SPACE TECHNOLOGY IN THE 21ST CENTURY

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Abstract : This paper discusses different issues related to the development of the space technology. The purpose is to analyse different parameters such as cost of the advanced and key technologies, development approach for long-term development and criterion for long-term development. Implications of the modern technology on the social and economic life have also been discussed. Apart from this, the challenges involved in the future developments and applications have been discussed.

Keywords: Space Technology, Key Technologies, Technology Insertion.

1. Introduction

In the early twenty-first century, the plan to launch a wide variety of spacecraft for astronomy, remote sensing, communications, crewed and robotic exploration, and other activities are in the consideration around the world. Advanced space technologies are required for potential future space activities at lower cost and improved performance than current ones. To enable ambitious future space activities and to achieve its long term goals, it needs efforts in space research and technology development in critical areas needed for the long terms.

In this report, different issues related to the development of the space technology are discussed. These are as follows:

- Forecast for space technology:
    - Development Approach for long-term development
    - Criterion for long-term development
    - Key technologies
    - Technology insertion
- Implications for social and economic life:
    - Growth of Internet
    - Telemedicine technology
    - Space debris
- Cost – Benefits (Advantages and Disadvantages)

For long – term challenges, budgets constraints have also had a major impact on the space agencies of the world. NASA (National Aeronautics and Space Administration, USA) has recently responded to restrained budgets by developing small spacecrafts that incorporate modern technologies, thus increasing the number of missions and reducing the cost of transportation to orbit [1]. These efforts however, are intended to yield clear benefits in the relatively near term, the agency currently supports very little work on long term space technology development.

Today's high cost of space access is a tremendous limitation to scientific research and space commercialization. The government should only sponsor the military and civil space activities. The commercial space industries, the academic institutions and the government (s) (committee) should group themselves to build the critical technologies which require long term lead-time research and technology development to ensure they are available when required. The space agencies will have to develop a plan and mechanism to support advanced technology development for the long term if it intends to be source of technology for industry and other government program in the new century. The government research council should examine the future space technology needs and the budget it can fit into it economically and socially. The NRC (National Research Council, USA) committee on Advanced Space Technology examined future technology needs and opportunities to create a technology create a technology development portfolio of same enabling space technologies that would maximize the impact of the small amount of technology development funding that NASA is expected to be able to provide in a constrained budget environment [1].

2. Forecast For Space Technology

In the 21th century, there is some ambitions, existing vision for the future; those of speeding up the exploration of the space through very advanced technology. The main issues as lowest cost, enhanced safety procedures and reliability should top the list of requirements. The agencies and institutions should develop revolutionary technical advances and space flight concepts that will help mankind push back the final frontier. The challenge is to prove that certain cutting-edge technologies, as well as new mission concept work in space.

Using the technologies and concepts for the new millennium, it will soon be possible to send intelligent spacecraft into the solar system. These probes may get around very quickly using ion propulsion, or they may penetrate the surfaces of planets to explore underground, or they may fly information in space to function as a giant instrument, or they may even be able to touch down on fast moving comets. Technologies for these daring flight concepts are being tested by the missions, and, currently there are more exciting mission concepts on the drawing boards [1]. One incredible aspect of this speeded-up technical development is that the Internet revolution will be carried into space, and we may be able to 'visit' Mars or the Sun from the comfort of our homes.

Linking Advanced Technology Development to the requirements established by enterprises will increase the likelihood that Technology Development results will be relevant to the agency missions. Requirements must address both near and far term agency missions to allow this program to include an appropriate balance.

2.1. Long-term Technology Development and Implementation

Investment in the long-term technology is essential for many ambitious missions NASA or other agencies envision for future [1]. Thus, an appropriate balance is needed in how technology development resources area split between projects with near term and long-term objectives. To achieve an appropriate balance, the needs for near term objectives and promise of long term projects must be considered to make the informed decisions. With the aid of better data on investment allocations and trends, it would be possible to follow up on the efficacy of this implementation. Retaining data on current expenditure would build a historical record of value to future planning efforts.

Some technologies lend themselves to continue process of incremental improvements. In other cases, significant require revolutionary changes that involve totally new approaches. Thus, the work on revolutionary technology could be viewed as an essential element of long-term development, and sufficient technology funds should be set aside for this purpose. It is especially important to include experts from academia and industry in the early evaluation of technology needs and goals related to the development of sensors, instruments and spacecraft systems – areas in which academia and industry are heavily involved in advancing the state of the art. The most effective approach to increasing the involvement of academia and industry in the technology development involves open, competitive processes to identify the best qualified people and organizations to undertake each new projects.

