and Technical Information Center and have provialed for a Computer Operated Software Management Information Center (COSMIC). This systemcan be tapped by industry, U.S. citizens, state and local governments and universities at any time. Both information and computer programs coming out of NASA and other federal laboratory programs are available through the system.

The Applications Engineering Program is people intensive. It's in this program that we identify and define user needs. Once the problem is fully understood, our scientists and engineers try to match NASA-developed technology to the problem. If there is a match, a working partnership is developed between the user and NASA. If a successful match is found, industrial or business development leads to marketing and commercialization of the technology.

Our network is located around the various NASA Centers. It consists of the Industrial Applications Centers (IAC's), COSMIC and a Technology Applications Team. The system serves industry and the public by providing information, retroactive technology searches, and 'hands-on' assistance in problem solving. There are some small fees involved for IAC and COSMIC services and a required commitment of funding in application engineering. The Industrial Applications Centers are kept current on evolving NASA technologies through the various NASA Centers and/or laboratories. Evolving technologies are summarized or documented in various NASA publications. Some of these publications are called NASA Tech Briefs, Annual Technology Utilization Reports, NASA Patent Abstracts, Research and Technology Operating Plans, Special Publications and Technical Memoranda, Scientific and Engineering Journal Articles, etc.

Transfer of technology from these programs to the building industry or anywhere else does not happen without a lot of elbow grease, technology 'know-how,' motivation and support from upper management. All NASA technology that eventually ends up being used for nonaerospace applications must go through some form of adaptive engineering in order to satisfy the needs of the new problem. I have yet to see a one-to-one transfer, i.e., a situation where the aeronautics or space technology can simply plug into the new application without some form of modification.

Examples:

Several new technologies can be applied to fire protection. For instance, we have used NASA turbo-pump technology to develop a new water-pumping system with a flow of 3-5 thousand gallons per minute at 150 psi. Acceptance of this technology has been slow even though it is badly needed. Conversion to this type of equipment requires new thinking in the fire-fighting community. It requires training and an expensive marketing effort. The fire-fighting module, as we call it, can be lifted by helicopter and placed almost anywhere — cities, rural areas, forests, aboard ship. In addition to its use in fighting fires, it can provide drinking water to ports serving countries facing severe drought, or even used to salvage oil in areas where spills have taken place at sea.

The power-factor controller, which I'm sure all of you have heard something about, was developed conceptually within NASA. It is now found in industry and large buildings. It is even used in energy management of escalators. This system is based on electronic technology available today throughout the industry. It took the creative efforts of an aerospace engineer to conceive and develop the concept.

Several years ago NASA and HUD worked together with some aspects of the building industry to develop the NASA Tech House at the Langley Research Center. NASA is pretty good at systems engineering. In the case of the Tech House we demonstrated how one could systematically develop an energy-efficient house using state-of-the-art and innovative technology. To evaluate the concept, the Tech House was literally wired for sound, similar to the way we would technically monitor the performance of a new experimental vehicle. In fact, we are still monitoring, collecting and evaluating data. The data that NASA collected pertained to operation of solar collectors, solar panels, electronic systems and water management; it was analyzed for efficiency, reliability and maintainability.

The Flat Conductor Cable is an example of how difficult it is to bring new technology to the building industry. It has been about twelve years since the concept of transferring aircraft and space vehicle flat conductor cable to the building industry was tried. NASA developed the technology to save weight, space and energy. It is just now becoming available, for non-aerospace use, as a marketable product. For retrofitting or remodeling homes, offices or factories, it offers a fairly simple solution. For new house design, it could be integrated with composite materials to develop new concepts for modular and mobile wall structures. Improvements could be seen in outlet placement and energy management.

As you know, NASA is confronted with water and waste management problems in aircraft and spacecraft. Reuse of water will be especially critical in future manned space missions. Future concepts and resulting technologies are becoming available and could be applied to the building industry. Why build on our best and most fertile land when water and waste management systems provide alternative solutions. The extreme is to take waste or gray water and make it safe and potable drinking water. Gray water can be recycled many times for wash water. Energy and land management conservation methods can be employed if one is willing to apply the technology and change traditional ways of doing things. Some of these concepts have been demonstrated in the NASA/HUD Tech House; however, the concepts are not being rapidly adopted or put into practice.

There are several technologies that are on the horizon and will be seen in the near future. The REDOX energy storage system, which is an oxidation reduction system, is representative of such a technology. The NASA Lewis Research Center and the Department of Energy have been working on this technology for many years. The idea was derived from the fuel-cell technology developed for U.S. spacecraft. Essentially, this is a type of battery storage system that is going to become available and marketable in the near future. In order to transfer the technology, NASA is working with SOHIO. SOHIO is investing in a demonstration program that will eventually lead to small community, industry and, perhaps, individual home use of the REDOX technology. Imagine a community that is using the REDOX system; it stores its energy in a cost-effective manner and offloads it or sells it back to the power company as opportunities develop. The key to the system is a reduction/oxidation system with soluble liquid electrodes which make energy requirements independent of power demand.

