

The Impact of Space Activities upon Society



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As the 21st century gets further underway, the impact of space activities upon the welfare of humanity will only increase. It has been acknowledged that one of the most significant events of the 20th century was when humanity left its ancestral home and stepped on the surface of another celestial body. We can imagine that during the 21st century the human expansion and insight into the cosmos will produce some of the more significant events of this new century.

The period between 1957 and 1991 saw the dawn of the space age with flights to the planets, footprints on the Moon, and global communications; however, this history of space was anchored in the global cold war with its massive budgets for military space exploitation. The last ten years, however, have brought about a new era of space exploration, images of distant stars and galaxies, international cooperation and a focus on our own planet. In the not-too-distant future we may have unlimited, clean, solar energy from space powering our industries as well as heating and lighting our homes. Our nuclear waste may be safely and inexpensively disposed of by being carried up a Space Elevator and released towards the Sun. We may become a tourist in Earth orbit or on the Moon. We may carry out extra-terrestrial mining and even introduce the development of a multi-planet economy. In addition to the enormous knowledge that space exploration has already delivered, space technologies have become integrated into everyday life so deeply that modern society could not function without them. Weather, telecommunications, environmental analyses and national security are only the most obvious space

technologies that humanity relies on, though spin-offs and transfers from space to non-space sectors provide many additional indirect benefits.

For most of this time, the International Academy of Astronautics (IAA) has brought the World's foremost experts in the field of astronautics together on a regular basis to recognize the accomplishments of their peers, explore and discuss cutting-edge issues in space research and technology, and to provide direction and guidance in the non-military uses of space and the ongoing exploration of the Solar System. The Academy is now helping to formulate the future through recognition of the positive impact that space activities have upon society. With the assistance of a dedicated study team, the Academy has created this special book which gives personal views from world leaders, recognized authorities and influential personalities as well as space experts in response to the statement "*I believe that space activities are impacting society through.....*"

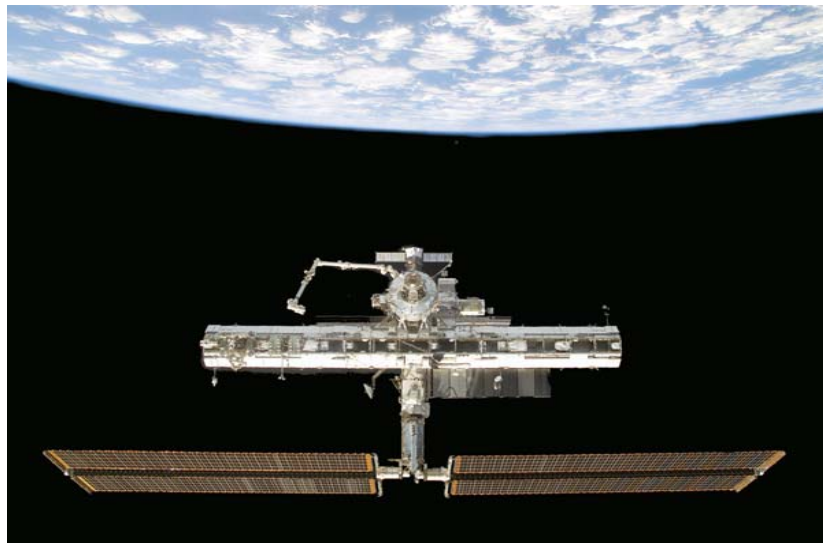
The intention is to illustrate that space activities have a positive and beneficial impact on everyday life and society and thus help people to understand that, despite the high costs of space activities, there is a tremendous return to the community in terms of jobs, technological know-how, scientific knowledge and space spin-offs. Tellingly, none of the responses portrayed a negative impact, for instance that space activities were a waste of money. On the contrary, all were very positive. The respondents range from a student, to a famous science-fiction writer and to the Secretary General of the United Nations. Many

Preface

of the responses are from members of the International Academy of Astronautics.

We are only 50 years into the next expansion of the human spirit. What we find and where we go will impact society in manners as yet unforeseen. With this book, through the insights of others, we record the start of this adventure.

David Raitt, Cathy Swan, Peter Swan
& Arthur Woods
Study Team Co-Leads
International Academy of Astronautics Commission 6



Foreword

Jean-Jacques Dordain
Director General, European Space Agency

The statements expressed in this book confirm what I have long believed, namely that research and development organizations, such as ESA, must continually adapt to an environment that their very successes transform: the emergence of new user communities, the introduction of new public and commercial services, the advent of new operators, citizens' dependence on services using new space systems, etc. As a consequence, space agencies are becoming part of a political, economic and social frame, which is continually evolving, creating new needs and opportunities, but also giving rise to constraints and shifting responsibilities.

The activities of ESA show very clearly how space is impacting society. ESA combines responsibilities in three distinct areas: the basic activities required to develop and maintain the fundamental elements on which a space policy depends for its implementation (access to space, the technology base, industrial capabilities, ground facilities); the inspirational activities of sciences and human and robotic exploration; and utilitarian activities – developing space systems to support public services (such as meteorology, environment, disaster management, education, energy, agriculture) and commercial offerings (telecommunications, navigation and imagery) for the benefit of the citizen.

As a result of such activities, both governments and the general public are today increasingly realizing the enormous potential of space and just how it is being integrated into everyday life. For its part, the European Union (EU) is being confronted with a quantum shift due to globalization and the challenges of a new knowledge-driven economy. Its own space priorities have led the European Union to

conclude an agreement with ESA for efficient and mutually beneficial cooperation relating to initiatives in telecommunications and navigation, global monitoring for environment and security, and exploration – areas all geared to the needs and requirements of society.

Space activities stimulate the development of new technologies – as an innovation factor, as a competitiveness factor, and as a key to the consolidation of industrial capabilities, without which there are no space activities. ESA's 'Cosmic Vision 2015-2025' workshop, held at UNESCO in Paris in September 2004, showed that Europe is richer than ever in ideas regarding what should be done in space science in the coming years – and much of this, as statements in this book show, will result in spin-offs and benefits to humanity.

Education is also an integral part of space activities. Education or transmission of knowledge from one generation to the next has been the driving force behind the progress of humankind. The duty of any generation is to educate the following one. Space is not only a fantastic tool for inspiring and educating youth, but also because of the many disciplines involved and the expertise that space developments require. Furthermore, the introduction of 'space incubators' will afford young entrepreneurs the opportunities to take space technologies and create new products and services for the non-space sector – thus adding even more value to the investments in space.

Space activities, implemented through visionaries and pioneers, has helped create the concept of One World. The impact has never been greater.



The impact of space activities upon society has largely been measured in numerical terms. How many spacecraft have been launched by a given country? How many phone calls are made over a satellite? How many lives could be saved by hurricane-watching satellites? How much money was spent on space within a given country or by a corporation?

The problem with this approach is that, generally, the value to humanity is not measured. Then, since space endeavours are, for the most part, funded through taxes from the general public, it becomes inevitable that the value and benefits of such space activities must be justified. While not itself in a position to justify these things, the International Academy of Astronautics believed, nevertheless, that it would be of real interest and serve a real purpose if somehow the reasons for and results of space exploration could be presented to both the public at large and the non-space sector. Accordingly, in 2001, the Academy initiated a study project to look at the impact that space was having on society as a whole – as seen through the eyes of a very diverse set of people. The project was carried out by a dedicated study team and the idea was that personal insights and views from world leaders, recognized authorities and influential personalities, as well as space experts, would be sought in response to the following statement:

“I believe that space activities are impacting society through.....”

Even though the study team tried to employ the theory of six degrees, which suggests that

Introduction

everyone in the World is connected to everyone else through no more than six connections (or degrees), it proved very difficult to elicit responses from members of government, politicians and leading industrialists. However, with persistence a number of very apposite replies were received from interesting personalities who felt they had something to say. Indeed, the success of the project can be measured by the value of the respondents and the insights they provided.

The study team stressed to those invited to contribute that the intention was to illustrate to the general public that space activities have a positive impact on everyday life and society. Their personal statement would be placed unchanged on a specially created Web site*, as well as the Academy Web site, together with those of other global figures as an assessment of and reflection on the impact of nearly fifty years of space flight upon society. In addition, a subset of responses, selected by the study team, would be considered for publication in book form by the European Space Agency.

In the end, nearly one hundred responses were received, over half of which are included in this book. Replies have been chosen, as submitted, to portray the authors' own views about the impact of space activities. The affiliation of the respondent is that which was current at the time of writing the statement – a few of the authors might have moved elsewhere or retired in the interim. The authors, representative of many of the nations of the World, are diverse in their jobs and lifestyles, but have much in common in their beliefs in the beauty and scope of space, their hopes for the

future, and their recognition that the human race has an unlimited capacity.

The book therefore provides an insight into the opinions and views of individuals regarding space activities and the impact they are having on society and every day life. Some of the respondents work or have worked within the space field, others have not. Some responses are borne of experience and first-hand knowledge of space programmes, others are considered judgments of how they believe space has been of benefit to the World – by providing opportunities and challenges, by stimulating jobs, by extending knowledge and education, by making available enhanced services and technologies, and by fostering international cooperation.

Although space programmes are expensive and the public might query why so much money is spent on space, the respondents are very positive in their views that space has contributed significantly to humankind. The responses in this book provide a rich catalogue of the ways in which space activities have helped and improved society – providing communication and education services in remote areas, bringing information and entertainment to the masses, creating new materials for stronger and more durable structures, providing meteorological data so ships can be safer at sea, monitoring the threat of pollution, enhancing medical instruments for better health-care, enabling hikers and skiers to be located when lost, and many more.

If there is a conclusion to be drawn from this study and the responses received, it is that space activities impact society in diverse ways – not only obvious ones like provision of telecommunications

and weather forecasting, but also less obvious ways such as the relentless quest for knowledge about our planet's place in space and time. The path to gaining this knowledge winds through scientific as well as technical discoveries, and these in their turn benefit society in many ways. The camera in space developed to take pictures of far-distant galaxies is reborn as a medical instrument to detect lymph-node cancer. The instruments on an orbiting spacecraft designed to find out more about the structure of planets can be packaged into a portable device for identifying the minerals in rocks on Earth. The Sun's rays can be harnessed to provide cheap and abundant solar energy to warm and light our houses. None of these things would have been possible without space activities. The search for life also drives space exploration. Are we alone in the Universe? Are we unique? We will never rest until we know. So this drive spawns high-tech robots and samplers, hardware and software – all of which will ultimately be spun back into mainstream consumer and medical electronics and gadgets that make life more worth living.

There have always been explorers and pioneers – it is a basic instinct, and not necessarily only a human instinct – for animals in search of new pastures, for prehistoric man who crossed continental divides in pursuit of food and to find new places to live, and for people in our own times who have sailed the oceans and traversed the land in search of adventure. Where would we be today without the great explorers of the past? So we have an in-built need to explore new places – especially the tiny pinpricks of stars in the night sky – simply because they are there and we are

curious. For the purposes of such exploration, we then have a need for new or improved technologies. Given that we have this built-in desire to explore, we will eventually develop the technologies to do this when the real need is there and when other enabling technologies and materials become cheap enough or feasible enough to do so. This may take years or centuries to achieve, but as is evidenced by the comments and thoughts in this book, such space activities will always have an impact on society and humanity.

Organization of Responses

The organization and presentation of the responses in this book is based upon the unifying theme of One World (Fig. 1) that emerged from the contributions themselves. Responses to the question posed have been placed in the One World category that seemed most to reflect the writer's sentiments.

The seven major components of the One World concept are described below. The concept is that all the components fit together in a comprehensive look at the impact of space upon society, as shown in Figure 2: Global Impact of Space Activities. The seven components are:

- One World Perspective
- Challenges for Life
- Knowledge Development
- Opportunities Across the Globe
- Technology Development
- Educational Stimulation
- Communications for All

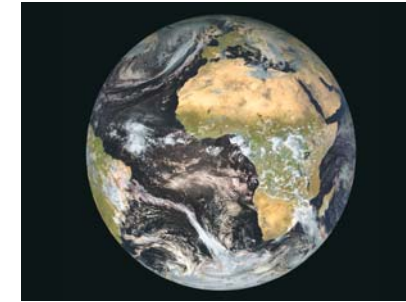


Figure 1. The One World Perspective

One World Perspective: The people of the World saw the blue marble of the Earth as an 'Earth-rise' from the window of Apollo 8. Recognition of the impact of this has steadily grown into a realization that humanity can view itself in a new light. The wholeness of Earth was breathtakingly achieved in one moment – one photograph. This beauty and isolation lead to the significant term 'One World'. This fantastic view from space has enabled the World to establish a vision of itself – not as separate elements with borders, but as a perfect whole.

Challenges for Life: To reach beyond ourselves is a challenge we all face as individuals and as part of larger communities. Space has historically provided an avenue to accept these challenges that fuel careers and passions. Dreams drive humanity in many ways, with the opening of the space frontier as a direct result of its early pioneers. Where dreams of going to the Moon and Mars as a 'virtual member' of a robotic or

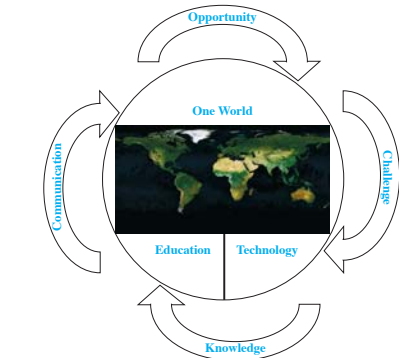


Figure 2. The Global Impact of Space Activities

human expedition are still just that, soon we will be able to buy a ride to space at a price equal to two or three years salary. Inspiration comes from the vastness of space and the ability to see beyond our limited horizons. The great telescopes of our time are indeed enabling us to see into our past and view our future, thus yielding ever more puzzles to challenge us further.

Knowledge Development: The human species has been building knowledge step by step for millennia. As we learned to speak, write and read the nature of human capital increased at a remarkable rate. Even before we ventured into space and expanded our boundaries, the technology of computers was foretelling a knowledge explosion. Now this knowledge is expanding exponentially; in the understanding of the Earth, our Universe and other planets, for technologies in harsh environments, human physiology and health, and in where we came from within the Universe. The quest of space exploration has opened many new doors and stimulated the development of knowledge.

Opportunities Across the Globe: Earth-observation satellites have enabled global cooperation in natural-disaster mitigation activities and the sharing of images from space with all nations. This is just one example of peaceful ventures reaching across borders, fostering feelings of a global community and providing opportunities for nations, companies and individuals worldwide to participate. Less altruistic is the entrepreneurial aspect of commercial space where global communications satellites enabled new companies to be formed and profits earned

for the risk taken. Prize money is now being given as an incentive to push the private sector into space: the X Prize of \$10 million already awarded for taking private individuals the 100 kilometres into space; the \$50 million America Space Prize to spur the development of space tourism in low-Earth orbit; the more modest competition prize money to develop components for a Space Elevator. And on the other hand, the technologies developed for such space activities are in turn providing opportunities for many around the globe because of their potential application as spin-offs in non-space sectors.

Technology Development: Going into space requires scientists and engineers to invent, refine and adapt current and future technologies. This creative push to operate and succeed in the harsh and extreme environment of space has led to phenomenal technological developments such as micro-miniaturization, precise navigation, global communications, telescopes that see back to the beginning of time, lightweight materials and medical advances – all valuable to human existence back on Earth.

Educational Stimulation: Young people need stimulation to go beyond the 'easy answer' and pursue the knowledge required for a challenging and rewarding life. As shown by Apollo, Mir, the International Space Station, the recent Chinese human spaceflight, and the Lunar/Mars initiatives, the enormity of space and its inherent challenges can, and do, stimulate students to pursue academic endeavours. The inquisitive minds and natural curiosities of human beings are released from their habitual reluctance by the challenges

inherent in the development of space. In addition, revitalization of the human spirit after formal training can lead to new ways of learning and contributing, such as distance learning. The stimulation of education and proactive outreach has been a historic strength of the space arena ever since people began looking into the heavens for answers centuries ago.

Communications for All: As the space field has matured, the innate human desire to communicate has grown ever more significant. The need to transmit data, information, and knowledge from

afar has driven communications technologies – whether it be communication with a spacecraft beyond the Solar System or with a friend by mobile phone. Through television we can watch wars in real time as they are being conducted on the ground, we can witness the prowess of individuals at the Olympic Games, we can listen to latest news on the radio while driving in our cars. The ability to communicate easily and quickly with ships at sea, aircraft in mid-flight or a relative on the other side of the globe is a direct result of communications technologies developed for space.

Courtesy of NASA



No borders, just bright lights



One World Perspective: The people of the world saw the blue marble of the Earth as an 'Earth-rise' from the window of Apollo 8. Recognition of the impact of this has steadily grown into a realization that humanity can view itself in a new light. The wholeness of Earth was breathtakingly achieved in one moment – one photograph. This beauty and isolation led to the significant term 'One World'. This fantastic view from space has enabled the World to establish a vision of itself – not as separate elements with borders, but as a perfect whole.

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[K. Annan]

...“an opportunity to reach for the stars and see ourselves as one harmonious species (e pluribus unum) on our small pale blue dot.”

[J. Galloway]

...“fostering awareness of the interdependency of our lives, umbilically connected to our parent planet.”

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One World Perspective

I believe that space activities are impacting society through...

... the recognition that the exploration of space has always been a central aspiration of human beings across the globe. Indeed, while the vastness of the Universe may humble us, it also provides infinite stimulus for human curiosity.

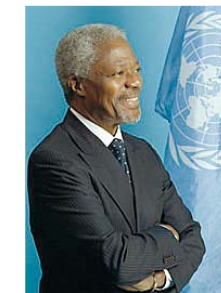
Humankind has made important strides in the peaceful exploration of outer space, and this has changed our lives here on Earth for the better. Not only have we gained scientific knowledge, but we have also learnt to look at our planet from a new perspective. When one of the early missions produced the first photographs of the Earth taken from space, it revealed a planet without national borders, a fragile orb dependent on a delicate web of resources and ecosystems, a single sphere that is the common home for all of humanity.

Space technology, for its part, has yielded a number of 'spin-off' benefits that have tangibly improved our daily lives and that are helping us to address a range of daunting social and economic challenges, including poverty eradication, environmental protection and disaster prediction. Earth-observation satellites, for example, have been used successfully in Africa, Asia and Latin America to detect the risk of outbreaks of malaria and other infectious diseases. Satellite communications are being used in several developing nations to provide health services and 'distance learning' to rural communities, and to relay information for the management of land, ocean and freshwater resources. Such applications represent the mere tip of the technological iceberg.

The United Nations is deeply committed to the peaceful exploration of outer space – as a way to build bridges among peoples and nations, and as an integral part of our work to achieve the objectives set out at major world conferences of the past decade, including the Millennium Development Goals. The Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space, known as UNISPACE III, has developed a strategy for harnessing the benefits of space science and technology to this effort. I hope all people and all partners will join the United Nations in the quest, and do their part in creating a more equitable and sustainable future for all people on Earth.