2.2. General Criterion for long-term Technology Development

- Safety and Reliability
- Lower Cost
- Miniaturized Spacecraft
- Reusable Launch Vehicle
- Automated Management of the systems

2.3. Key Technologies for Development

The high risk, high payoff technologies which have the greatest potential for improving the capabilities and reducing the costs of the space organisation, other government and commercial space programs in the2000 to 2050 time period are to be determined. It also involves the determination of which of these technologies could benefit most from long lead time development. Determining the exact amount of funding is beyond the scope of this report, but NASA has assumed that funding each technology of about 3 million to 5 million a year for three to five years would be sufficient to create a high probability of significant advances. The list of key technologies is not static, nor does It represent all of the high risk; high payoff technologies NASA should pursue. The technologies below represent a small but broad investment portfolio that appears to build high promise for large future benefits at the cost of a small investment [1].

Wideband communications over Planetary Distances
Wideband, high data- rate communications over planetary distances could enable live transmissions of high-resolution images from robotic rovers, orbiters, and astronauts on mission to other planets. The need to develop technologies including high-precision spatial acquisition and tracking systems and high-efficiency lasers to support such communications over planetary distances.

Precisely Controlled Space Structures
Structures in weightless environment especially structures that are unique to space pose difficult control challenges. These challenges must be met to enable the next generation of instruments for space based astronomy and to support the development very large antennas for communications and remote sensing. As far as research in this area is concerned NASA in uniquely suited for this type of research in area such as controlling deformable reflectors and formation flying of spacecraft to created distributed sensors.

Microelectromechanical systems for Space
Microelectromechanical systems could enable the development of small, relatively low cost spacecraft devices and subsystems with very low mass, volume and power consumption. These systems could be used to enhances conventional; spacecraft or to create miniature spacecraft that could be enable a broad range of new space activities. Although a vitreous government and industry supported Microelectromechanical systems research effort is underway, little to this work is aimed at space applications.

Space Nuclear Power Systems
Advanced space nuclear power systems will probably be required to support deep space missions, lunar and planetary bases, extended human exploration missions, and high thrust, high efficiency propulsion systems. A major investment will eventually be needed to develop advanced space nuclear power sources, but low-cost research and technology development investments can make the systems that are eventually developed more efficient, less expensive and safer.

Low-Cost, Radiation-Resistant Memories and Electronics
Radiation in the space environment can damage sensitive electronic, disrupt signals, cause single-event phenomena, and degrade microelectronic device. Low cost, high capacity, low mass, radiation-resistant memories and electronics are not currently available. But NASA's support lays the groundwork for major improvements in radiation-resistant memories and electronics.

Extraction and Utilization of Extraterrestrial Resources
The capacity to extract and utilize space resources can significantly improve the performance and lower the cost of planetary exploration, reduce the cost of constructing and shielding human habitants, and enable and accelerate the development of new generations of in space capabilities.

Interplanetary Propulsion Technologies
Solar Electric Propulsion Propellants. These technologies reduce the cost of planetary exploration, and would enable the development of new generation space technology.

2.4 Technology Insertion

There are inherent contradictions between the space agencies with to advance new technologies and the desire to avoid mission failure. Balancing the long term payoff that a new technology may provide if –and-when it has been proven in flight with risk of losing a near term mission that tests the technology is difficult. One approach could be managing the risk accompanying the use of unproven technologies would be more aggressive in incorporating new technologies in smaller class missions and University Explorers than in more expensive ones. Several challenges will need to be addressed:

- How to use new technology in flight programs without adding unacceptable risks;
- How to arrange for timely flights tests of new technology, so that it can be incorporated into science missions before it becomes obsolete;
- How to broker agreements between technology developers and flight program managers to bridges the gap between ground based validation of technology and prototypes flight demonstrations for mission readiness.

The next century mission should be intended towards addressing the above problems. To carry out ambitious missions in the future and explore in a way the space agency should develop a new generation of technology.

Advanced spacecraft instruments and systems currently being developed by NASA will ensue its missions in the next century will be capable of much more exciting exploitation.