Another evolving concept is the Magnetic Heat Pump. This technology is based on the fact that certain magnetic materials discharge and absorb large amounts of heat when strong magnetic fields are alternately applied and removed. In theory, the ideal magnetic cycle is more efficient than the ideal evaporation cycle that utilizes freon for refrigeration and heat pumping. Heat transfer considerations suggest a superior efficiency for magnetic pumping and analytic studies predict lower capital cost for machines above 50-100 kW cooling or heating power. The higher predicted efficiency of magnetic cycles would have a favorable economic impact through lower operating power requirements, and considerable fuel savings, in a wide range of applications that includes heating and air conditioning, industrial process refrigeration, air separation (for steel plants), and heat pump ing for process heating.

Heat pipe technology, one of the first real examples of practical applications of this technology outside of the Space Program, is seen in the Alaskan pipeline where it controlled the permafrost in the ground. All spacecraft tend to use the heat pipe technology to control, balance and maintain desired spacecraft internal temperatures. This management of solar energy and heat pipe technology is now finding its way into domestic use. Today, the Kennedy Space Center is working with several companies in hopes of using this technology for home, office and/or large building air conditioning systems. It is speculated by some that future homes may effectively use heat and electricity that is derived from solar energy, ground heat, heat and electrical storage systems and heat pipes. The heat pipes will allow heat to be moved from place to place while sophisticated battery systems will accommodate electrical energy storage.

The future holds a promise for new techniques in structural analysis, nondestructive and non-invasive testing of materials. At the Langley Research Center a major effort is underway in ultrasound technology. Here, instead of looking at the torque stress in bolts, the torque on the bolt is viewed as friction. NASA scientists are looking at the elongation of the bolt and the resulting stress. The Langley scientists have been so successful in demonstrating this concept that the Space Shuttle, U.S. mines, aircraft and other systems requiring bolts as fasteners are applying ultrasound as a noninvasive stress tester. There could be many applications of this technology in the building industry.

Earlier we discussed robotics and automation. NASA is not the leader in new robot or automation technology, and it doesn't plan to be in the future. NASA can help U.S. industry move ahead in automation and robotics by exploiting its specially developed sensing, computer, image enhancing and display technologies. At the NASA Jet Propulsion Lab oratory, NASA and industry are working together to transfer some spacecraft sensing technology to develop 'smart robots.' These robets are being developed to have enough visual image information to see edges and corners and adjust accordingly. The technology stems from highly specialized integrated circuitry, chips, proximity sensors, microprocessors, etc. The technology transfer here is not the robot — it is the special components that the machine needs in order to respond to the environmental challenge.

There is also pultrusion technology, and CAD/CAM systems that can be applied to the building industry. The concept is similar to that described as evolving in Japan. The idea is that you program what you want and, based upon your computer design, the automated machinery provides you with studs, wall panels, doors, shingles, 'I' beams, etc., all to the precise stress and other measurements you call for in your building design. Plasma-coating material has potential for future applications of glass materials and ceramics. The plasma coatings that were developed for the astronauts visors to prevent scratching and fogging are now being applied to windows and sun glasses.

The crystal and other types of materials that are going to be developed in space may have an application that allows for greater automation and computer power. Future energy systems may become a magnitude more effective than they are now, which will allow for smaller, smarter, and more powerful tools that require less energy, less time and maintenance, and help mankind work with greater precision and safety.

The Programmable Implantable Medication System or PIMS might also apply to the building industry. The outer case for the PIMS is made out of titanium, developed for the aeronautics industry. The internal working parts of the PIMS are electronic microprocessors. The microprocessor in this device is approximately equivalent to the IBM-105O. It can operate over fifty color TV sets. It can program microliters of medication into the body as prescribed by the physician. The physician can reprogram the PIMS anywhere in this country, or in the world for that matter, as long as he has a phone modem between the patient and himself. The concept is based on our satellite and telecommunications capability. The electronics technology is derived from our spacecraft and satellite technology while the fluid management system comes from the Viking lander that landed on Mars and tested the Martian soil for life forms. Imagine a device the size of a hockey puck implanted in the body providing biological functions through microminiaturization of many component parts that would have taken the space of a ten foot by eight foot by two foot thick wall only fifteen years ago.

Now, what I'm saying here is that none of the technology that has gone into this system could have been applied without taking the time to understand the problem and applying imagination and technical 'know-how'. There is a lot of space technology that is unused; many applications could undoubtedly be made for the building industry. For example, the concept of infusion pumps has been studied and developed for medical use during the last several decades by the National Institutes of Health. Working with the Johns Hopkins University, the National Institutes of Health, and industry, the PIMS represents several years of time compression since the total development took less than three years. The cost to NASA was $1,6 million over three-and-a-half years, while the industry investment will exceed $30 million (estimated) to place the device in the market. In this case, the government was the catalyst as it stimulated a business opportunity by using unrelated technology to address and solve a complicated problem.

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