Mr Kofi A. Annan

*Secretary General
United Nations*



Mr Athanasios Batagiannis

Student

National Technical University of Athens

I believe that space activities are impacting society through...

... human activities in space having influenced life on Earth in a number of ways. Satellite communications, Earth observation, applications of space technology and the knowledge gained from space exploration are some of the most profound ones.

In my opinion however, the most important effect space activities have had on society is psychological and not materialistic. I believe that space activities, possibly more than anything else, helped to foster the belief that a unified humanity can achieve anything.

I cannot think of a better example of unity than the first landing on the Moon. Millions of breathless people across the globe watched Neil Armstrong walking on the Moon declaring this a 'great leap for mankind'. Everyone must have felt proud that a human being achieved the unthinkable. The Moon, once a subject of speculation, was now within man's grasp.

As humans evolve it is becoming evident that unity is the only way to exceed our limited capabilities. Space exploration has the potential to unify humanity in order to overcome our problems and materialize our dreams.

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I believe that space activities are impacting society through...

... their fascination for humans, through their capacities to improve their lives on Earth, and through the power they provide them with.

Fascinated by space since their origin, humans wanted to understand their surrounding Universe. This fundamental quest nurtured thoughts, dreams and imagination (particularly in science fiction and the arts) and stimulated research in space, on space and from space. These activities impacted strongly society by providing a key clarification between science, theology and imagination that led to a better knowledge of the Universe and of its evolution and thus of the actual place of humans within it. They discovered that they are all passengers on one tiny, complex and fragile spaceship that has to be taken care of more and more seriously, impacting dramatically on their behaviour.

Space activities are also impacting society by providing tools that are changing daily life on Earth. Telecommunication and television by satellites have changed our societal behaviour and perception. Every human, wherever they are located, has the possibility to communicate with anyone anywhere in the World. It is possible to send TV images around the World from any of its regions. More and more humans can see live images coming from all parts of the World, as the large growth in dish antennas is demonstrating. Such instantaneous worldwide connections confirm humans in their feeling of living on the same finite planet. This feeling is reinforced by the

global and repetitive views of Earth provided by remote-sensing satellites. Everyone will feel 'at home' and secure everywhere on Earth when space navigation and positioning tools provide his/her position with sufficient accuracy and indicate the best way to reach any given place. They are already good enough to modify the transport industry's and individual's travel habits. Space tools generate new relationships between humans and their home planet by changing their ways of managing it, by improving their ways of using Earth's natural resources while still preserving their environment, and by facilitating their life and its protection.

Space tools also impact society by their ability to influence the relationships between countries. They can contribute to the development of peace by facilitating international control of international treaties, and by supporting the reconstruction of countries devastated by conflict. But they can also be used to increase the military power of a country and its ability to intervene everywhere in the World, thus increasing the risk of conflicts within nations.

In conclusion, I believe that space activities impact society through their ability to increase dramatically the capacity of humans to act on their planet and on its surrounding 'celestial' bodies, and to interact with other individuals or nations with increasing strength, and therefore with increased consequences. I therefore believe that space activities do impact society by challenging its ability to raise the sense of responsibility and the moral strength of humans to the level set by the power that space tools provide them with.

Prof. François Becker

Dean

International Space University (ISU)



17

Dr. Eilene Marie Galloway

*Honorary Director
International Institute of Space Law
Trustee Emeritus
International Academy of Astronautics*

I believe that space activities are impacting society through...

... formulating patterns of international cooperation that promote peace among nations. The first Sputnik aroused fears of orbiting weapons of mass destruction, but this quickly turned to hopes for peace when scientists and engineers explained that outer space could be used for developing many peaceful applications. As satellites orbited the Earth in 90 minutes, disregarding national boundary lines, nations welcomed the new space benefits and gave up sovereign claims over this new environment. The combination of fear and hope spurred nations to pass national and international laws based on the policy of maintaining outer space as a safe, orderly place to use for peaceful purposes for the benefit of all mankind.

The system of space law that was established early in the space age has brought the World 47 years of peace, during which spectacular benefits have developed in global communications, meteorology, navigation, medicine, agriculture, education, etc. Those goals were met by establishing national and international space organizations and extending the roles of existing organizations, such as the International Telecommunication Union (ITU), the World Meteorological Organization (WMO), and other international bodies that could benefit from space technology.

The United States enacted NASA in 1958, as a civilian agency separate from the military, and with authority to engage in international cooperation on space projects.



The United Nations established the Committee on the Peaceful Uses of Outer Space (UNCOPUOS), which formulated five space treaties. The 1967 Treaty Governing the Activities of States in the Exploration and Use of Outer Space Including the Moon and Other Celestial Bodies has been ratified by 98 nations. This Treaty specifies what can and cannot be done to maintain peace on the Moon and other celestial bodies. At this time when a number of countries are exploring the Moon and Mars, it is comforting to realize that the legal framework into which any military personnel must fit has already been agreed to by 98 nations. Furthermore, space laws are strengthened by the necessity for compliance with the unchangeable laws of physics that prevail in outer space.

The record of 47 years without wars in space, or from space to Earth, should be maintained.

I believe that space activities are impacting society through...

... the space age ushering in a time when humans can transcend traditional wars and conflicts on Earth. We have an opportunity to reach for the stars and see ourselves as one harmonious species (e pluribus unum) on our small pale blue dot. I see human movement into space as an example of the logic and experience of cooperation and our Darwinian heritage of altruism as well as competition (hopefully in the future, commercial and not national rivalry).

After the space age began with Sputnik on 4 October 1957, the United States was caught up in a competitive prestige race with the Soviet Union, but rather than let this race deteriorate into a zero-sum game, the National Aeronautics and Space Act of 1958 committed the US to, inter alia, 'peaceful purposes for the benefit of all mankind'. The US is to be 'a leader' (not 'the' leader) in 'the conduct of peaceful activities'. Further, the principal space treaty, the Outer Space Treaty of 1967, commits states to explore space 'for the benefit and in the interest of all countries'. Thus, the US and other States party to the Treaty (there are ninety-eight) foresee win-win outcomes over time. The logics of win-lose and lose-lose are still present, but over time I expect non-zero-sum, win-win games to characterize the space age. Ultimate non-zero-sumness will arrive when humanity becomes a multiplanetary species and when we recognize ourselves as one people rather than conflictual subsets of our species.

Dr. Jonathan Fuller Galloway

*Professor Emeritus of International Relations
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Mr Roy Gibson

*First Director General of the European Space Agency
First Director General of the British National Space
Centre*

I believe that space activities are impacting society through...

... impacts most of which are tangible and for all, or nearly all, to see and experience in their daily lives, but I should like to draw attention to two less visible impacts.

Firstly, I believe that space activities have had a tremendous influence on society by providing the opportunity for nations all over the world to work together on complex and peaceful projects, the complexity of which has never before been seen. In this way an experience was developed in handling large projects which previously simply did not exist, and which is now serving in many other – non-space – areas. So far as Europe is concerned, I would go further, and say that this participation in large space projects – both manned and unmanned – has been a potent unifying factor. Although there is some way still to go before there is a really united Europe, working together on space projects has certainly been one of the major positive influences.

Secondly, I believe that it has inspired large numbers of engineers, scientists (and even administrators) to give of their very best, thereby providing role models worthy of being copied in many other fields. There has been no major space project that does not owe its success to the near-super-human efforts of a small group of men and women.

Intangible though both of these impacts are, I believe that they are of great significance, and deserve to be measured along with all the other more obvious impacts.



I believe that space activities are impacting society through...

... not just the direct scientific discoveries, but more broadly through an effect on global culture, and our perception of our human relation to the cosmos. In this sense, cosmic exploration addresses issues that have perplexed us for 10,000 years.

As I recall from personal observation at the time, the first eyewitness photographs of Earth as a distant sphere – made by the Apollo astronauts on their way to the Moon – mesmerized the public. Posters of those images were everywhere. The concept of Earth Day and the mushrooming of modern global environmental consciousness followed within a few years. The Copernican revolution – that 500 year explosion of human consciousness – was extended. We are not the lords of the Universe ruling from a central, imperial capital, but are more like partners of a larger, dynamic, cosmic system! Earth is a finite, fragile place, and humans through the next few generations will depend on how we treat it.

People who didn't 'get it' are still fighting wars based on medieval fundamentalist paradigms about dominance – economic, religious, environmental. People who do 'get it' are fostering awareness of the inter-dependency of our lives, umbilically connected to our parent planet.

Either way, through ignorance or consciousness, planetary exploration has forced us to recognize the challenge of how we will balance population, fossil resources, sustainable resources, and

consumerist economies over the next 50 and 100 years, and through what socio-economic frameworks we will eventually expand our culture beyond Earth.

Dr. William K. Hartmann

*Researcher / Author / Artist
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Dr. Holly Henry

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I believe that space activities are impacting society through...

... the comment of Wyn Wachhorst: *"If the essence of exploration is to touch the boundary – the beach, the mountaintop, or the Moon – the core of the human condition is the attempt to see the self in context. To stand on the moons of Saturn and see the Earth in perspective is to act out the unique identity of our species"* (The Dream of Spaceflight 78).

Long before photographs were possible from orbit, humans artistically rendered in the late 1800s what the Earth looked like from the Moon. Astronomers like Camille Flammarion, among others, envisioned Earth as a tiny oasis of life in the vast abyss of outer space. Apollo 8's photos of the Earth rising over a desiccated lunar landscape galvanized forever our understanding of our planet as a fragile haven whirling through the interplanetary depths. Those photographs forever reconfigured our relation to the planet and, more importantly, to each other. This vision, affirmed specifically as a result of space exploration, calls us all into accountability to each other, to the survival of the planet and all species, and to dedicate ourselves to understanding life in the Solar System, and in the galaxy that we call home. Space challenges humankind: to love that which we inhabit, and to seek out that which is not yet known. How can we not answer the challenge?



I believe that space activities are impacting society through...

... witnessing the lift-off of a launch vehicle – that is the moment which has a strong impact and even gives a sublime feeling for everybody, not only those who directly involved in that particular space programme, but also every citizen who happens to watch the scene through television. Why is that? I believe that is because everybody, by instinct, realizes that launching artificial objects into space is something beyond our usual concepts in the arena in which we have been accustomed to reside for the past thousands of years, and therefore sends a strong message to our DNA.

I think that is the very reason why we should continue our space activity. It is evident that space activities for the past 50 years have given us wonderful innovations in our daily lives in the areas of communications, broadcasting, navigation, earth observation and sciences. However, even if we exclude those direct benefits, society has learned through space activity how human technology and knowledge is limited. Through space activity, we can establish our own coordinates in the Universe, which we cannot otherwise achieve. This will give us the idea where we stand, and tell us how foolish we are if we act without it.

Therefore, space activity by itself is impacting society by giving us a different perspective, or giving us another 'eye' to look at this world, our culture and everyday life. If our activities were

confined within this small planet, with our eyes only on the Earth's surface, human beings may lose their way to survive for the coming centuries, millenniums and beyond.

Space activity needs long-term investment all over the World because it is not just simply a means to make profits or a handy tool to improve our society. We should continue space activities even if they may not be so 'profitable' for industry or it is difficult to persuade taxpayers or governments. To continue space activity is therefore one of the most important missions for us, the IAA members.

Mr Hiroshi Kanai

Managing Director
Institute for Unmanned Space Experiment Free
Flyer



Mr Imran Majid

Regional Representative to the Asia Pacific Region
Space Generation Advisory Council

I believe that space activities are impacting society through...

... intercultural understanding. Working in an international environment to meet your needs in terms of manpower, resources (silicon for electronics, hardware components) and launch facilities all requires collaborating with people from various backgrounds.

The Internet, cable TV and direct broadcasting are some of the applications that have removed the barriers of time and space. Now one can sit in the comfort of one's own drawing room and shop for a product around the globe, speak to a loved one on another continent, and receive lectures from a professor doing research on the other side of the planet. Moreover, weather news and predictions have given farmers and agriculturalists more reason to plan ahead.

Space has given reason for people to think about dimensions other than their own surroundings, to think across fields and across specific lifestyles. It has also enabled man to take a much more tolerant approach of cultures. It has tremendous potential to bridge the gap between civilizations since in the outer reaches of the cosmos we can only regard ourselves all as humans. Most of the cultures of the World have an awe and inspiration for the stars out there and for the beautiful expanse of vast and unexplored territory. Let us take this message out for our fellow earthlings so that we can truly contribute towards sustaining the 'lovely blue marble'.



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I believe that space activities are impacting society through...

... the fact that in the collective imagination, space embodies the expectation for what the future will bring, somewhere between a dream and the creative vision of what is possible, the most advanced frontier of our perspective. Carved in our history is the image of the Earth captured by the astronauts on the Moon – observed through an extraterrestrial eye, able to embrace all of our planet, as today, at every instant, do telecommunications satellites that make immediately available to all any information reflected from space.

Revisiting the history of the wonderful period that was the race to the Moon, the role of politics appears to have been fundamental: the intuitive foresight of premier Khrushchev and the crazy gamble of President Kennedy have indeed been essential ingredients of an extraordinarily complex combination of political events that has been so favorable for research and technology. Even today space activities continue to need the support of a political strategy: on the one hand, for the effort for the space infrastructure necessary for the services that are useful to the inhabitants of the Earth and the support for the technology transfer to fertilize industrial activities with the knowledge originating from space; and on the other, for the struggle for research and knowledge, an effort that answers an imperative for our civilization.

It is certain that space offers new opportunities. It is also conceivable that the flourishing of new

global space systems may alter important cultural certainties of the past because the global reach of the sea-space continuum allows the (re)drawing of charts and routes that ignore traditional political and geographical borders. The scientific reading of the history of space, the understanding of the laws of physics and of life itself contribute to fostering the hope of a globally shared knowledge, that projects itself, with due respect, as an answer to fundamental questions about the existence and destiny of mankind. Equally, the growing ability of technological systems to influence relations between humans and the environment will eventually enforce a reflection on the collective use of space at the service of Earth. If the International Space Station, which is the result of an enlarged collaboration, offers an image of a peaceful outpost at the service of all for fundamental investigations in an exceptional environment, then space-based security, navigation and monitoring systems can anticipate new control instruments designed to serve the interests of national politics and sovereignty.

As we travel hesitantly toward our future, the astronaut becomes the modern and reassuring proposal of the ancient myth, of the challenge – equipped with knowledge and courage - to the limits imposed by nature and by the environment. Preceded and helped by ever more powerful robots and telescopes, man will never refuse the experience of travelling beyond the Pillars Of Hercules to explore other worlds, as part of an endless quest to find himself.

Dr Franco Malerba

Director
Office of Alenia Spazio in Paris
First Italian Astronaut (1992)



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Ms Susmita Mohanty

*Space Entrepreneur
Moonfront (USA), Liquifer (Austria), Spaceships
that Think (India)*

I believe that space activities are impacting society through...

... ourselves, HUMANKIND, being part of a cosmic continuum.

It is impossible for us to draw a line between Spaceship Earth and the rest of the Cosmos. Space, to me, represents that 'umbilical cord' that connects us to the stars. The impact of space on society can partly be described in words, and for the remaining part can only be summed up through individual experiences, and dreams. It is as much about space technology and how it impacts the everyday lives of people around the globe, as it is about imagination, flight, and self-discovery.

Space, to me, is about TECHNOLOGY. Technology that can save, enrich and connect lives.

It is about IMAGINATION. That is as important, or perhaps more important than technology.

It is about PERSPECTIVE. About who we are. And where we stand in the grander scheme of things in the Universe.

It is about FLIGHT. About spreading our wings and flying to the stars.

It is about EXPLORATION. Of both outer and inner space.

It is about BREAKING FREE. From petty manmade boundaries and distinctions of race, religion and colour.

It is about CELEBRATION. Of the blur that separates fact from fiction.

It is about 'that' PALE BLUE DOT. That beautiful, fragile spaceship we call home.

It is about PEACE, LOVE, and CONNECTEDNESS.



I believe that space activities are impacting society through...

... the provision of perspective on planet Earth and perspective on humans. Our space activities are helping us to see planet Earth as a small speck in a vast Universe, and as the only environment perfect for humans. We can now see Earth as a small and delicate environment in need of care, and humans as one population dependent on that Earth. Before space flight, for the whole two hundred thousand years of our existence, we humans were creatures with three major neural mechanisms for behaviour, and three major activities: increasing our numbers, increasing our comfort and pleasure, and having conflicts between groups.

The perspective of space is helping us to reduce these behaviours. We can now stop being slaves to our neural mechanisms for behaviour. We can now tell our neural mechanisms for behaviour to go to hell and we can do something else. We can create colonies independent of planet Earth and we can populate the Universe. We can now see that it is more interesting, more worthwhile, to create Earth-independent colonies rather than just continuing to increase our numbers, increase our comfort, and have conflicts between groups. We can see that we are one group on Earth. Homo sapiens can become Homo spaciens and we can evolve into many groups, many different species on many different planets.

Space activities help humans to look outward from planet Earth as one family. As we orient more to

space the first behaviour to be diminished will be the conflicts between groups: the wars, the genocides, the terrorism, the racism, the religious killings – the 'us against them' behaviours that were helpful to early primates and are now a curse on us. The perspective provided by space activities will improve our behaviours.

Dr. Kenneth Eric Money

International Academy of Astronautics (IAA)



Sir Patrick Moore

*Astronomer
Member of the Royal Society*

I believe that space activities are impacting society through...

... the progress it brings in all forms of science, notably in medical studies, and because it is now purely international. In space, all countries work together – and this may be vital in uniting the whole of mankind. We are all citizens of the Earth.



Prof. Dr. Mazlan Othman

*Director General
National Space Agency of Malaysia (ANGKASA)*

I believe that space activities are impacting society through...

... creating an awareness that our planet is special, but at the same time vulnerable, and uniting the hopes of people around the World that humankind will someday physically explore other worlds.



Prof. Dipl.-Ing. Heinz Stoewer*President**Space Associates GmbH**I believe that space activities are impacting society through...*

... the realization that space has opened new dimensions for mankind. The foremost one is a new mental dimension. On account of the space exploration of the past few decades, people today understand much better their own environment as citizens of a unique planet. Many have come to realize that the Earth is a fragile jewel whose resources are limited and which needs the utmost care and preservation if it is to last for future generations. Others have understood that there is a new dimension to be explored beyond the Earth, and that our destiny may sometimes lead us to settle on different 'worlds'. Others have begun to embrace the opportunities opened up by using space for better managing our daily lives here on Earth. Altogether, space has altered the way we think of ourselves and of our destiny, and has thus created a new mental perception for mankind.

*I believe that space activities are impacting society through...*

... their potential for influencing the attitude of people in facing the relevance they give to the expectations they have of the future.

Today, almost everywhere society is largely dominated by the attention given to the 'contingent problems', the focus of interests, and as a consequence our endeavours are concentrated on the very short timescales.