The future program should develop and test in space flight futuristic technologies that will primarily help reduce the size and increase the safety of the future spacecraft. Technologies should be tested that would make spacecraft intelligent, expert and adaptive, so that not much handling is required by operators on the ground. A significant portion of mission's budget allocated for a launch vehicle (the larger a spacecraft, the larger and more expensive the launch vehicle) under consideration would apparently show how much of a saving these advanced technologies will enable.

3. Implications for Social and Economical Life

To economists it often comes as a surprise that many innovations have very widespread societal efforts, but whose, measurable economics efforts are small or at best indirect in terms of macro-economic growth and efficiency. The economic significance of some technical advances is difficult to predict, but probably small. For some innovations the societal may be very great even through the direct measurable economic impact is insignificant. Economists are not only aware of the societal impact of technological change. They are insufficiently aware of the wide variance in economic impact of technological change. In analyzing the activities one is confronted with especially thorny questions about the actual direct economic impact of such technological advances.

Though there are few social benefits, but economically are they viable? This is the question to be discussed seriously. E.g. the growth of the Internet can be a boon for the society, but economic aspects like bandwidth expenditure; increase in space debris related issues should also be looked upon. The 21th century mission objective is to enhance, promote and develop 'satellite friendly' applications for future.

3.1 Internet Growth

Through the use of dynamic architecture provided by hybrid (terrestrial and satellite) networks that incorporate communications satellites, the bandwidth on-demand capacities of advanced communications, satellites can be efficiently used in Internet applications. The goal is to demonstrate the advantages and to encourage the use of a satellite link in a network for various types of Internet applications.
Currently, the Internet consists of many backbones connected satellites as integral links in hybrid networks; the performance of Internet-based applications could be greatly improved. Heavy multimedia applications such as video conferencing, distance learning, or telemedicine will see the greatest benefits from this. In the future, the Internet applications will fully utilize the advantages presented by including communication satellites in the network architecture.

3.2 Telemedicine

Telemedicine is the capacity to practice medicine and provide medical consultation and teaching at a distance through the use Telecommunications, telemetry, and teleoperators. Telemedicine is a critical requirement in the delivery of quality health care to astronauts living and working in space during extended space travel. The next century objectives is to nurture and develop satellite related technologies and telemedicine applications that will also enhance and promote the reliable delivery of health care into remote under-served and stricken areas.

The current telemedicine application and demonstration projects, which highlight the role satellites will play in future systems, include the Spacebridge to Russia and Telemammography using Satellite Communication projects. The 'Telemedicine Spacebridge to Russia ' testbed is a calibration of medical cases between American and Russian hospitals using a store-and-forward scheme on the Internet. This testbeds helps develop a technique that can be used to provide remote medicine to rural, under-served or inaccessible areas.

Satellite Telemammography has the potential to provide high-quality, low – cost mammography screening and breast cancer expertise to under-served populations. Telemammography over satellite can provide significant cost saving and greatly improved health care services in many of these under-served areas.

4. Cost Benefits

With the new booming technologies, the space program would be safer and reliable and more important at the lower costs than the existing ones. Through, the space programs can be a boon to some social divisions, but it is of no use to the ignorant society living in the remote or backward area where even bread and butter is not easily earned. Some space missions e.g. the missions to 'Mars' inevitably raise any questions. These missions are faced with contradictions between the power and potential blessings of modern science and technology on the one hand, and the failure on the other, of the capitalist system to solve the age-old social problems of poverty, hunger, disease and ignorance.

Though the new technologies like internet, video conferencing, telemedicine etc. as a result of the blessings from, the space technology can make the world compact and easy to access place. But the same time there are some other issues related to the humanity which politically mark a big questions on the face of the international community to put suitable constraints on the mission budgets. If a man is able to mount missions to Mars – and lay plans to land human on the planet early in the next century – there is no reason to believe he cannot recognize his own society in a rational manner so as to eliminate poverty and needs.

5. Conclusion

Though there us manifold benefits to the human society from the new century space program. The space program would bring the information technology on the finger tips of the society at lower costs. Further, it would be safer for the astronauts and the engineers, but still the question of international welfare as a whole remains unsolved. Hence if the humanity turned its collective genius, which for half a century has largely flowed into scientific and technological channels, toward the solution of social problems, they could be overcome. What problem of any kind could withstand such a concentrated effort, once society was freed from the restraints imposed by the profit systems? This, however, requires the revolutionary mobilization of the working class through the building of its own, socialist and internationalist political party.

6. References

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Biographical notes

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