It is significant that very few initiatives worldwide, in whatever field, are in progress today or even planned that require commitments and efforts lasting over a generation or even over a decade. The lack of vision penalizes the prospects for growth and evolution of humankind, and contributes to spreading of a sense of instability and concerns about the future.

In such a situation, space activities, in addition to continuing to provide a variety of useful services in the application fields, such as telecommuni-cations, earth observation, meteorology, navigation and defence, which have contributed to an increase in the standard of living, have the potential to support an 'opinion movement' open to raising future projected interests and capable of opening new horizons.

By setting broad and far-sighted objectives, such as the Exploration and Development of Space beyond Near Earth Orbit, targeted at the Moon, the planet Mars and other bodies in the Solar System, the prospect of people, in particular the young

generation, might be directed towards longer times goals.

In a World that is today characterized by continuous progress that in many cases happens as a result of efforts that are not easily identifiable by people, and not easily visible to them, the enterprise of space exploration possesses a unique appeal, through being globally evident, easy perceivable and highly involving, especially when humans are brought into the equation.

Relevant benefits can be derived for 'tomorrow's society' from several other activities, but what other initiatives are in a position to create the expectations of challenging ventures with which everybody can identify, as is the case with space initiatives?

Exploratory space activities are able to provide all of us with a magnificent gift, in that they can indeed revitalize the latent spirit of discovery, of search and of enlargement of the boundaries of the environment in which we live. Exploration and development enterprises, if judged only on the basis of cost/benefit parameters, would never be undertaken; it is therefore necessary to develop a cultural framework that provides recognition of values of a different nature from the economic one.

In assessing the benefits of initiatives that mainly enhance factors of an imponderable nature, different meters of judgment have to be adopted with the consciousness to evaluate situations and take decisions on the basis only of their intrinsic merits, without attempting to value the 'fall-outs' that will surely be derived in the years to come.

Prof. Ernesto Vallerani*Past President**Associazione Italiana di Aeronautica e Astronautica (AIDAA)*

The exploration and development of space are investments for future generations that we have to make people understand, accept and support.

Today we have to move forward, going wherever we can go. One day, the sons of our sons will go further and push the frontiers out further, and so on for the generations to come.

I believe that space activities are impacting society through...

... the 'space option'.

Already in the early years of the 21st century it is becoming acutely obvious that the impact of an expanding human species on a finite planet is resulting in situations that are having major impacts on global issues such as climate change, the environment, energy, politics and economics. Indeed, the sustainability of human society may soon be in question, unless immediate and effective measures are taken. Fortunately, space visionaries and pioneers long ago recognized this eventuality and they and their followers have quietly developed both the scientific rationale and the technological concepts to open the space frontier.

Upon these works is the development of a concept called 'The Space Option' and, because this option offers humanity the most 'optimistic' pathway to sustainability, it is a choice humanity will most likely make in order to maintain its well-being and its ultimate survival.

The Space Option concept is an evolutionary plan to meet the basic and anticipated needs of humanity through the utilization of near-Earth resources – especially that of energy from space. The wide-scale and successful implementation of the Space Option could contribute substantially to the restoration of the global environment by its reliance on unlimited, clean space solar energy to replace humanity's dependence on fossil fuels, which are finite, or nuclear fuels, which have negative environmental and political aspects.

Such a new energy source would not only maintain and stimulate the global economy, the eventual exploitation of other extraterrestrial resources would guarantee future generations a sufficient supply of material resources. Thus, the Space Option provides hope for the less-fortunate societies on our planet to aspire to reaching a living standard substantially beyond their present situation, while the present advanced societies can maintain their standard of living and continue their development – an approach to the future that differs greatly from many of the current scenarios for 'sustainable development' that are under discussion.

As such, the Space Option could and should become the primary motivation for continued space exploration and development – perhaps even becoming a more powerful driver for space activities than national prestige, security and scientific exploration have been. Indeed, it should be a catalyst for the opening of a 'New Space Frontier', attracting the energies and capital of a new generation of explorers and entrepreneurs.

If implemented in time and with sufficient commitment, the ultimate reward will be a prosperous and dynamic planetary civilization living in a healthy environment, and the creation of an infrastructure in space through which the expansion of the human species throughout the Solar System and beyond could be realistically anticipated.

Mr Arthur Ray Woods

*Artist, President & Founder
The OURS Foundation*



Challenges for Life: To 'reach beyond' is a challenge we all face as individuals and as part of larger communities. Space has historically provided an avenue to accept these challenges that fuel careers and passions. Dreams drive humanity in many ways with the opening of the space frontier as a direct result of its early pioneers. Now we dream of going to the Moon and Mars as a 'virtual member' of a robotic or human expedition. Soon, we will be able to buy a ride to space at a price equal to two or three years salary. Inspiration comes from the vastness of space and the ability to see beyond our limited horizons. The great telescopes of our time are indeed enabling us to see into our past and view our future.

...“Space activities are difficult and expensive—and exciting. This combination has turned on many minds, both young and old...”

[W. Ailor]

...“The future is bright and filled with promise for us all. And the human spirit, driven as it is with an insatiable desire to know, to explore, and to understand, will continue forever to reach upward and outward.”

[R. McCall]

...“Space exploration then, is not just a physical journey, it is also an imaginative journey.”

[D. Puttnam]

Contributors

William Ailor
 Roger-Maurice Bonnet
 Vanna Bonta
 Johanna Catena
 Arthur C. Clarke
 Kathleen M. Connell
 Margaret Doetsch
 Karrie Dougherty
 Norbert Frischauf
 Andrea Guidi
 Valery Korepanov
 Robert McCall
 Ayako Ono
 Yvonne Penney
 Irina Ponomareva
 David Putman
 Laura-Kate Wilson

Challenges for Life

I believe that space activities are impacting society through...

... demanding the best from humankind. Space activities are difficult and expensive – and exciting. This combination has turned on many minds, both young and old, and encouraged them to think not about local squabbles or world problems, but about new technologies and new possibilities that stretch the mind and demand excellence and cooperation. Thanks to our space activities over the last 40 years, we have reached a historic plateau in the evolution of life on Earth – we can now defend our planet from threats from asteroids and comets and can go into space with confidence that we will succeed. The promise of space has challenged our people, our education systems, our infrastructure, our organizations, and our governments. Protecting our planet and going forward in space will continue to challenge us and demand the best.

Dr. William Ailor

Director

*Center for Orbital and Reentry Debris Studies
The Aerospace Corporation*



Prof. Roger-Maurice Bonnet

President
Committee on Space Research
(COSPAR)

I believe that space activities are impacting society through...

... science and research into extreme phenomena and on other planets in our Solar System and around other stars. The revolution in our knowledge of the Universe that we have witnessed over the past 40 years or so, has been dramatic thanks to the utilization of satellites and interplanetary probes. The future promises to be even more impressive as a consequence of the development of new and increasingly more performant systems in the various space agencies. As usual, it is nearly impossible to forecast accurately what the benefits of such activities will be in the other domains of science or of technology. It is quite obvious, however, that this increased perception of the phenomena and laws of nature, thanks to space activities in science, will impact not only on space technology but also society in general, be it through the forecasting of the weather, of the climate, or the surveillance of our planet. Because of their fundamental character, progress in the space sciences is based on the broadest international cooperation possible. In this way, they do represent a unique vector for dialogue and for peaceful interaction between all the people of the World.



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I believe that space activities are impacting society through...

... adjusting our population's perspective of the idiom 'the World'. The impact of space activities is nothing less than the galvanizing of hope and imagination for human life continuum into a future of infinite possibility.

Images introduce us to multitudes of moons, to the red soil of once-faint imagery but now remotely sensed terrain, to stars and galaxies; they broaden our field of vision and engage our understanding of an immensity of which our Earth is only a small part.

Space activity has the fundamental byproduct of social coalition. When given a broader perspective of goals to accomplish, rather than turning upon one another in conflict, cultural differences translate into a harmonized concerted effort towards human triumph.

Looking upward and outward, how can we not respect this ever-vigilant cognizance that distinguishes us: the capability to envision, to dream, and to invent; the ability to ponder our existence; and be aware of our existence on the outer arm of a spiral galaxy in an immeasurable ocean of stars? Cognizance is our crest. Are we not creatures, despite our shortcomings, to be regarded with awe and reverence? And the endeavours to further comprehend the mysteries of our world, the cosmos, among the most worthy in our evolution?

If humans are maligned as aggressively motivated, reflection reveals that our need for opposition and obstacle to trigger incentive is not in itself dishonourable, rather a misapplied quality when aimed at inappropriate targets for lack of a more worthy opponent.

Infinity is a territory towards which the inherent human impetus of conquest can be productively directed. Space is as infinite as we can imagine, and expanding this perspective is what adjusts humankind's focus onto conquering our true enemies, the formidable foes: ignorance and limitation.

Ms Vanna Bonta

Writer, Film Artist, Producer



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Ms Johanna Catena

Graduate of Air and Space Law
University of Leiden, The Netherlands

I believe that space activities are impacting society through...

... contributing to the well-being of society through monitoring the environment, weather prediction, mitigating natural disasters, providing valuable warnings in preparation for such disasters. This is just one aspect of enhancing our safety as technologies develop and we can continue to improve our co-ordination and strategies; in particular for regional conflicts, reducing instability through working as a 'community'. Another aspect to space activities is that of working as an international community to further our scientific understanding and continue to develop technological capabilities. The International Space Station is an obvious example as we work together, with one of the many end goals being improving our health and our understanding of the human body in weightless conditions. The sense of 'community' is also built upon global telecommunications and information technology applications. We will continue to interact with others on many levels; transporting cultural knowledge and education throughout the whole World.

Private space activities have entered a new realm, making what was thought to be an improbable dream one step closer to reality. Just as the Earth's mariners took to the oceans and sailed around the World, discovering, it was inevitable space would capture our thoughts and our hearts. It is human nature to search, explore and challenge ourselves in order to understand our place in the Universe. Our curiosity is the key to developing our social awareness to forge a better



life for the future, and in particular for those living in less-developed areas of the World.

I believe that space activities are impacting society through...

... the fact that, for more than half a century, I have been lucky enough to observe – and occasionally experience – the greatest revolution in the history of astronomy, perhaps the oldest of all the sciences. With the coming of Sputnik in 1957, it moved from observation to experimentation – and now exploration.

When I joined the British Astronomical Association (BAA) in the 1940s, any talk of space travel was regarded as hair-brained nonsense, fit only for boys' magazines and the cheaper pulps. It is now amusing to recall some of the objections raised against the idea that we would one day be able to leave the Earth. In a famous (or infamous) editorial, The New York Times once castigated Robert Goddard for thinking that a rocket could work in a vacuum, when 'there was nothing to push against.' Though it apologized in the special Apollo issue of 1969, by then Goddard was dead.

My own introduction to space travel (apart from numerous works of fiction) was David Lasser's 'The Conquest of Space' (1930). This was the first serious book on the subject in the English language – and the author later lost his job because a US Congressman said that anyone who wrote about travel to the Moon was obviously insane. I don't know if an apology was ever forthcoming in this case.

I also recall a wonderful headline in a British newspaper during the 1930s: 'We are prisoners of

fire!', when radio echoes revealed that the temperature in the Ionosphere was some thousands of degrees. The journalist responsible for this headline obviously didn't understand the difference between heat and temperature. One would soon freeze to death in the Ionosphere, if the only warmth came from the rare thousand degree gas molecules. (For a good example of this distinction, consider those delightful Guy Fawkes Night fireworks that you can hold against your hand, even when they are spitting out showers of incandescent sparks.)

Until quite recently – except for those deluded individuals who believe in horoscopes* – it was generally considered that celestial bodies had no influence on this planet, except of course in such obvious cases as the Sun and the Moon. Then, during the course of a little more than a decade, it was realized that impacts from space have had a profound affect upon Earth. We might not be here today if an asteroid or comet had not wiped out the competition some sixty-five million years ago.

I can still recall arguments at the BAA meetings over the origin of lunar craters, where one astronomer remarked: "The presence of central peaks completely rules out the meteoric hypothesis." One cannot altogether blame him because there are obvious examples of volcanic activity on the Moon, e.g. the crater Wargentini, which is full of lava up to the brim. So when we know one process is at work, it seems unnecessary to look for another. And who would ever have imagined that the brief upward splash that occurs when you drop a lump of sugar into a cup of coffee can be reproduced on a million-fold greater scale – in solid rock!

Sir Arthur C. Clarke

Writer



There is a sad irony in the fact that Gene Shoemaker, the man largely responsible for proving that Meteor Crater, Arizona, had been correctly named, was killed in a stupid car accident in Australia, while looking for impact sites. But at least he had the enormous satisfaction of seeing Shoemaker-Levy's encounter with Jupiter – a cosmic spectacle visible to the entire World.

Earth's turn will come one day: it could be tomorrow, it might not be for a hundred years. Looking at the statistics, I feel that we have been quite lucky during the last century.

This is why I proposed Project Spaceguard in my novel 'Rendezvous with RAMA' (1973). I am happy to say the name has been widely adopted: NASA's Report 'The Spaceguard Survey' (January 1992) acknowledged the source. The detection of earth-threatening objects (Space Watch) has scarcely begun and Spaceguard itself lies still further ahead – but not too far, I hope. As science-fiction writer Larry Niven once remarked: *"The dinosaurs became extinct because they didn't have a space programme."*

Finally, I am still rather spooked by the fact that I dated the asteroid impact in RAMA at 11 September. Don't ask me why I chose that sinister date, almost thirty years ago.

* That's almost everyone here in Sri Lanka. When asked for my own views I always reply: "I think astrology is utter nonsense – but then I'm a Sagittarius, and we're very skeptical."

I believe that space activities are impacting society through...

... exploration systems in space and the resulting systems capability to solve the challenges facing humanity.

Since the launch of Sputnik, and then via the Apollo landings on the Moon, and recent robotic missions to Mars, Earth's people have experienced an ever-increasing global awareness of the interconnectedness of humanity and our life-support system, planet Earth.

In turn, international space exploration demands the creation of new systems and technologies. This enables us to evolve a future for humanity everywhere in the quest of exploration and settlement of the cosmos.

As importantly, space exploration systems allows us – even demands of us, as a matter of global ethics – to apply these new systems to solve the major challenges facing humanity today. These involve clean water, the remission of the AIDS epidemic, medical knowledge or a space-communications-enabled international economy, that empowers communities on every continent.

Equally as exciting, space activity creates the platforms for broad cultural contact and the understanding that can emerge from a vision of global unity and an appreciation of local differences in the adventure of space.

The joining of robust space systems and the creation of a global political will to apply space

capabilities to our needs today, are intertwined now. 'We, the people' are in the process of realizing our historical destiny in moving aloft, together, from our planet of origin.

I look forward to working with you in realizing an 'International Mission to Humanity'.

Ms Kathleen M. Connell

*Adjunct Faculty and Project Director
Center for Humanity and Space Exploration*



Ms Margaret Doetsch

Publications Editor
Athena Global

I believe that space activities are impacting society through...

... their exciting stimuli, which inspire the innate human urge to explore new frontiers of knowledge for the benefit of all humankind.

Following the examples of mythology such as Daedalus and Icarus or historical figures such as Aristarchus, with his heliocentric view of the Universe, and the great explorers of subsequent centuries, modern man and woman now seek to expand our knowledge of the Universe through setting up colonies on the Moon and Mars. A new dimension is added to our lives as we vicariously live the excitement of exploring a new frontier through these adventurers.

As a layperson who has been as it were on the periphery of space for the past 30 years through being married to a space professional, I never fail to marvel at the impact space activities have on so many aspects of our lives. I am in awe when I see a surgeon on one side of the globe directing an operation thousands of miles away through telemedicine, or when I see children in developing nations benefiting from educational resources through tele-education, all due to satellite technology. I am astounded not only by the information transmitted by the Hubble Telescope, but also by the beauty of the images, nature's works of arts. I gaze in wonderment at the bright light of the Space Shuttle rising into the dimly lit dawn sky, and the robotic Canadarm silhouetted against black space, testimony to modern man's engineering genius.



How fortunate we are to have space as our frontier, offering not only opportunities to improve the lot of human kind, but also providing an aesthetic experience and an inimitable adventure!

I believe that space activities are impacting society...

... on two levels, one practical, the other inspirational. Space activities affect our lives every day, though that influence is so seamlessly and unobtrusively integrated into the everyday that we are usually unaware if it, or take it for granted. Yet the World of 2004 is a very different place from the World of the early 1960s, in no small measure because of the development of satellite networks for communication, weather monitoring, remote sensing and navigation. The changes that these technologies have wrought in our societies are not always obvious, yet they are nonetheless real and wide-reaching: worldwide communication has created a true 'global village'; remote sensing enables us to better understand and manage our natural and built environments; weather monitoring assists in disaster preparedness and amelioration; military surveillance during the Cold War helped to avert nuclear conflict. Spin-offs from space research and activities, especially in the medical field, help to save lives, and aid lives, every day.

The excitement and the challenge of space exploration also impact upon society by inspiring us: with a spirit of adventure, with a sense of awe at the beauty and mystery of the Universe that it reveals, with a greater awareness of the precious fragility of our own home planet, and with a greater understanding of our place in the cosmos. Space activities and the cosmic wonders they help reveal, not only inspire artists, poets and songwriters, they also imbue every one of us with a sense of what humanity can accomplish as a

species, when we set our minds to a task: a powerful antidote to the social depression that arises in times of international tension. A society without challenges to overcome is one that stultifies and stagnates: responding to the challenge of space impacts upon society by helping to keep it alive and vibrant.

Ms Kerrie Dougherty

Curator
Space Technology
Powerhouse Museum



Mr Norbert Frischauf

High Energy Physicist and Future Studies
Systems Engineer
Booz Allen Hamilton

I believe that space activities are impacting society through...

... the fact that if there is one major effect that space activities exerts on our daily lives then it is the implantation of the buzzword 'global' in our mindsets. Space is not a national territory, it not something that only particular countries have access to, such as the sea. Every country is free to run its own spaceport. Every government is free to develop the necessary technologies to launch its own astronauts and/or satellites into space. Every person is free to look onto the starry sky at night and to dream about going into space themselves.

Going into space in person and living this experience is unfortunately something that only a few hundred people have so far had the privilege of doing. Based on a state monopoly, access to space is expensive, by far too expensive for the majority of mankind. But with the success of the X-Prize and SpaceShipOne things might change for the better, so that the dreamers will finally get their chance.

Once up there, above the tiny thin blue crescent of the atmosphere, you are prone to experiencing one thing: it is ONE world, beautiful and fragile. The national borders are only illusionary, but what is real is the thin line between life and the void of space: the atmosphere. You had better do everything you can to protect it, as it is our only shield against the life-threatening hazards out there. The tiny blue marble deserves our deepest respect, which means that we have to treat it not as a landlord, but more like a guest – a guest who

is willing to play by the rules that his host has set up as his own standards.

Telecommunication and navigation satellites, weather and earth-observation systems; all these spacecraft – mostly unnoticed – enable us to live together with a technological standard absolutely unimaginable a few decades ago. Space has no frontiers, and so all these systems can therefore eventually become available to all of humanity to enable a better life for us all. As long as this is not the case, space can already help to inspire and allure. Space activities are an attempt to reach out for an unreachable goal, the fulfillment of our dreams and ambitions. If space activities have one impact on human society, then it is about the will to make one's dreams materialize, to measure one's intellect against the final frontier, and to do so in a cooperative way on a global basis.



I believe that space activities are impacting society through...

... the creation of the awareness of the importance of a well-structured society for the advancement of humankind.

Only a well-structured society, in fact, can guarantee the right political support together with a well-balanced private interest, a fair competitive market supported by high-level co-operation, a globalised work environment with a strong feedback in terms of regional interests. These are only a few of the complex ingredients that are needed for the success of the space race.

Mr Andrea Guidi

Newton Flight Control Team
SciSys Ltd./ESOC



Prof. Valery Korepanov*Scientific Director**Lviv Centre, Institute of Space Research**I believe that space activities are impacting society through...*

... the following components:

Firstly, the negative ones: a considerable amount of financial investment is extracted from the public domain, which might otherwise be used for solving social problems, helping the Third World, etc. Also many highly professional engineers and scientists are diverted from important industrial tasks, such as the development of alternative fuel and power-supply sources, etc.

Secondly, the positive ones: Earth is the cradle of mankind, but it cannot remain in that cradle for all time; it has to expand beyond it if it wants to survive (K. Tsiolkovsky). Also the high concentration of funds on one problem allows the quick achievement of technological results, which would otherwise take considerably longer. The best examples here are microelectronics, new metallic and non-metallic alloys, semi-conductors and super-conductors.

Last but not least, important new knowledge is obtained about our home, the Earth, as well as about biological specimens and microgravity's influence on them, and on technological processes, to name but a few.

Mr Robert McCall*Artist**McCall Studios Incorporated
National Space Society**I believe that space activities are impacting society through...*

... the awareness as a young boy that I could not believe the words I read in books... that the stars in the night sky were really distant suns, billions and billions of miles away. I read about galaxies, enormous clusters of stars wheeling through space – that there were billions of such galaxies. The heavens were teeming with mysterious worlds.

Peering through the telescope at Ohio State University, near my childhood home, I saw many of these wonders, including the planets of our Solar System and, of course, the Moon, our magnificent many-cratered moon.

In those days of the 1930s, even the most optimistic did not dream that mankind would ever travel in space. Today, following three decades of incredible space achievement, humanity is on the threshold of a new era in space exploration, one that will return us to the Moon, take us on to Mars, and eventually to the stars.

Someday, humankind will populate the cosmos. The small space stations that orbit the Earth today will grow like snowflakes to become great crystal cities in the sky. The wonderful possibilities are endless – as endless as the infinite regions that surround planet Earth.

The future is bright and filled with promise for us all. And the human spirit, driven as it is by an insatiable desire to know, to explore, and to understand, will continue forever to reach upward and outward.



Ms Ayako Ono

Artist

Tokyo National University of Fine Arts and Music

I believe that space activities are impacting society through...

... the arts. The role of art is to stimulate the imagination and enhance the sensitivity of humans, and things like pictures of the Earth's surface, Mars's surface, and 'Earthrise' as seen from the Moon have certainly affected a lot of people.

It is important to inspire the next generation and the general public. If suitable art can be created for a microgravity environment and in a confined space, it will not only improve the mental health of astronauts but also inspire people. Great art has an impact and has the power to inspire people to learn about the Universe and space development, just as space inspires great art.

As one way for space and art to work together, I propose a relaxation room that can be used as an art gallery connected to the International Space Station (ISS). Astronauts could relax even in this confined space, and artists could use this place as a new environment for expression. The relaxation room can have multi-channel speakers mounted on the walls, where astronauts can enjoy quiet sounds to relax the whole body. The lighting of the room can also be varied to suit the music's atmosphere. The room will also have objects and fine arts designed to relax through tactile stimulation and sight. For the World, the new environment of ISS art gallery will motivate professional artists, students, and even the general public to dream and explore new possibilities of expression.



My hope is for the ISS relaxation gallery to be a symbol of the non-military, peaceful use of space.

Ms Yvonne Penney

Board of Directors

Canadian Space Society

I believe that space activities are impacting society through...

... imagery.

As humans, we are visual creatures with the ability to see depth and perceive colours unlike any other species on Earth. Through the advancement of photography by digitization or even 3D lasers, we can now see things as we never have before.

In the past, we saw the surface of the Moon or Mars and other planets through the eyes of the artists. Now, we can actually see what composes the heavenly bodies through pictures beamed back from the originating spacecraft.

Hubble's pictures of the nebulae are breathtakingly beautiful. The panoramas of the Martian surface are unbelievable, as are the detailed pictures of Earth from the Shuttles and the Imax film from the International Space Station. The Earthrise from the lunar surface will always be an awesome sight for us, as it reminds us how fragile our planet really is, and how alone we are amongst the stars.

Through laser imaging, we can now see the Earth, the skies and the oceans in the kind of detail never before imagined. These sorts of pictures also tell us how we are treating our home and can perhaps guide us in how we can repair the damage we've done.

As a child, when I first heard of Sputnik, and then the Cosmonauts and Astronauts, I wondered what they saw, and I hoped to see pictures of it all.

Today, through the magic of digital cameras and laser imaging, we can see as far away as the next galaxy, or as close to the atoms that make up the World we live in.

It is said that a picture is worth a thousand words; however, these images that we see leave us at a loss for words.



Mrs Irina Pavlovna Ponomareva

Leading Researcher and Deputy Head of the Department of Implementation, Realization and Promotion of Scientific Achievements SSC RF – IBMP RAS

I believe that space activities are impacting society through...

...the development of cosmonautics generating new directions in the development of science and technology; in particular it gave impetus to the rise of space biology and space medicine. This, in its turn, led to creation of new specializations, to the appearance of new professions in these spheres, and an afflux of young specialists.

I belong to the group of people for whom connection with the initial period of manned cosmonautics became significant and determined the scope of my professional interests for my whole life.

Participation in model and flight experiments, including the international programmes Intercosmos and Mir-NASA, and work with the ISS-3 and ISS-5 crew members of the International Space Station, showed that international cooperation was a fertile field for the mutual exchange of experience from different scientific disciplines, for improving mutual understanding and mutual relations between different nationalities and the spiritual intimacy of peoples. I would even say that it serves the aim of strengthening peace on Earth.

Humanity constantly faces different cataclysmic dangers, such as asteroid impacts, possible exhaustion of mineral resources, etc., which can lead to despair in our society, and the appearance of anxiety in our children.

The further development of space science and techniques can give hope to our society by way of

pushing back boundaries and going beyond the limits of Earth's civilization. The unpredictability of space catastrophes will cause humanity to mobilize itself to solve these problems; it may serve to counteract aggression in society, to provide a sense of optimism, and encourage humanity to give up wars and terror.



I believe that space activities are impacting society through...

... space exploration being one of the greatest achievements of the twentieth century. Putting a man on the Moon was, by any standards, a quite extraordinary and remarkable feat, one that captured the imagination of everyone on the planet. It symbolised the way in which science and technology have brought all kinds of things within our reach, which would have been absolutely unthinkable to earlier generations. In fact, quite literally, they were the stuff of science fiction.

Space exploration, then, is not just a physical journey, it is also an imaginative journey. It broadens the horizons not just of those directly involved, but all of us who witness it. It requires enormous ambition and vision and an unwavering sense of purpose.

It is, of course, expensive. But this also means that space projects are now invariably undertaken as collaborative projects involving different countries. It facilitates international co-operation; there is no better testament to that than the work of ESA. There are economic benefits too; the aerospace industry in the UK employs over 100,000 people, and working on a space projects helps ensure the stability of those jobs.

As we know, there are also very practical benefits to space travel. It enables us to test new technologies, to experiment in ways that are simply not possible on Earth. Space exploration is a key driver of innovation.

There are those who argue that the risks of space travel outweigh the benefits that it brings. But while there are of course risks, I think it's important that we don't let go of all the benefits that space exploration brings. That would be a backward step. Let us keep the boldness of vision and the commitment to scientific progress that took us into space in the first place.

Lord David Puttnam CBE

Chair National Endowment for Science, Technology and the Arts



Ms Laura-Kate Wilson

Young Graduate Trainee
ESA/Kourou Communication Service

I believe that space activities are impacting society through...

... space activities being central to our lives in many ways, our economy and our future, especially in French Guiana where I live. In fact, the space sector is the main economic activity of this French overseas department and makes up 30% of the GDP (Gross National Product) of direct and indirect employment.

The current downturn in the launch-services market has been very noticeable here. Due to the sudden reduction in the rhythm of launch campaigns (from an average of 11 per year between 1995 and 2002) to only 4 in 2003 and 3 in 2004), many people detached by their European companies have recently left Kourou; it feels quite empty and there are fears of unemployment. Yet beyond this purely conjunctural setback, I believe there is a silver lining. The space activity in French Guiana has the constant support of the European Space Agency. The exciting future developments will also bring their fruits to French Guiana. The Vega programme, led by ESA, is coming to Kourou and the first launch is set for 2007. The Soyuz launch site is also under development. This Russian launcher will also up the pace of launches from Kourou and guarantee launch durability. Moreover, the new European Constitution gives a particular importance to space as an essential tool for Europe (as it is since many years for the US) to implement its strategic aims.

What is amazing in French Guiana is that nearly 45% of the population is under 25 years old.

Moreover, French Guiana is a bridge for Europe and South America, and the space activities are bringing both continents and people together. We are all learning at least one foreign language, albeit French, Portuguese, English, Russian, Spanish, Italian even Taki-Taki. Living in this rich melting pot is fascinating, as is living in two very contrasting, but potentially complementary worlds: on the fringe of an immense jungle with the most up-to-date technological know-how on its doorstep. We are young, dynamic, and very enthusiastic about space and its implications for French Guiana in many ways. We will contribute to the future of French Guiana, the space sector and all that comes with it: the infrastructure, a more expansive university system, reliable financial services, the environment (80% of which is Amazonian forest) and sustainable-development issues.

It is the beginning of an exciting challenge for us, and with the help of our predecessors we could harness this country's potential spurred on by the space activities.

Knowledge Development: The human species has been building knowledge step by step for millennia. As we learned to read and write, the nature of human capital increased at a remarkable rate. As we ventured into space and opened up the limits of our horizons, the technology of computers came along and enabled a knowledge explosion. Now this knowledge is expanding exponentially: in the understanding of the Earth, our Universe and other planets, for technologies in harsh environments, human physiology and health, and in where we came from within the Universe. Space has stimulated the development of knowledge.

... "Space exploration slowly but surely changes our ideas on such fundamental frames of reference as space and time."

[I. Almár]

... "Space is a minor economic activity in today's global economy. But like salt and pepper in our food, without it our future as a whole will be sour and dull. Space is not a caprice, not even a fundamental human quest. It is the only way to have a future."

[A. Azcarraga]

... "Space science stands as a testimony to society of the unstoppable acceleration of scientific, rational thought..."

[G. Bignami]

... "Exploration brings new and often unexpected knowledge and understanding, which in turn has a profound and irreversible impact on society."

[M. Yarymovych]

Contributors

Knowledge Development

Iván Almár
Jacques Arnould
Álvaro Azcárraga
Giovanni Bignami
James Burke
Don Davis
Karl Doetsch
Giancarlo Genta
Richard Kline
Robert Larned
Sergio Marchisio
Vladimir Plester
Victor Pylypenko
Robert Sackheim
Istvan Vago
Frans von der Dunk
Michael Yarymovych

I believe that space activities are impacting society through...

... several channels.

Satellites have gradually transformed our everyday lives, although most are unaware of it. Space probes improve our general view of the Universe and our Solar System in particular. Space exploration slowly but surely changes our ideas about such fundamental frames of reference as space and time.

Our changing concept of space is more obvious. Apollo astronauts, having already gazed at the big blue marble over the lunar horizon, gave us a new view of our planet Earth. It shone in the sky among other celestial bodies, but was still exceptionally large with visible details on its surface. Astronauts staying on the surface of Mars will see it differently, as one of the bright 'stars' wandering among the well-known constellations. This view will certainly make a big impression. It will modify our general idea of space, celestial bodies, the sky, and also the real role of our Earth in the Universe.

The changing concept of time is not so evident. We are accustomed since birth to the fact that everything around us is changing with a diurnal, monthly and annual rhythm. From time immemorial, mankind has measured the course of time by days (based on the period of rotation of the Earth), months (the orbital period of our Moon) and years (the orbital period of Earth). This tradition has an enormous influence on our everyday life in terms of celebrating birthdays, anniversaries, feasts of state or religion, etc.

This will all change completely with space exploration, when astronauts will leave the neighbourhood of the Earth. Neither the rotation of the Earth nor its orbital period will have any significance for astronauts living on the surface of Mars. They might measure days, months, and years by a clock, but these units of time will be meaningless. Even today, the concept of a 'day' is rather artificial for astronauts orbiting the Earth in a space station. They are living quite independent of the rotation of the Earth, although, for practical reasons, 'Houston time' or 'Moscow time' is kept onboard.

I am convinced that this kind of change in spatial and temporal reference frames will have the deepest of impacts upon mankind.

Prof. Iván Almár

*Astronomer
Konkoly Observatory of the Hungarian Academy
of Sciences*



Dr. Jacques Arnould

French Space Agency (CNES)

I believe that space activities are impacting society through...

... reducing the World to the dimensions of Man, expanding Man to the dimensions of the World.... Who today would dare propose such an ambitious project to our human societies and their members? This is however, exactly what the 'space enterprise' has achieved for almost half a century. An immense task, maybe impossible, because we do not dare tell which one of the two infinities, the World or Man, is the most profound and the most frightening. Also, however, thanks to remote-sensing and telecommunications satellites, thanks to the interplanetary satellite probes and the space telescopes, and finally thanks to the manned flights, Man has given himself the means to discover the World that surrounds him, to size it up, and, by so doing, to arrive at a better knowledge of himself.

In fact, this dual movement of concentration and expansion is nothing else but what the foundations of what Western thinkers, at the dawn of modern times, have named 'humanism'. Far from being an arrogant claim, the humanist proposal seeks rather to make Man even more human, by making him participate in all that may enrich him in nature and history.

Space, taken altogether as geographical location and as human activity, therefore presents itself to us today as a real challenge. It demands from us that we consecrate in it some scientific tools, technical and economic, that we add also some judicial and ethical thinking and above all, before and beyond all that, that we question ourselves

about the identity, the human personality which invests itself in it and emerges from it. The new frontier is not so much Space but Man himself.



I believe that space activities are impacting society through...

... activities that can be divided into two broad areas, namely those:

- from Earth: Exploration, SETI, future space exploitation, etc.
- to Earth: Space applications and terrestrial sciences.

In terms of the first:

Humankind has maintained through the generations a keen curiosity and a need to know. Space activities cover a substantial part of this curiosity, and may provide the answer to some fundamental questions, such as where do we come from, where do we go, and mainly are we alone?

Just identifying, without any doubt, the existence of 'others', whoever they are, will dramatically change our life on Earth, including our present internal fighting and feuding. But more, we may learn fundamental answers to basic questions like health and the origins of life, and eventually the way to modify ourselves into another form of life. The possibilities are enormous, but first we must dare to cross the oceans of space. Finally, Earth, and also the Sun, have a limited capability to maintain the growing demands of our society. As the human race, we will be forced to tap the resources of outer space, from mining the Moon and the asteroids, to getting energy via large platforms directly from the Sun.

In terms of the second:

The first idea is the one related to national rights: Who owns the Earth orbits? So at least, as in Antarctica, having a space activity bestows a certain 'ownership'.

But modern life today cannot be conceived without space. It is much too dependent on the telecommunications and direct TV broadcasting. We have the weather reports, the use of satellites for precise georeferences, with direct cadastre applications. Also the Earth-observation activities, from pollution control to agricultural checks, border surveillance and control. Furthermore, with all of the navigation and precision positioning, we are on the eve of a new era, which will include ATM and ATC, automatic distress signalling and much more. Today without the VSAT (very small aperture terminal) hundreds of businesses would not be viable, from petrol-station networks to franchising operations all around the World.

As a final remark:

Space is a minor economic activity in today's global economy. But like salt and pepper in our food, without it our future as a whole would be sour and dull. Space is not a caprice, not even a fundamental human quest. It is the only way to have a future.

Mr Álvaro Azcárraga

*Managing Director
Aerospace and Systems Department
Sener Ingeniería y Sistemas*



Prof. Giovanni Fabrizio Bignami

Director
CESR Centre d'Etude Spatiale des
Rayonnements

I believe that space activities are impacting society through...

... space generally making people dream, and all the more so when it yields the possibility of seeing men and women like us on extraterrestrial bodies, such as the Moon yesterday and Mars tomorrow. A personal survey carried out with people in the street as to 'what has been mankind's greatest achievement in the 20th century' has given me a vast consensus on 'The Moon landing'. And not because of any application, however useful, that may have arisen from the Apollo missions, or indeed from any other space programme.

For society as a whole, the impact of such a fundamental exploratory quest is only matched by the search for extraterrestrial life, and by the exploration and understanding of our Universe. These two activities are now being vigorously pursued in space, and they both have a chance of profoundly influencing our society. The discovery of present or past life forms on Mars, for example, or of convincing pre-biotic material in a comet, would have an impact comparable to Columbus finding a form of intelligent life in the West Indies, which clearly Adam and Eve could not have reached.

On the other hand, we have now been looking at our Universe from space for the last forty years. The depth and breadth of the information gathered by our telescopes at all wavelengths has given society a richer and more profound knowledge than 400 years of ground-based observations, from Galileo until today. Those four centuries have, in turn, given mankind an infinitely better

view of the cosmos than the previous 4000 years of naked-eye astronomy, from the Caldeans to Copernicus. Thus, space science stands as a testimony to society of the unstoppable acceleration of scientific, rational thought.



I believe that space activities are impacting society through...

... in 1957, space flight came upon the World as a shocking surprise, even though it had been long described in science fiction and long predicted in serious councils among the aware minority of citizens. This was an example of a sound, but not generally understood, prediction of the future. Space activities today present opportunities for similar predictions.

Humans are likely to achieve permanent residence on the Moon; the only unknowns are for what reasons and consequently when. Humans are likely to achieve a scientific understanding of the origins of life on Earth; the only unknowns are how and when. Humans are likely to discover life elsewhere in the Universe; the only unknowns are: (a) is life uniform as on Earth, or (b) is it diverse, (c) is it ubiquitous and common or rare, (d) do contemporary civilizations exist within observable range, and consequently when will the results of (a) through (d) be known?

Without knowing the answers to any of these questions, we are still able to say some things about their probable effects upon humanity. If contemporary civilizations are extremely distant and rare, we may not find one during a time comparable with recorded human history, say ten thousand years. However, just in the act of searching, we shall gradually install in the conscience of society a new way of thinking about humanity and its place in the cosmos – essentially a continuation of the Copernican revolution that has already had such a profound effect.

Meanwhile, space activities will deliver the practical benefits described in the other essays. As more people begin to realize how we are a part of Earth's single biosphere and act toward a sustainable future in it, and as more people come to have enough to eat, clean water, education and time to think beyond mere survival, the deeper benefits of space activity will gradually filter into human awareness and become part of the structure of Earth's civilization.

Eventually, with humanity a two-planet species immune to destruction by terrestrial or celestial catastrophes and having passed beyond the juvenile stage we are in now, our civilization may become robust enough to survive, not just for millennia but essentially for ever. That may be the essential condition for joining a galactic society. If it is, our early strivings into space will have been worthwhile.

Mr James T. Burke

California Institute of Technology, Jet
Propulsion Laboratory (Retired)
The Planetary Society, American Institute of
Aeronautics and Astronautics, ISU



Mr Don Davis

Artist

International Association of Astronomical Artists

I believe that space activities are impacting society through...

... the knowledge that human affairs now encompass the heavens as well as the Earth. The very planets that were at one regarded as moving stars able to exert magical influences upon people, have been examined by devices extending our physical senses. First telescopes were used to introduce us to our neighbouring worlds, then far flung machines bearing cameras and other instruments revealed them in detail. Our ability to extend our earthly senses to physical regions and spectral wavelengths unreachable by human beings brings vast forces to our attention which shape entire worlds.

These insights become part of the body of human knowledge, available to many who are curious about the limits of our understanding of nature. The educated elite from which scientists and philosophers emerge will draw from such knowledge and build upon it in their work. Millions more individuals in varying degrees seek out and incorporate our current frontiers of ideas and knowledge of the Universe into their personal education. The greatest philosophical influence from space science is perhaps the erasing of the illusion of uniqueness of our world, our Sun, and even our galaxy. Only life is still undetected elsewhere, although this may also change as techniques for examining other planetary systems improve. Once a sense of physical perspective concerning the place of Earth in the cosmos is made known, this becomes a powerful background against which to decide what is important and what is not in world affairs.

Since the late 1940s, space has influenced the character of religious visionary experience. In

industrialized countries, the angels once conjured by Western spiritual consciousness were largely replaced by wise aliens in spaceships. In the late 1960s, as human exploration of space was reaching its apex, 'space' became a counterculture metaphor for personal explorations of consciousness using all available means. As a few military pilots flew into outer space, the times were also ripe for uncountable journeys to inner space by a generation whose frontiers of reality had spread beyond that of much of their societies. The first hand-held camera photographs of Earth as a planet in space were entrancing even to many who questioned the spending priorities that made such images possible.

Since the glory days of the 'space age', a slow trickle of people have visited space and a handful have actually walked on another world, but far too few to have a significant cultural impact through direct experience. Although the fortunes of efforts to promote human expansion into space are subject to the uncertainties of cultural, economic and political whims, the fact that it was at one time possible to visit the Moon should be an inspiration as long as civilization continues.

If there is ever communication established with an interstellar civilization, there would be things we would of course like to parade as worthy achievements. Some events in human history stand out from the rises and falls of civilizations and intervening chaos, the wars of ever greater destruction, and the cities that grow and are destroyed, or even this or that great engineering feat such as a dam or building. A photo or video of people on the lunar surface would be one thing I would make sure they saw, for this is the kind of thing I imagine would arouse the positive attention of a mature space-faring civilization.



I believe that space activities are impacting society through...

... the diverse paths they offer for new knowledge, opportunities for sustainable development of Earth, and a limitless future for the human species.

Our Earth is a tiny, seemingly insignificant planet in the vastness of the Universe, but Earth supports life and humans are its most highly evolved species. Is there life elsewhere in the Universe? Can we find it? How has it evolved? If destroyed, what caused this destruction? How will society be affected by finding life elsewhere? What is the origin of our Universe, what is its structure? Space activity enables us to seek answers to such pivotal questions.

Humans have by now developed the collective power to dramatically influence the Earth's environment in both sustainable and irrecoverable ways. Space activities provide a unique opportunity to observe, measure and manage the effects of both human and natural events that change our Earth.

Space activities enable essential human needs to be met and can be a powerful bridge across the digital and other divides that exist in our societies. They enable and facilitate education in all societies, the provision of high-quality health care, the management of our food and water resources; they add to our security in the face of continual natural and human-made disasters; they allow global communications, safe transportation, and may, in future, provide the necessary sources of

clean energy. Today, space activities have become essential to finding the solutions to the major global problems facing society and its leaders.

Space activities motivate and provide a deep sense of adventure and wonder for large segments of society, whatever their background or state of development, and they remove barriers to the essential evolution of humankind and of its societies.

Dr. Karl Doetsch

President

Doetsch International Space Consultants
Former President, International Space University



Prof. Giancarlo Genta

Professor
Politecnico di Torino

I believe that space activities are impacting society through...

... the deep impact that space activities are having, and above all will have in the future, on human society in different ways.

From an economic viewpoint, space is already essential in some business sectors like telecommunications. In the longer term, only space exploitation will allow humankind to overcome the limitations to its development linked with the finiteness of our planet's resources. Exploitation of extraterrestrial resources (the so-called 'space option') is the only way to increase the standard of living of the less-developed countries without limiting the development perspectives of those who are already in a better situation.

Space exploration and exploitation require a general technological advancement, producing a fall-out on other human activities. While this is well known, the reverse process (a technological transfer to the space sector from other industries in which the much larger scale of production allows research costs to be distributed across a larger number of products) is at least potentially very important.

It must be realized that even today the costs of a space mission (even a major one) is not much higher than the cost of other projects like building a motorway or a railway, the more so if conducted with the economic criteria of private enterprises. To this effect, the role of private enterprise in space exploitation and to an extent also



exploration, must be increased. From a scientific viewpoint, space exploration has already changed our views of the Universe in general, and of the Solar System in particular. Beyond astronomy, all sciences are benefiting from the new possibilities opened by the use of space as a laboratory. From a human viewpoint, the challenge of space exploration is providing inspiration and motivation to many, particularly young people. Space exploration is a powerful means for promoting scientific and technological culture, which is essential in our society, both for general reasons (fighting against irrationalism and fundamentalism, and assessing correctly, also at a political level, the advantages and potential dangers of technology, etc.) and for preparing new generations of professionals and technicians.

To be significant from the human viewpoint, space must not be just a 'laboratory' or a place to locate devices like telecommunications satellites, but must slowly become an 'ocean' to be crossed towards destinations that are not just scientific outposts, but actual places where humans can live and work, enjoy their life and create their culture.

In the long term, humankind will become a spacefaring civilization – at least if it aims to survive. The point is whether our generation will be able to seriously undertake this task by making the first steps (exploring the Solar System, starting outposts on the Moon and Mars, etc.) or whether it will fail, leaving this task to future generations or civilizations.

I believe that space activities are impacting society...

... most significantly because of their effect on the human spirit. We quickly become accustomed to major improvements in our life style, such as better telecommunications, weather forecasting, imaging, navigation and positioning, and these are very important results of the space programmes. But I believe that it is the inspiration of exploring new space frontiers, either robotically or in person, and learning more about our Universe that has a greater impact on our human condition. The new-found knowledge or information about our space environment is profoundly stimulating, but at the same time the process of accomplishing the exploration has great value in itself. Contributing as a member of a project team on a cutting edge space project where we work together to accomplish the goal makes each of us grow in stature. And, where it is done on an international basis, the value is even greater because the project forges new and important relationships for all concerned.

While there has been a tremendous impact on our society in the short years that space has existed as a significant endeavour here on Earth, the greatest question is what impact is it likely to have in the future? It was encouraging to see over 9000 students and educators descend on technical projects during the World Space Congress in 2002 with an intensity that was truly awe-inspiring. It is not enough, however, to applaud the interest of these and other students. We need to create the climate such that this enthusiasm can find productive outlets for productive space activities in

the future. Each of us should assume a responsibility to help make this happen.

Mr Richard L. Kline

President
Klitech, LLC



Brig. Gen. (Ret.) Robert Eric Larned

Vice President, Space Programs
Burdeshaw Associates, Limited

I believe that space activities are impacting society through...

... far more than the oft-cited 'technology spin-offs' that themselves will continue to bring significant economic benefits to the World's markets. At a macro level, the advent of precision navigation from space is a transformational innovation that we still do not fully appreciate. The ability to know where things are, anyplace on or near Earth, is a truly stunning milestone for safety and navigation.

Similarly, space has enabled companies with operations scattered around the World to operate as a single unit, integrating their voice and data requirements to create a virtual e-campus with a rolling work-day through 24 time zones. These e-integrated companies lower their operating costs, improve their productivity, reach more clients worldwide, and increase sales.

Beyond the miracle of precision navigation and the expanding impact of e-businesses, instantaneous communications and access available from space have made the World smaller and its peoples more interactive. People in every corner of every land can see and participate in events around the World as they happen – there is no isolation anymore, even for those few who try to direct it. Awareness reduces ignorance that too often breeds mistrust, suspicion and hostility. At every level, space is making the World a safer place.

Space also provides a venue for bringing our countries together in noble adventures of discovery and wonder. The 20th Century expeditions to put telescopes in space, humans on the Moon, and robots on Mars have expanded our frontiers beyond the limits of our

atmosphere and, more importantly, beyond the limits of our minds.

Finally, the brute-force technological obstacles of building gizmos that can survive and operate in the unforgiving environment of outer space have reaped exceptional benefits within many engineering disciplines. In particular, space projects of the 20th Century can justifiably be credited with virtually inventing the field of Systems Engineering. These space endeavours demanded the ability of thousands of people from hundreds of companies and organizations in dozens of countries to work together and create something bigger than any one group could do themselves. These pioneers produced a staggering array of circuits, black boxes, components, assemblies, software, networks and architectures, and then made them operate as a seamless whole. The magnitude of these programmes dwarfs the massiveness of the pyramids and the intricacies of the Manhattan Project – the Systems Engineering discipline has really been the key to our successes in space.

As we look across today's societies, our governments, and our industries, it is hard to find the 21st Century equivalent of these grand and glorious projects that kept our minds sharp and our talents focused. Indeed, we may be losing our ability to conduct thorough, ruthless Systems Engineering, which threatens our ability to solve tremendously challenging problems here on Earth. Ecosystem stability, energy sufficiency, environmental pollution abatement, world health systems, and other grand-scale societal problems that need to be relentlessly tackled by humankind – all depend upon exceptional Systems Engineering skills honed in space.



I believe that space activities are impacting society through...

... their contribution to the World's collective knowledge, which could lead to collective action at the global level.

The wide range of space applications affects many aspects of daily life throughout the World. Space applications allow many facets of the global tasks facing the World in order to improve the human condition to be successfully accomplished in such general areas as achieving a sustainable World, protecting the environment, enabling all people to benefit from global communications, better managing and ameliorating the effects of natural disasters and enhancing capacity-building in all parts of the World, mostly in underprivileged regions, and providing for economic development not otherwise possible.

Actions using space applications could support global efforts to ensure that no individual and no nation is denied the opportunity to benefit from social and economic development. Those actions could also contribute to poverty eradication and protection of the vulnerable in all parts of the World. The coordination of space-based services could help to control diseases, to manage natural-disaster mitigation, and to ensure that all affected populations are given every feasible assistance and protection. Space applications, particularly through earth observation, can provide effective tools for global governance of the environment by providing means of verification for compliance with international agreements relating to environmental protection.

Satellite communications has significant potential to bridge the digital divide by contributing to the development and strengthening of the information and communications infrastructure as an essential foundation for a knowledge-based society. Satellite products have also become an integral part of the humanitarian response to international crises.

In this context, one of the most significant goals is to strengthen space activity in the United Nations system, by reaffirming the role of the Committee on the Peaceful Uses of Outer Space and its subsidiary bodies and Secretariat; by developing space law and by promoting the peaceful uses of outer space with all States, international organisations and civil society.

Prof. Sergio Marchisio

Professor of International Law
Chairman of the Legal Subcommittee of UN Committee on the Peaceful Uses of Outer Space
Director of the Institute for International Legal Studies of the National Research Council
University of Rome - La Sapienza



Dr. Vladimir Pletser

Senior Physicist - Engineer
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I believe that space activities are impacting society through...

... opening our minds and imaginations to the vastness of the Universe, while allowing the rigorous conduct of many scientific investigations.

We are all part of a generation of humankind fortunate enough to live in an epoch during which space travel was made possible through the efforts of a few pioneers, and which culminated in the sending of some representatives of mankind on another celestial body and which is now preparing to send other human beings to another planet, Mars. Space exploration has also made possible immense developments in technology and has brought many answers to long-standing questions about the Universe, and in doing so has asked new questions about our near Solar System environment and our farther galactic and extragalactic surroundings. Among the technologies developed for space travel, communications and computing are in my view the two main drivers. But many other developments have led to improvements on the one hand in our fundamental understanding of physical and living systems through studies in weightlessness, only accessible in low Earth orbit onboard space ships and space stations, and on the other in our knowledge of our natural spaceship Earth and the way it reacts to our tampering with its atmosphere and climate.

Other scientific developments coming from the space age have increased our knowledge about ourselves, back on Earth, leading to new approaches in helping to cure diseases and preventing natural catastrophes. It has also given

us also a global vision of the planet on which we are living, allowing global communications and gradually rendering the notion of rigid political borders between countries and people a thing of the past. Looking to and probing other celestial bodies and stars would eventually allow us to answer the ultimate question: are we alone in the Universe? Is life a unique phenomenon that we are lucky enough to have seen appear on our planet? Or is it a ubiquitous phenomenon that appeared also on other planets, maybe around other stars?



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I believe that space activities are impacting society through...

- acquiring basic and applied scientific knowledge and extending the possibilities of humankind
- creating the global system of space services (communications, broadcasting, weather forecasting, observation, and navigation)
- space tourism, which will be widely available in the years to come
- promotion of progress in the fields of science and technology related to evolution of astronautics
- technology transfer to other industries (materials, electronics, fuel cells, automation, etc.)
- furthering our knowledge.

Real progress in astronautics withstands anti-scientific tendencies and ideas impeding the progress of mankind. The use of space capabilities and the popularization of achievements in space science and technology are essential to educational programmes. Space activities are a key element of efforts being pursued to guarantee the security of populations worldwide, to predict and mitigate the impact of natural hazards, including the space threat.

Over the past 50 years space activities, with the hundreds of thousands of skilled workers, and services to millions of people all over the World, have become an important sector of the World

economy. I am convinced it will be further developed and expanded. Let's consider the outlook for space activities.

Its main lines have just formed: communications, science, Earth observation, and launchers. Undoubtedly, they will be boosted, offering new knowledge, capabilities, and services.

Pressing problems are:

- for communications: the creation of cheaper telecommunications and data transfer – 'Internet in the sky'
- for Earth observation: prediction of earthquakes, volcanic eruptions, and climatic phenomena
- for launchers: reusable space transportation systems, and space tourism
- for science: general cosmology (e.g. the problem on 'dark matter', general planetology, including SETI, and the search of planets in the environments of other stars).

Among new avenues for space research are the advanced work related to exploration of the Moon and Mars. Major 'negative' impacts of space activities are their high price and their potential ability to take up a great number of resources needed for activities on Earth. That is the reason why this aspect will determine the future Moon/Mars manned missions and the exploration of these planets. Studies of space, the Earth and the planets using automated spacecraft will be developed, and will contribute to a better

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Academy of Sciences



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understanding of the fundamental scientific laws and improved security and standard of living on Earth. Ultimately, the success of space activities over the next decade will depend on the solution of the global problems of mankind and real contribution of astronautics to the solution of these problems. In any case, astronautics will have to be developed under limited-resource and budgetary-constraint conditions. Environmental effects will be the most crucial challenge facing a number of advanced space technologies: nuclear power, solar power plants, projects involving Arctic-region illumination. Requirements on the utilization of space techniques and the prevention of space contamination will be greater. Limited planetary resources and requirements on global security will aggravate the evident tendency in the last decade for coordination of space policy and optimization of space activities through international cooperation. International institutions (primarily the United Nations) and leading space powers possessing a world-class space industry and technologies, will be a driving force in this process. Among them is the Ukraine, which will pursue its efforts to develop its space activities for the benefit of society through closer international cooperation in its scientific, economic, and social interests and for good of the global community.

From my practical experience and professional skills in the field of space technologies, rocket engines, and in my opinion conventional liquid/solid rocket engines, will remain the main tools for space launches, although other types of propulsion will play an increasing role. The creation of reliable and efficient combined-cycle propulsion will enable us to build reusable

launchers and to cut the cost of access to space, opening up new avenues for activities. As to nuclear propulsion, its development will be determined by the solution or otherwise of the environmental and safety problems, also having most political impact on nuclear engineering.

I believe that space activities are impacting society through...

... continued scientific discoveries and bold human exploration that greatly increase human knowledge, understanding and cooperation (through sharing of information and scientific data).

For example, as early as the 19th century, telescope observations led some astronomers to speculate that Mars might harbour life. Subsequent robotic missions to Mars during the 1960s and 1970s showed that its surface is currently inhospitable. However, more recent missions have transformed our understanding of Mars. New data indicate that liquid water likely flowed across the surface of Mars in the distant past and may still exist in large reservoirs deep underground. This raises the prospect that simple forms of life may have been developed early in Mars' history and may persist beneath its surface to this day.

In the USA, NASA is aggressively pursuing the search for water and life on Mars using robotic explorers. The MER Spirit and Opportunity rovers that landed on the Red Planet in January 2004 were the latest in a series of research missions planned to explore Mars through 2010. By the end of this decade, three rovers, a lander, and two orbiters will have visited the planet. NASA will augment this programme and prepare for the next decade of Mars research missions by investing in key capabilities to enable advanced robotic missions, such as returning geological samples from Mars or drilling beneath its surface. This suite

of technologies will enable NASA to rapidly respond to discoveries this decade and pursue the search for water and life on Mars wherever it may lead next decade.

In addition, we know that our Solar System is composed of nine planets, including the Earth, that circle a central star, namely the Sun. Astronomers and philosophers have speculated for millennia about whether other stars harbour worlds like Earth and whether these worlds are inhabited. However, it is only in the last decade that telescopes have become powerful enough to detect whether planets of any type circle other stars. In 1995, astronomers discovered the first solar system besides our own. Since then, they have found over 100 planets orbiting other stars – and the number continues to climb with regular new discoveries.

All of the extrasolar planets discovered to date are either very large planets, or planets that circle very close to their parent stars. Some extrasolar planets are many times larger than the largest planet in our Solar System, Jupiter, and orbit even closer to their parent star than the closest planet to our Sun, Mercury. Because of the obscuring effects of the Earth's atmosphere and very challenging optical requirements, the detection and characterization of small planets with very normal orbits like Earth is extremely challenging using ground-based telescopes or relatively inaccurate interferometric techniques.

Mr Robert Lewis Sackheim

*Assistant Director & Chief Engineer for Propulsion
NASA/Marshall Space Flight Center*



Mr István Vágó

Television Personality
Hungarian Television

I believe that space activities are impacting society through...

... the mere fact that we are thus closer to 'out there', a place to which man always looked up with awe and curiosity. As long as well-equipped rockets did not rise high enough to see what lies beneath and measure what comes from very far, man had always been suspicious about distant planets, unknown civilisations, the inconceivable Universe.

I would not state that all this is over. Alas, a major part of the World's population still shares some of the beliefs of past centuries. But now scientists are in a much better situation in terms of reasoning on behalf of knowledge and facts: they are able to demonstrate to eager minds what has been experienced and what has not.

Take the example of UFOs, for instance. UFO believers are finding it more and more difficult to persuade others about what they claim to have seen. The more 'eyes and ears' we have around the Earth, the less convincing it is that a flying saucer could penetrate our atmosphere without being detected. Now more sophisticated 'proof' is required to persuade us about their 'close encounters'.

The more we know about space, the more familiar we become with the influence of celestial bodies upon us here on Earth. What is left for horoscope zealots? How will they explain their conclusions drawn from the 'constellation of stars'? What is their answer to the many why's and how's? Every time they attempt to give reason to their

statements, they increasingly run into refuted trains of thought.

Or is it too optimistic a situation I have just described? I am afraid it is. We are not yet at a stage where space activities could argue masses out of their misbeliefs. This is why many of us, sceptics, urge scientists to do as much as they can to make their findings and conclusions public in a way they can also be comprehended by less learned people. Because science should regain its respect also in the eyes of those who still opt for UFOs and horoscopes.



I believe that space activities are impacting society through...

... many ways, but at the highest level through offering a window on infinity.

What child has not wondered at some time where and how the World would end – would there be a final wall, or a deep pool humans can never cross – and then, still, what would be beyond such a wall or pool? Such questions will always be pertinent, there will always be yet another wall or pool. In this way, space also reflects the infinite possibilities offered to humanity: outer space reflects the fourth dimension of time, infinite as it is, next to the three classical physical dimensions of length, breadth and height.

Other than in the three traditional dimensions for humanity – earth, sea and air – which are inherently and definitively finite, measurable in length, breadth and height or depth, in the fourth dimension of outer space there's always more to be discovered, more to be learned, and more to be exploited. In the final resort, therefore, space activities thus also come to represent the ultimate hope for mankind – as well as the ultimate danger, if such hope is quashed: it also means that less and less of human nature is foreign to outer space anymore.

Increasingly, elements of normal human behaviour need to be dealt with in space: we have seen the first tourists in orbit, we've seen efforts to advertise, to 'bury' human remains, and we're even seeing the first efforts to establish lunar robotic pleasure parks. Luckily, so far, the legal

framework for all such human activities is still holding together, but it is increasingly creaking under the strain of growing human interests.

Law, after all, not only has the function of establishing certainty and predictability with regard to other human's actions, of down-to-earth traffic rules. Outer space simply is not down to earth; and left or right completely loose their meaning in the endless void out there. Law also has the function of establishing or, better, reflecting some kind of fairness and justice. Humanity should therefore strive to keep the legal framework intact, update it in accordance with good international practice, and of course change it if really necessary not only to enhance certainty and predictability but also fairness and justice, and thus keep the window to infinity wide open.

Dr. Frans von der Dunk

Director Space Law Research
International Institute of Air and Space Law



Dr. Michael I. Yarymovych

Former President
International Academy of Astronautics

I believe that space activities are impacting society through...

... all aspects of humanity's life on Earth, ranging from the satisfaction of the basic needs of survival to the highest ideals of a civilized society. Space has fueled the imagination of the human race since the beginning of intelligent thought.

The use of space started out with the need for military protection and preservation of peace. The initial technological breakthroughs, which were fuelled by ideological competition between two very different societies, have eventually matured into services that enable all people on Earth to communicate with one another, learn from one another, help one another and prevent or mitigate disasters.

Space has enabled globalization, with all of its good and bad consequences. It facilitates the expansion of commerce and productivity, it enables the understanding of the impact of human activities on our planet, and it drives technological developments that are rapidly expanding into non-space-related applications. Space helps create a global civilized society, which can look forward to living responsibly without hunger, misery or devastating disease. The mark of a civilized society is the freedom to explore in order to satisfy the basic human drive of curiosity.

Exploration brings new and often unexpected knowledge and understanding, which in turn has a profound and irreversible impact on society. Just as the current evolution of human society on Earth would have been totally different without the use of

space, so the future evolution is inconceivable without the use of space.



Opportunities Across the Globe: Earth-observation satellites have enabled global cooperation in natural-disaster mitigation activities and the sharing of images from space with all nations. This is just one example of peaceful ventures reaching across borders, fostering feelings of a global community and providing opportunities for nations, companies and individuals worldwide to participate. Less altruistic is the entrepreneurial aspect of commercial space where global communications satellites have enabled new companies to be formed and profits earned for the risk taken. Prize money is now being given as an incentive to push the private sector into space: the X Prize of \$10 million already awarded for taking private individuals the 100 kilometres into space; the \$50 million America Space Prize to spur the development of space tourism in low-Earth orbit; the more modest competition prize money to develop components for a Space Elevator. And on the other hand, the technologies developed for such space activities are in turn providing opportunities for many around the globe because of their potential application as spin-offs in non-space sectors.

...“Space activities, as adumbrated by science fiction, space exploration and space spin-offs, are having a definite impact on society because they are bringing home to it in a very public manner the enormous opportunities which are within its grasp...”

[D. Raitt]

...“Consequently, a new generation of entrepreneurs has emerged...”

[S. McKenna-Lawlor]

Contributors

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Opportunities Across the Globe

I believe that space activities are impacting society through...

... unique key contributions:

- Because of the human, scientific and strategic challenges they involve, they are at the very heart of human adventure and contribute greatly to people's fascination with new horizons.
- They are integral part of our everyday lives; this is true not only for telecommunications and television, but also for meteorology, environmental observation and surveillance, agriculture and transport.
- They shape our future when contributing to security and defence goals and to the protection of our planet. The contribution of space systems for crisis and natural-disaster prevention has been widely recognised as a valuable asset.
- When fifty years ago our fathers and grandfathers decided to devote significant effort to creating European space capabilities, they really made the right choice. Today it is our duty to pursue the same direction simply because, beyond what we already see as economic and societal benefits, space activities are opening up new possibilities for the future.

Mr François Auque

*Chief Executive Officer
EADS Space*



Dr. Marietta Edit Benkoe

Attorney-at-Law
Institute of Air and Space Law, Cologne University

I believe that space activities are impacting society through...

... the fact that during the last decades, scientists were able to acquire vast knowledge about new possibilities for the exploration and uses of outer space.

However, we have learnt that society also has a responsibility in this respect. Although outer space offers almost unbelievable potential for space activities, we know that this environment is extremely vulnerable and must also be protected for future generations. This became unmistakably clear through our serious confrontation with the problem of 'space debris'. Let me explain: space debris consists of non-functional objects in outer space, regardless of whether they are still intact or have broken up, like deactivated satellites or parts thereof. They pose a threat for operational space systems since objects in outer space can reach extremely high velocities. Even small particles like a drop of water have such an impact that they can penetrate an American Silver Dollar when colliding with it. Since satellites have less dense walls, they can easily be hit and penetrated. Even more vulnerable are astronauts on space-walks. A micro-sized particle of paint hitting the space suit could have fatal consequences.

As to the so-called 'debris population' in outer space, ESA measurements showed already in 1988 that only 5% of more than 7000 trackable objects in orbit around the Earth were operational spacecraft.

Debris will 'disappear' from Earth orbit within a couple of months or a year only at altitudes below approx. 1000 km. Here space objects are dragged



into the Earth's atmosphere and burn up. Still, very large or compact structures may survive re-entry and fall back to earth on land or at sea.

In geostationary orbit, however, the orbital lifetime of space debris may exceed millions of years, since there is no aerodynamic drag from a residual atmosphere at this altitude. So debris remains in this orbit 'forever', at least as far as today's human population and future generations on Earth are concerned.

As to the effect of space debris, it has been established that it not only poses a risk to space activities in the orbit where it was generated. For example, if an earth orbit is polluted by a debris cloud (which is always spreading rapidly), access from the Earth to outer space can be seriously endangered if spacecraft have to cross this orbit during launch or re-entry. Then space debris orbit can have the same effect as 'barbed wire' around the Earth.

Statistically the risk of encountering space debris is still relatively small, but will develop into a universal threat if it is not dealt with soon. National as well as international actors are already aware of the problem and are working on solutions, but globally coordinated efforts are necessary.

The UN Committee on the Peaceful Uses of Outer Space has also been studying this problem and adopted a Technical Report on Space Debris in 1999. Now the problem must also be dealt with from the legal point of view by elaborating guidelines with a universal approach, aiming at an international solution.

I believe that space activities are impacting society through...

... communications, Earth observation, science, navigation and manned spaceflight. Spacecraft communications is perhaps the most developed commercial space industry. It is different from other terrestrial links through its robustness and controllability. For instance, after 9/11 the only non-military communications links that did not crash due to overloading were those provided by satellite service providers. Space communications can be the only method of sending messages in remote areas where there are no landlines, in wilderness areas, and in some parts of the developing world. Finally, space communications are important for military users, and form a vital technological advantage over terrorists and other less technologically advanced enemies.

Earth observation is important for weather prediction. It can be shown that the accuracy of weather prediction has noticeably improved with the launching of certain space missions. Earth observation is very important for environmental science from oceanography to the study of climatic change, giving information that could not be obtained by other means. Radar missions now offer sub-metre resolution in all weathers in all parts of the World. Earth observation is also important for map making and the planning of trips to remote locations. In terms of military activities, these missions offer the ability to collect information and plan all means of operations. Spacecraft can also be used for eavesdropping to collect further information.

Science missions fall in to two broad categories: astronomy and exploration. In terms of astronomy

and particle physics, space missions have revolutionised our understanding of the Universe and led us into the golden age of astronomy, now the fastest progressing fundamental science. Exploration missions to Mars and other planets help humanity to find its place in the Universe and are superb test-beds for cutting-edge technology that will be used on commercial missions in the future.

Navigation missions provide important position and timing information for a great many users. Whilst the GPS system was developed for military purposes, the majority of the users are civilian. This ranges from receivers for civilian aircraft to the time-stamping of business transactions by providing the definitive universal time. Future applications would include the incorporation of receivers in mobile phones, so that in the future it may never be possible for individuals to get lost again.

Finally, manned spaceflight is the most important and the most expensive. It serves to develop the World's aerospace industry in all domains by providing jobs for the most gifted engineers and scientists. The International Space Station provides a platform for the World to unite and work together to build a project for everyone to take part in. Spaceflight technologies have many technological spin-offs as a result of employing the best people to solve the hardest problems. Manned missions also have a direct benefit to medicine by providing more information about the human body when in a harsh environment. Finally, I believe the future of manned spaceflight is at hand through the development of space tourism. This will finally unlock commercial money rather than government funding to be spent on manned missions.

Mr Richard Broughton

Spacecraft Operations Engineer
EADS Astrium

Dr. Saad Bashir Eksander

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I believe that space activities are impacting society through...

... the fact that in the old Iraq, the Saddam regime subjected all scientific activities to military considerations. Satellite pictures were used to monitor troop movements and to identify enemy positions during the Iraq-Iran War (1980-1988). Satellite pictures were also used by the regime to dry out the Arab Marshes in the south as means of punishing the locals for expressing their opposition. While using the latest technology for war purposes, the regime refused to resort to space technology to meet urgent economic and demographic needs, such as expanding agricultural lands or establishing green zones to protect the main urban centres from the sandstorms of the western desert. During the 1990s, the United States and Great Britain also used space technology for military purposes in Iraq, e.g. to look for Saddam's weapons of mass destruction.

The collapse of the former regime and the end of the long years of isolation and repression has opened a new window of opportunity. For the first time in their lives, Iraqi citizens can now have direct access to the Internet, watch foreign satellite television, and enroll in distance-learning programmes. Communication with the rest of the World and having direct access to all kinds of information has been playing a significant role in the reconstruction of the new democratic and Federal Iraq. It should be emphasized, however, that no one has planned or expected this. In the new Iraq, there are plans to use the latest space technology for development purposes, for

instance, to restore natural life to the famous Arab Marshes, to construct new oil pipelines, to build new dams and to safeguard historical sites. It is no exaggeration to say that in the new Iraq, modern space technology is associated with freedom, peace and progress in all of their forms and dimensions.



I believe that space activities are impacting society through...

... providing the opportunity for humanity to dream and explore. Space activities over the last four decades have influenced the lives of generations of individuals. Whether they were alive to witness Sputnik, the launch of the first person in space, or Apollo 11 as man walked on the Moon for the first time, it has influenced their ideas about what is possible. Or if they grew up after these significant first events, they grew up in a World that knew beyond a doubt that everything is possible. If humanity could send a man to the Moon, then we can do anything that we dream about. Society was given the opportunity to dream and to explore again. Space has become a cooperative effort bringing together continents and forming ties between countries. As space activities provide global information and instantaneous communication, humanity discovers connectedness and the benefits of working together towards common goals. Space is not the activity of one small group of people, one company, one nation; it is the dream of humanity as a whole. Society and humanity join together to explore Earth, the Solar System, and the Universe beyond.

Ms Alicia Evans

System Test Engineer
Boeing Satellite Systems



Prof. Gyula Gál

Space Lawyer
Assistant Professor at the International Institute of
the Péter Pázmány Catholic University of Budapest

I believe that space activities are impacting society through...

... international law.

Some fifty years ago, the human civilization created artificial satellites moving on their orbits like celestial bodies through the laws of celestial mechanics – at a time when here on Earth human society was organized in the traditional way with sovereign states divided by grave antagonisms and rivalries between great powers.

Space exploration, however, is a global activity. Its effect cannot be restricted to one nation or group of nations. Space law is a compromise. It attempts to squeeze rules for space activity into the conventional framework of international society based on state sovereignty. This involves the impact of space on the legal order of the international community: to accept mankind as subject of human activities in outer space.

The first steps were taken in the system of basic space-law treaties:

- The exploration and use of outer space ... shall be the province of all mankind. (Space Treaty 1967, Article I.1)
- States to the Treaty shall regard astronauts as envoys of mankind in outer space and shall render them all possible assistance. (S.T. Article V.1)
- The Moon and its natural resources are the common heritage of mankind. (Moon Agreement 1979, Article XI.1)



Mankind – this giant crew onboard International Space Station Earth – is today no subject of international law. Space activities most probably will give impetus for the time being to a utopian intention to give mankind the right place above States in a radically new structure of the international community.

I believe that space activities are impacting society through...

... the fact that since the 'space age' dawned in 1957, the flow to the market place of items originally developed to support space-related activities has gradually increased from a trickle to a torrent. Telephone communications, weather forecasting and crop monitoring have all come to be conducted by satellite, and hardware derived from studies in space navigation and control is presently used by the general public to establish positional information in environments as varied as those provided by the transport and leisure industries. Telecommunications constitutes the largest, and most rapidly expanding, market in space products, and this growth area currently offers substantial financial opportunities to service providers, operators and purveyors of infrastructure within both the already 'classical' area of mobile communications, and the newer regime of information services. The associated hardware in use by both young and old becomes more miniaturized every day, while generally remaining powerful, portable and affordable.

Space-based communications offer critical support during natural disasters, particularly in situations where the local ground infrastructure has been destroyed. Early warning of such disasters is increasingly provided through the informed monitoring of precursors. Radar interferometry can, for example, detect the first minute displacements that precede volcanic eruptions, and also the small tectonic shifts that can lead to earthquakes. Other indicators that can be monitored from space include gas emissions,

thermal anomalies, gravity anomalies and electromagnetic signals.

The detection of forest fires and the organization of search-and-rescue activities in remote areas can, in addition, be usefully undertaken by satellite. A dramatic example of the use of space-related hardware to alleviate a 'manmade' catastrophe is instanced by the utilization of a robotic vehicle, originally developed for the remotely controlled exploration of Mars, for the on-site clearance of dangerous substances following the nuclear explosion at Chernobyl. Today, the next generation of dedicated robotic systems is under development for use in a variety of hazardous terrestrial environments.

In our general example of disaster mitigation, the establishment of operational models can involve: the employment of advanced image processing; integration of distributed data archives; fusion of data acquired over a range of spatial and temporal resolution; and the utilization of technologies related to data storage and transmission. All of these techniques were developed to a high level for space applications and are presently used not only to support disaster-associated activities, but in the service of a plethora of ground-based businesses. On an 'all planet' scale, a deeper understanding of the complex interactions between the oceans, land masses and the atmosphere of the Earth has been acquired through remote-sensing studies. These insights are currently bolstering a sense of global responsibility towards the ecosystem which, in turn, drives initiatives at social and political levels to find means to counteract those

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anthropomorphic activities that put our planet at risk.

In diverse enterprises (provision of power-grid networks, prospecting, the airline industry, etc.), there is a developing awareness of the disruptive influence that can be exerted on ongoing operations by 'space weather'. Consequently, a new generation of entrepreneurs has emerged who, through numerical modelling of the propagation of solar-related shocks and particles through interplanetary space, routinely forecast terrestrial phenomena that potentially affect a wide range of commercial, as well as military, programmes.

Spin-off space technologies introduced within hospitals bring to the ailing hitherto unavailable levels of diagnosis and relief. For example, ultrasound assessment of burn damage depth is available for victims of fires; also, astronaut-based suits have been developed that, through the circulation of a coolant, significantly reduce the symptoms of multiple sclerosis, cerebral palsy and other traumatic conditions. Innovations in composite-material design and fabrication support the realization of body implants characterized by reduced rejection levels and long durability. In intensive-care units, fault-tolerant electronics developed for space flight provide enhanced reliability for life-support systems.

Programmes to provide education by satellite to populations in remote, under-developed, areas help to provide a more even playing field for the disadvantaged. Meanwhile, in scientifically and technologically more advanced regions,

knowledge no longer remains the preserve of a privileged few. Rather, the rate of transfer of information pertinent to a particular scientific advance, dating from its first emergence among experts through to its general incorporation into global literature as 'received knowledge,' currently takes place at a very rapid rate. In this regard, while the general public may not understand all that is associatively involved, there has occurred, nevertheless, an associated raising within society of an appreciation of sophisticated subjects. When, for instance, Einstein developed Relativity Theory in the early nineteen hundreds, only a handful of people, worldwide, had an insight into what was involved. In 2004, when the Gravity Probe B Mission was launched to test two predictions of General Relativity (concerning the warping of space-time and the frame dragging effect), newspaper articles available internationally could successfully convey, at a level understandable to non-scientific readers, the meaning and beauty of the experiment that was being attempted.

A new general awareness of man's place in the Universe has emerged in parallel. Initially, the Grand Tour of the Solar System implemented by Voyager 1 and 2 sparked, through the medium of television, an unprecedented interest in the spectacular landscapes of Jupiter, Saturn, Uranus and Neptune. Thereafter, without the cultural convulsion that characterized the Copernican revolution, the identification of other planetary systems around distant stars subtly changed forever mankind's perception that the Solar System constitutes a unique environment. Evidence that the basic conditions for the

evolution of life may be fulfilled more frequently than had previously been assumed at remote locations is currently being gathered, and this area of research holds enormous public appeal. The imaginative prospect of establishing a lunar base and of the manned exploration of Mars now beckons to many and, fed by the products of the related market for authoritatively written 'paperback' books on astronomy and space science, conversations concerning the origin and fate of the Universe have moved out of academia into taxis and coffee houses, where they are enjoyed at an increasingly informed level.

The new scientific insights, innovative and efficient technologies and progressively more comfortable life styles achieved by the main space-faring nations over the past, approximately fifty, years has, in addition, generated an important consequence. Namely that many, as yet developing, nations are currently following NASA and ESA in combining the skills of multi-disciplinary experts (astrophysicists, biologists, geologists, engineers, etc.) to mount challenging space programmes of their own. This work is encouraged and supported through the organization of workshops and symposia by: the International Academy of Astronautics (IAA), the International Astronautical Federation (IAF) and the Committee on Space Research (COSPAR). All of these bodies, in close co-operation with the United Nations, strive to foster the efficient transfer of key space technologies from one country to another. Against this co-operative background, an ever-growing international coterie of scientists and engineers, informed by the successes of the past and inspired by dreams of

the future, is massing. It can be anticipated that these people will, within the coming fifty years, provide the intellectual and emotional commitment that will allow mankind to take the next step forward in space, developing thereby those themes and technologies that will, in their turn, positively impact the global societies of tomorrow.

Mr Jordan Pelovitz

Student
US Virgin Islands

I believe that space activities are impacting society through...

... space travel, ever since its inception, having fired the minds and hearts of young souls everywhere. As the space programmes of various countries advance, so too does our understanding of the World we live in. Space travel and activities have had profound effects on our society as a whole.

During the early years of the 1950s to the 1970s, space travel ignited interest in worlds beyond ours, creating new scientific endeavours and quests for knowledge. Thousands of children all over the World began to yearn for the adventure and thrill of space flight, giving birth to a generation of dreamers, scientists, and architects, trying out new ideas and new concepts, influenced by their childhood dreams of space exploration and science-fiction battles, such as those shown in Star Wars, which started a worldwide phenomenon, equal only to that of Star Trek. Both of these series have created masses of loyal followers, all bent on finding a way to emulate their favourite science-fiction heroes and their adventures.

In the 1980s and 1990s, space travel showed how different countries could work together for scientific gain, as with the International Space Station, spearheaded by the USA, the leading advocate of space travel today.

Indeed, as space travel continues to venture forward into the heavens, so too will society follow suit, captured in a trance of dreams and wonder at the magnificent heavens beyond our small planet.

I believe that space activities are impacting society through...

... three distinct ways – each of which provides a different, though continuous, viewpoint that is stimulating the imagination and interest of the public at large and providing it with a new impetus to learn more.

Firstly, let us take science fiction – a genre full of rich ideas as well as images. Science-fiction literature, artwork and films, are full of descriptions of space technologies and systems – often just pure imagination, sometimes based on some semblance of fact. Early science-fiction authors, artists, and illustrators described space concepts and spacecraft based on the limited scientific knowledge available at the time, whereas more modern writers generally portray the same basic systems as used in real life spaceflight in their literature and art, even though artistic licence is often employed. But the fantastic cover art of SF magazines and books, and the stories themselves, have, over the years, produced a certain yearning and thirst for more knowledge about space. The SF films currently being produced are piquing the curiosity, excitement, even fear, of millions of people and are raising the expectations of what might be found in space. Such films enable people to become aware of the possibilities of, say, settlements on other planets or asteroid strikes on the Earth (something that will affect their lives directly), and thus they not only prepare the public for such eventualities, but also give them a more urgent and personal interest in space and its exploration.

Secondly, there have always been explorers and pioneers – it is a basic instinct – from animals in search of new pastures and prehistoric man who crossed continental divides in pursuit of food and to find new places to live, to people in our own times who have sailed the oceans and traversed the land in search of adventure. Where would we be today without the great explorers of the past? We have an in-built need to explore new places – especially the tiny pinpricks of stars in the night sky – simply because they are there and we are curious.

Besides being curious, people are also, for the most part, inherently superstitious – and so are awed by natural phenomena in the heavens – auroras, rainbows, eclipses, meteor showers, the spectacular Milky Way. Good press, television and web coverage is now enabling people to participate in rare events like the transit of Venus or red sprites and share the noise and risks of launch vehicles blasting into space – including those heralding a new era of space tourism. Pictures of the Earth from space, stunning real-life images from the surfaces of other planets, the discovery of ice or water, all create a climate of wonder and fascination in the public. Who has not been excited by the sight of a satellite moving against the stars, or been amazed at seeing Mir or the International Space Station going overhead and realizing that men were actually inside the orbiting spacecraft. Or to gaze at the Moon and know that men had walked on its surface. The pride shown by the general public in elements of its country's space endeavours (e.g. Apollo or even Beagle 2) show that society is becoming more accepting of space programmes, more

Dr. David Ian Raitt

Senior Technology Transfer Officer
European Space Agency - ESTEC



aware of the exploration of space, and increasingly interested in the possibilities that life in some form or other may eventually be found out there.

Thirdly, on the other hand, although the general public is aware that space ventures are exceedingly expensive, they are becoming increasingly informed, through proactive space technology-transfer programmes, of the economic, social and medical benefits that can result from space research and development. Innovative adaptations of space technologies, transferred to Earth applications, are enhancing the quality of life for many, bringing economic benefits to society, and contributing to industrial competitiveness. The continuous striving to find new opportunities and markets for space-based technologies, which eases the burden imposed on public resources by adapting technologies developed for one sector for use in another, is having a three-fold effect.

First, there is the creation of a growing awareness of space agencies and their space activities in the eyes of the public due to the very nature of technology-transfer applications. Examples are the visibility of ESA in sporting events such as the 24 Hours at Le Mans endurance race, the Dakar Rally, or the America's Cup yacht race, etc., whereby ESA's name is seen by millions worldwide; and increasing involvement in the world of fashion and luxury goods. Second, there is a growing sense that space agencies can help to provide solutions to problems that, while important to only certain segments of society, nevertheless provide a degree of hope in facing

adversity. Examples, taken from ESA, are the creation of a special UV bodysuit for sufferers of Xeroderma Pigmentosum; a needleless injection system to overcome fear of injections and to avoid contamination; and the development of a system to detect landmines. Third, by proactive lateral thinking, new applications and hence markets are being discovered for products from space companies at the outset. Such an approach: maximizes the return on investment in space activities; minimizes duplication of R&D and opens the door for dual-use; provides new opportunities for collaboration; and moves research (particularly from universities) to the marketplace more quickly. This in turn provides an incentive for the space industry to become more competitive and efficient and enables companies (both space-technology donors, as well as technology receivers) to increase their turnover. Furthermore, by fostering young entrepreneurs, opportunities can be provided for the creation of new and innovative products and services based on space technologies, thus stimulating the growth of start-up companies as well as contributing to the well-being of society.

In conclusion, space activities, as adumbrated by science fiction, space exploration and space spin-offs, are having a definite impact on society because they are bringing home to it in a very public manner the enormous opportunities which are within its grasp.

I believe that space activities are impacting society through...

Mr Kara Bela Antal Szathmary

*President and Chairman of the Board of Trustees
International Association of Astronomical Artists*

... our physical explorations of celestial worlds as well as in terms of scientific studies of our Universe. Since the beginning of man's presence on this planet, he has attempted to interpret the heavens, make sense of astronomical events, and visualize his terrestrial world, the Solar System, and beyond to cosmological scales including the conceptual voyage to the Planck Scale. Space art began with an image of what we could expect to be 'out there' in the space environment.

Artists have been at the forefront of space exploration since its beginnings. They have documented, in the media and style of their choice, the wonders of what it might look like in the nearby neighborhood of our Milky Way Galaxy. Space travel has enabled mankind to step briefly into the cosmos and through his ability to create images, has made the heavens accessible for all of us. It is one thing to describe another world in terms of written language, such as the case for studying documents from various historical and analytical sources. But to 'know' another world, as if to see it with ones own eyes, is the goal of the space artist, who offers us a stepping stone into the stream of stars.





Technology Development: Going into space requires scientists and engineers to invent, refine and adapt current and future technologies. This creative push to operate and succeed in the harsh and extreme environment of space has led to phenomenal technological developments such as micro-miniaturization, precise navigation, global communications, telescopes that see to the beginning of time, lightweight materials and medical advances – all valuable to human existence back on Earth.

...“more importantly through providing a future that we can get excited about...”

[B. Edwards]

...“For most people in the World it’s true that wherever they go, whatever they do, it’s impossible without application of space science and technology...”

[W. Meirong]

...“Space exploration: ...will establish technological innovation and space leadership...”

[M. Mott]

...“Space activities speed up the change in traditional technology fields...”

[L. Zheng]

Contributors

Technology Development

Yean Chong

Bradley Edwards

David Hardy

Volker Liebig

Wu Meirong

Michael Mott

Virgiliu Pop

Peter Swan

André van Gaver

Jacques Villain

Lizhong Zheng

I believe that space activities are impacting society through...

... the use of Earth-orbiting satellites for Earth observation, telecommunications and navigation.

Earth-observation satellites provide real-time observations of the actual environmental conditions on the surface of the Earth. Such observations contribute considerably to an accurate knowledge of the environment, as well as to the effective management of the natural resources.

Meteorological satellites continuously acquire data on the weather. Information on the weather conditions is used by the aviation industry to ensure safe flights for airline passengers.

Meteorological satellites enable early warnings to be given of approaching extreme weather conditions and can thus considerably reduce damage from natural disasters.

Communication satellites enable information to be exchanged almost instantaneously between different points on the Earth. Live television transmissions and mobile telephones have contributed towards unifying the whole of humanity to operate as one single entity.

Navigation satellites provide very precise information on the location of ships in the ocean, aircraft in the air, and vehicles on land. Within a city, satellite navigation enables the driver of a vehicle to choose an optimal path to go from one point to another.

Prof. Yeon Joo Chong

*Professor of Physics (Retired)
National University of Singapore*



Dr. Bradley Carl Edwards

*President
Carbon Designs, Inc.*

I believe that space activities are impacting society through...

... telecommunications, weather monitoring, military activities, etc., but more importantly through providing a future that we can get excited about. In our daily lives there are many things we see that are mundane or negative. A future with new worlds and new opportunities is a stark contrast to the media news of fighting in Iraq, oil shortages, AIDS, pollution...

We need to place more emphasis on the great things we can do as a species and work toward them. Accelerated space activities would provide an even stronger driver for positive progress. With the proper direction and vision, our current expenditures could open the Moon and Mars to human life, provide a system producing limitless clean power, and remove the bounds of location we currently have. Imagine a future without the threat of oil shortages, with new frontiers to explore, and generations with dreams the size of the galaxy. That is the possible future that space activities can provide.

Our space activities could save our World figuratively and literally – space is no longer a luxury, it is a necessity.



I believe that space activities are impacting society through...

... the realization that Earth is merely a planet orbiting a star – one of many billions in the Universe, some surely harbouring life. Through exploration of the Solar System, we also learn much about our own planet, its meteorology and the dangers of, for instance, global warming. But on a more practical level, everyone on Earth is affected to some extent by the technology made possible by space activities: worldwide television broadcasts, weather forecasting, telephony, global positioning. Yet to come are the benefits of space tourism and industry in space. The images from space also have an impact on artists; in particular, the spectacular images from the Hubble Space Telescope.

Mr David Andrews Hardy

*European Vice President
International Association of Astronomical Artists*



Dr. Volker Liebig

Programme Director
German Space Agency
(now ESA Director of Earth Observation)

I believe that space activities are impacting society through...

... first of all the change in the view of the people about their own planet. Only since the delivery of daily images from space to everybody's living rooms have they discovered that this planet is itself a spaceship with a tiny little layer of atmosphere, which protects us from the dark and cold of space.

A second major impact takes place in an almost invisible way via the embedded applications of space technologies in our daily life. Who knows that much of the Internet backbone traffic goes via satellite, or that the TV signal coming in via cable or another terrestrial distribution system could have already gone to a satellite and back from the location at which the signal was recorded. The influence of satellite navigation is more visible to society, as more and more cars use it.

So globalization in the minds of the people has to a certain extent started with space activities, and space applications have reached our daily lives.



I believe that space activities are impacting society through...

... applications of recoverable satellites or spacecraft to fly various seeds, roots or sprouts, which undergo genetic mutations due to the external conditions of microgravity, various cosmic rays, heavy particles, alternating magnetic fields, etc. Then follows ground planting to achieve fine quality varieties. It is a new channel for breeding. Aerospace breeding has the special characteristics of a high rate of mutation, big variation range, fine mutation steadiness and more good mutations. Space gravitational environments affect not only plants, but also other aspects of human working and living. Space gravitational environments provide microgravity material scientists with near-to-ideal conditions for studying phenomena that it may be impossible to investigate on Earth. It results in great breakthrough in terms of photonic information and will cause a revolution in information technology.

I believe that space activities are impacting society through the launching of Earth-observation, communications and navigational satellites, which can be used for disaster detection and evaluation, resources utilization and development, environmental observation and protection, tele-medicine, tele-education, high-speed communication and navigation support.

The following are typical examples of CBERS (China Brazil Earth Resources Satellite) data applications:

- Crop classification, investigation of crop planting area, monitoring of wheat and cotton growth.
- Investigation of land-use status quo in western parts of China.
- Forest-resource exploration, including exploration of planting area and growth conditions.
- Water-resource exploration and monitoring, soil-moisture exploration, study of water losses and soil erosion, assessment of water demand for agriculture.
- Regional geological map spotting on a scale of 1:50,000 to 1:200,000, including the exploration of lithology and structure.
- Updating and modification of topographical maps on a scale of 1:250,000, and experimental research into topographical mapping on a scale of 1:50,000.
- Investigation of the sources and environments of sand and dust storms, and their monitoring incorporating meteorological satellite data.
- Monitoring of water pollution, urban environment monitoring, urban virescence investigation.
- Sustainable-development research for the delta areas of the Yellow River.

Prof. Meirong Wu

Chief Expert
Secretariat of Asia Pacific Multilateral Cooperation
in Space Technology and Applications



- Exploration of geological disasters, landslides, and so on.
- Exploration and mapping of underground coal and minerals.
- Resource and environmental investigations of coastal zones.

For most people in the World, it's true to say that wherever they go, whatever they do, it's impossible without application of space science and technology. Humans, despite their long history, began only in 1957 to follow the dream of escaping the earthly environment by bravely going into space.

Exploring space for peaceful purposes is a great challenge that promotes international cooperation between humans and stimulates nations to create a new world, along with fostering technological advances. The impact of space activities on national security, social progress, people's lives, and national strength in the World exceeds anything that has gone before.

I believe that space activities are impacting society through...

- Tiny sensors that measure the pH of body fluids for use in space research. They are being modified by pediatric surgeons and biomedical engineers to monitor the post-operative health of unborn babies who were operated on to correct congenital defects.
- Growing protein crystals in space to get a better understanding of a new generation of designer drugs that could potentially treat a variety of diseases from AIDS to diabetes.
- The Hubble Space Telescope providing revolutionary scientific discoveries and also leading to breakthroughs in mammogram screening and digital imaging.
- An ultraviolet spectrometer that analyzes water and wastewater on-line and in real time. It detects iron, chlorine and heavy metals in water and wastewater.
- A condensation overflow sensor for air-conditioning units and heat pumps. It stops condensation from building up and spilling onto ceilings or floors and causing huge damage.
- An ocular screening device to detect vision abnormalities and diseases, some of which can lead to blindness if left untreated in children as young as six months old.
- A technology developed to examine astronauts' retinas in space that is now used in a digital

retinal fundus camera – a funduscope. This is used to enable 'telemedicine', by linking specialists with patients and colleagues in rural areas.

- A lightning detection and location network, providing real-time information to users via telephone lines.
- A research team at Baylor College of Medicine have applied high-pressure-pump and computational-fluid-dynamics technologies from the Space Shuttle's main engine to the design of a revolutionary heart-assist pump.
- The Apollo space suit has led to 'cool' suits used by firefighters, crop dusters, and those who work with hazardous materials, MS patients and children with a disease (Hypohidrotic ectodermal dysplasia) that causes them to overheat quickly.
- A system called the Advanced Computed Tomography Inspection System, or ACTIS. The medical version is used to scan the human body for tumours or other abnormalities.
- A technology from the Apollo programme used in new cordless, lightweight, battery-powered precision instruments that give surgeons optimum freedom and versatility in the operating room.
- A technology developed to monitor astronauts' respiratory gases in spacecraft is now being used in operating rooms for the analysis of anaesthetic gases and the measurement of

Mr Michael Irvine Mott

*Vice President & General Manager
NASA Systems
The Boeing Company*



oxygen, carbon dioxide and nitrogen concentrations.

- A metallized film developed for thermal-radiation insulation during the Apollo programme is now used in the Thermos Emergency Blanket.
- A Laser Doppler Velocimeter (LDV) developed from Apollo technology enables airport controllers to determine when it is safe to land. The LDV is also used as a meteorological tool to measure the winds aloft with greater accuracy than weather balloons, and as a way to measure smoke-stack pollution dispersion patterns.

I believe that future space-exploration activities will impact society through:

- The need to develop systems that could keep the air and water in the crew transport vehicle clean and life-supporting. Knowing how to filter out impurities in water and air would give us a much cleaner, safer environment.
- Innovative new medical systems and treatments. Medical techniques and procedures that could heal sick astronauts without scalpels or incisions could result in putting micro-machines into their bodies that doctors could manipulate from the ground.
- Efficient production of fuel and water from in-situ resource utilization would provide significant returns for energy production.

The goal of human missions back to the Moon and on to Mars will spark the cause of excellence in

science and math education amongst our youth and their teachers, and will spur a renewed sense of enthusiasm and commitment to university research in the sciences.

Space exploration will:

- increase our knowledge of our Universe
- advance science and engineering
- stimulate our national education systems and inspire students to learn
- establish technological innovation and space leadership
- generate new technologies for Earth.

Space exploration will rejuvenate our sense of challenge and vision, and has the capacity to inspire people, to cause them to produce the very best they have to offer.

I believe that space activities are impacting society through...

... the fact that imagination is the best rocket fuel possible, and acting upon it is the most important countdown!

I was born in a time of hope and in a World full of hope. By the time I came into being, humankind had already landed on the Moon, and was planning to go back – for good. I grew up in a communist Romania, where television was nothing but communist propaganda – except for Carl Sagan's 'Cosmos' series. I therefore grew up waiting for Thursday nights, when 'Cosmos' would be screened, playing with model spaceships, pretending to be an astronaut. Christmas mornings were bringing me new model spaceships and new books about space travel. And the night before Christmas, I was raising my hand, touching the star on the tree – knowing that one day, as the grown ups promised, I would touch a real one. I was in a hurry, as I was longing to trade the precious innocence of the childhood for the privilege of living in the year 2000, when the future would happen, when I'd see with my own eyes people living on the Moon, or go there myself.

As I was growing up, I was also leaving that blissful ignorance of childhood, and coming to terms with reality. No, there was no Santa Claus. No, my parents weren't really immortal as I thought, and they would pass away one day. And, no, the future would not happen the way we all imagined: the stars were no longer the aim.

The World of today is more advanced in technology and richer in resources. But it is far poorer in imagination than the one I was born into. Michael Collins was right when stating that what the space programme needs is more English majors, and that future flights should include poets. And Christa McAuliffe did not err when claiming that space is for everybody, and not just for a few people in science or math. I am not a mathematician, nor am I a scientist. In space exploration, the rule of the thumb puts technology third, economics second, and politics first. I am a specialist in space law and policy, and hence I think I have an important contribution to make, and, even more, I have a duty. I know that, in order to go to the stars, we need first to rediscover that wish – and to make the politicians rediscover it, and act upon it.

The time will soon come when I will have children of my own. They will learn, in turn, that dad won't live forever; they will learn, gathered around the Christmas tree, that there is no Santa Claus. But I won't allow them to learn that they can't touch the stars, because it's up to my generation to fulfil a promise that was made to me, and to countless other children, by the grown ups at that time.

Mr Virgiliu Pop

*PhD Candidate
University of Glasgow
International Institute of Space Law*



Dr. Peter Swan

*Chief Engineer
SouthWest Analytic Network, Inc.,
Project Leader, IAA Impact on Society Study*

I believe that space activities are impacting society through...

... invisible projects. Society marches toward the future one painful step after another, as is evident from history.

The application of science and engineering in space projects has largely accomplished miraculous changes in day-to-day affairs without much notice. Some elementary changes to humanity have been:

- lifting of the human spirit (Moon landing)
- recognition of the Earth's fragility (looking back at the home planet)
- mitigation of disasters (hurricane warning)
- global connectivity (Arthur C. Clarke's GEO platform)
- daily weather prediction (constellation of international systems)
- navigation, location, and timing (military start - civil dominance)
- materials development (micro-miniaturization, light materials, Velcro)

**Mr André Joseph van Gaver**

*Inspector General for Launchers
European Space Agency*

I believe that space activities are impacting society through...

... improvement of three main areas:

- The living standard. Space is used now in so many fields that its usefulness for every human being does not need to be proven: telecommunications, navigation and Earth observation are common services in our modern life. Voice, video information and data can be delivered anywhere in the World through space. The modern traveller constantly uses navigation systems, like GPS. Earth-observation satellites are necessary for weather forecasting, geophysical and environmental analysis, etc.
- The safety. Our safety as human beings is endangered mainly by two phenomena: natural catastrophes and the human conflicts:
 - Space is used to predict, to try to prevent, and to manage natural catastrophes as meteorite impacts, earthquakes, meteorological disasters, forest fires, etc.
 - Space has no frontiers, and can be used to hear and observe the enemy, allowing greater prevention and better conflict management.
- Sciences. The space contribution to the sciences is fundamental, not only in astronomy, but also in many other disciplines such as meteorology, geology, biology, etc.

The fundamental quest of mankind is to understand life, and space is necessary to contribute to this permanent human aspiration.



Mr Jacques Villain

Vice-President
SNECMA

I believe that space activities are impacting society through...

... many fields.

First of all, rockets gave mankind the possibility to leave the Earth, which had been a dream for two millennia. Man is a part of cosmos and for the first time he can reach it after having explored all of the Earth. Space activities have provided much knowledge about the Universe. A new door has been opened. The nature of the planets, asteroids and comets has been much better known since the beginning of space activities. The Hubble space telescope is one of the main successes in this field. With WMAP and Hubble we have seen back to the beginnings of our World. This is absolutely fantastic. Today, after discovering the Mars landscape, with Spirit and Opportunity, we can better imagine what will be the future of the Earth. As far as Earth is concerned, satellites are playing a great role in terms of surveillance for improving the environment. Satellites like Spot, Topex/Poseidon and others can detect changes on the surface of the Earth and the seas, knowledge of which is essential in order to understand the meteorological phenomena better or monitor pollution. The telecommunications and TV satellites have changed the relations between people. On the other hand, space activities have always been a very creative field in terms of electronics, navigation, energy, computers, etc. These technologies have also found applications on Earth.

At a moment when many problems are affecting daily life, I think space is one of rare domains that can still keep the dream alive.

I believe that space activities are impacting society through...

Prof. Lizhong Zheng

Deputy Director
National Remote Sensing
Centre of China

... promotion of the development of astronomy, geosciences, life science, information science, energy science and material science. For example, satellite meteorology has expanded the scope of research to the atmosphere of the whole World.

Space activities speed up change in the traditional technology fields. Satellites change the technology also in the field of communications, television transmission, data collection, weather forecasting, resource exploration, navigation and environmental monitoring.

Space activities improve the life style of mankind. For example, with e-education, e-business, e-commerce, and long-distance electronic postal services and medical treatment, our lives become much more convenient.

Space activities promote our ability to understand the changes in nature. From far away from our planet, we have a different perspective from which to study the Earth. For example, we understand the origin and evolution of the Earth more comprehensively since much more information has been available through space activities.

Space activities open up new avenues for sustainable development, and will be used to protect both mankind and the Earth. Remote sensing gives us economical and effective ways for making resource censuses. Satellite-based navigation systems provide precise positioning information for transportation.



As a developing country, China has recently become more active in space activities. In its reformation of traditional agriculture, China puts emphasis on the combination of remote sensing, GIS, GNSS and expert knowledge, and promotes a 'precision farming' approach, which has brought much greater benefits to the farmers. In western China, space-derived information has been used in the monitoring of environment and resources, and the planning and developing of small towns. Communications and broadcasting technology has been used to provide distance-learning education in those areas. There are now more than 2,000,000 students studying in distance-learning schools through broadcasts and television each year.

China suffers very serious natural disasters every year and space-based information technology has been used in warning, monitoring and evaluating floods, droughts, forest fires, sand and dust storms, etc. As a result, the costs resulting from damage caused by natural disasters are decreasing by several billions each year in China.

In conclusion, space activities contribute much to the development of modern China's economy.

Educational Stimulation: Young people need stimulation to go beyond the 'easy answer' and pursue the knowledge required for a challenging and rewarding life. As shown by Apollo, Mir, the International Space Station, the recent Chinese human spaceflight, and the Lunar/Mars initiatives, the enormity of space and its inherent challenges can, and do, stimulate students to pursue academic endeavours. The inquisitive minds and natural curiosities of human beings are released from their habitual reluctance by the challenges inherent in the development of space. In addition, revitalization of the human spirit after formal training can lead to new ways to learn and contribute, such as distance-learning. The stimulation of education and proactive outreach has been a historic strength of the space arena ever since people began looking into the heavens for answers centuries ago.

...“These activities are widening our horizons and helping us to understand the World we are living in.”

[M. Böhme]

...“The basic elements to achieve these goals are education and space awareness...”

[E. Gaggero]

...“Space is now regarded as the best medium for getting kids interested in Science and Engineering at School and University...”

[R. Holdaway]

Contributors

Marshal Blessing

Michael Böhme

Eduardo Gaggero

Loretta Hidalgo

Richard Holdaway

Reese Lumsden

Bruce Middleton

Yaroslav Yatskiv

Educational Stimulation

I believe that space activities are impacting society through...

... having a significant and beneficial influence.

Although many people think of outer space as an unreachable realm, too far removed to have any effect on their daily life, technology derived from space ventures has obviously had a major impact throughout the World. Initially, revolutionary technologies resulting from space were limited to space programme spin-offs, such as Velcro, but now businesses have arisen which utilize space and depend upon space activities. Both GPS and satellite radio rely on space infrastructure, and resulting products have improved people's lives both directly and indirectly. Although few people own GPS receivers, society has benefited from the improvements in the shipping industry fostered by satellite location technology.

Furthermore, I feel that activities in space have served to inspire generations of people. An increased awareness of math and science among space-minded youth can easily be linked to their desire to participate in space endeavours. Space has led many children and adults to study and work harder in the hopes of taking part in space-related activities and possibly travelling into space themselves. Even if the lure of space is farthest from their minds, hard-working individuals have found employment in aerospace industries, and have thus been indirectly motivated by space. Furthermore, space has stimulated interest in non-technical fields. People study languages to communicate with those in other nations who share an interest in space. Individuals improve

their writing skills to compose stories about mankind's future in the cosmos.

Space activities are making outer space more accessible to society. Missions like Mars Express and the Mars Exploration Rovers have put another planet nearly within our reach. As a result, people have been motivated to try to allow humanity to explore even further, while the knowledge and technological advances achieved along the way are improving life on this planet.

Mr Marshal Blessing

Associate

NASA Academy, Space Generation



Mr Michael Böhme

Artist

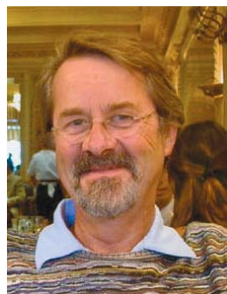
I believe that space activities are impacting society through...

... the many improvements in our daily life. It brings us inventions, which will help to preserve Earth from destruction and, last not least, it widens our horizons through the exploration of our Universe

There are innumerable innovations from space which impact our daily life and which may come into reality the near future. One of the most important is the anticipated utilisation of space solar power, which will hopefully be available soon. Once available, it will help us to become independent from oil, which pollutes nature and is the cause of fighting and wars around the World.

Another very important aspect is the exploration of the Universe by satellites, probes, manned spaceships and telescopes in orbit. These activities are widening our horizons and helping us to understand the World that we are living in. They may one day lead to the detection of another Earth-like planet in the infinity of space, and show us that we are not alone.

If this happens, it would surely be the greatest impact of space activities on our society. Not long ago, we thought that the Earth was the centre of our Universe and that we humans were the crown of Gods creation. It had a great impact on our society when we first detected that Earth was only a little planet and our Sun is only one of billions in the Universe. Nothing will impact our society more than the discovery that life has developed not only on Earth, but also on another distant planet.



Maybe it will also have intelligent life and we have to recognize that we are indeed not the pinnacle of God's creation, but only one civilization among others.

I believe that space activities are impacting society through...

... the knowledge, in the 47th year of the 'space age', of the positive impact that they have had both on individuals and society as a whole. From the perspective of an inhabitant of a developing country like Uruguay, I can confirm that the multidisciplinary nature and universality of space activities allows countries to assume roles and to participate despite economic or political constraints.

This has been our experience since the institutionalization in 1975 of the Centro de Investigación y Difusión Aeronáutico-Espacial (CIDA-E), described by the ESA as a pioneering world centre. We have accomplished a series of achievements and taken on responsibilities that we could only maintain thanks to cooperation, whether it be with the intergovernmental organizations that we participate in (UNCOPUOS, since the admission of Uruguay in 1981; UNISPACE I and II; the Space Conferences of the Americas, CEAS), or with the international non-governmental academic institutes of which our Center is member (IISL, IAF, IAA, among others). This permanently ongoing work, which continues regardless of the prevailing scientific or social circumstances, demonstrates that no country needs to consider itself excluded from the benefits to be derived from space activities.

As recognized by international law, space activities *"must be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and*

shall be the province of all mankind". We support the idea that a greater contribution of national capacities (be they human or material) will allow us to reaffirm a real planetary solidarity of shared responsibilities, taking into account that in space activities the scientific-technological and scientific-legal aspects are inextricably related, the latter serving as a stimulus and guarantee for the former, which must develop within the aims and purposes in force in the international community (National paper presented by Uruguay to UNISPACE II).

The basic elements for achieving these goals are education and space-awareness. It is also necessary to have a scientific critical mass, which should remain active and stable, despite the economic and political changes in each country. Uruguay is one of eight countries that provide educational opportunities in Space Law and Policy (ONU, Office for Outer Space Affairs, A/AC.105/671, Add. 1). But the scientific-technological advances must be consistent with a new ethic, the Ethics of the Homo Spatialis (not the old Homo Sapiens), which should allow us to avoid the negative impacts that they also produce. In summary, it should help us to understand the necessary unity that must exist and the essential nature of human beings that inhabit planet Earth, on which our own survival definitely depends.

Prof. Dr. Eduardo E. Gaggero

Director General
Centro de Investigación y Difusión Aeronáutica
Espacial (CIDA-E)



Ms Loretta Hidalgo

President
Space Generation Foundation

I believe that space activities are impacting society through...

... higher education.

Most of the young scientists and engineers that I know did not persevere through 4+ years of technical university coursework solely out of a love of math and science. They are some of the smartest, most ambitious, most articulate and competent people in the World and they chose to get a technical education because of their passion and dedication for expanding our space activities.

Many of us were inspired to one day become a part of the space programme and it was in the name of that dream that we excelled. These bright young people are now going on to do great things for our home planet – both inside and outside the space industry. But we never forget our roots. We know that it was our love for space that made us who we are, and we know that it is our greatest responsibility to pass on that passion and zeal for life to the next generation.

I believe that space activities are impacting society through inspiration.

I think the other major impact of space has been in inspiring a planet that anything is possible. Imagine (as I have to) all the World – both behind the Iron Curtain and in front – watching the same broadcast from the Moon in awe that a human, one of us, was up there on behalf of all mankind, millions of miles from Earth stepping onto the surface for the first time.



Space still inspires people. It inherently has people see the insignificance of small problems and the vastness of what lies ahead. It takes you from thinking on a national scale to thinking about things on a galactic scale. George T. Whitesides often tells students looking through his telescopes that the last thing the photon that just hit your retina touched was the rings of Saturn. It never ceases to amaze...

It is more important than people realize to have a bit of news, a picture from Hubble, or a human interest story that gives people cause for inspiration and hope – that society is advancing, that science is contributing to the quality of our lives. We have the privilege and the responsibility of being an entity that can provide that for society, and in fact it is one of the things I think people expect for their civil contributions. I think it is one thing we should be willing to happily deliver on.

I believe that space activities are impacting society through...

...a variety of very significant ways, some of which are immediately apparent and some of which are less obvious.

Climate change and environmental monitoring are key to the future sustainability of the human race, and much of this work takes place directly from space – for example, monitoring changes in the ozone layer, measuring pollutants in the upper atmosphere, recording global increases in sea-surface temperature, including El Niño.

Global communications is now almost entirely the prerogative of space. Most international news/TV comes via direct-broadcast satellite, as does an increasing proportion of home television. Direct-broadcast TV is also used for education purposes in much of the developing world, where satellite connects remote villages to the Internet, to medical facilities, to teachers.

GPS systems are now widely used in shipping, by commercial aircraft, by troops, by the public in cars, or trekking.

We are also learning more from space studies of the Sun about the impact of solar activity on the Earth's climate.

Finally, space is now regarded as the best medium for getting kids interested in Science and Engineering at School and University.

Prof. Richard Holdaway

Director, Space Science & Technology
Rutherford Appleton Laboratory



Mr Reece Lumsden

*Managing Director
Lumsden Consulting*

I believe that space activities are impacting society through...

... a number of levels:

The invention and subsequent utility of launch vehicles and satellites have allowed humans to traverse the atmosphere and look back upon our Earth. For the first time, such enabling acts have allowed us to see not only just how artificial our politically defined divisions were, but also to comprehend just how fragile our atmosphere is, given that we transcend it (the 100 km or so into space) in a matter of minutes.

They have been a catalyst in impacting our attitudes, providing a perpetual sense of discovery about the expanse that surrounds us, from the extremes of the micro to macro scale.

They have impacted our ability provide a safer World, while paradoxically allowing us to be more precise in our methods of conflict. Their utility has ensured that weapons programmes can no longer be carried out under the shroud of secrecy, but it has also allowed those with such capabilities to in effect have global reach.

New areas of endeavour have been created, opening up new platforms for commerce and entrepreneurship, creating new jobs and economic development.

It has provided a new context for the wonderment and excitement of today's youth, encouraging them to become the next generation of explorers by tantalising them with visions of the boundaries

in our knowledge hinting at what yet remains to be discovered...

Space activities have indeed impacted society on a number of levels.



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I believe that space activities are impacting society through...

... many fields: political, military, economic, social and medical, to name but a few. The World is undoubtedly a more comfortable, prosperous and healthy place as a result of developments driven by the exploration and utilization of space. Whether it is a safer place in the military and political sense is not so clear – but that outcome can hardly be attributed to space.

Rather than look back, I would prefer to contemplate what space activities might contribute in the future. There is reason to anticipate that future developments from and using space might add to the human condition in many fields.

Examples include:

- the provision of health and medical care
- the empowerment of disadvantaged communities for economic and social progress
- understanding global environmental change and implementing appropriate strategies
- developing new sources for base-load energy requirements
- reducing international political and military tensions, and
- enabling a better-coordinated response by the international community to regional conflicts.

Doubtless there are many more.

Although enormous sums are today being invested by governments in space development, the amounts being directed to objectives such as

these are relatively minor. A primary reason why objectives such as I have listed are falling short is, in my opinion, that the space development agendas of most countries are not focussed on such objectives. They are incidental, rather than central.

Yet if we look back to the 1950s and 1960s, there was a tight nexus between the most generous years of public funding for space development, and objectives for that development that were focussed on the political agenda of the day.

My hope therefore is that the focus of civil space development will be returned to more of the pressing issues of national and international politics at the start of the 21st century. I firmly believe that governments will again prove themselves generous, once they can be convinced that space activities are prepared and capable of contributing to the solution of those issues.

Dr. Bruce Stanley Middleton

*Managing Director (Retired)
Asia Pacific Aerospace Consultants Pty. Ltd.*



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Dr. Yaroslav S. Yatskiv

I believe that space activities are impacting society through...

Director

Main Astronomical Observatory of National
Academy of Sciences of Ukraine

... various aspects of human life, including:

- Understanding and education of people.
- Modelling and predicting how humans are affected by space.
- Development of new technologies to be used for benefit of mankind.
- Establishing the conditions for international cooperation on the Earth and in space.

**Communications for All****Contributors**

Ed Ashford

Robert Briskman

Jose Dorado

Jean-Claude Husson

Per Lindstrand

Ruud Lubbers

William O'Neil

Communications for All: As the space field has matured, the innate human desire to communicate has grown ever more significant. The need to transmit data, information, and knowledge from afar has driven communications technologies – whether it be communication with a spacecraft beyond the Solar System or with a friend by mobile phone. Through television we can watch wars in real time as they are being conducted on the ground, we can witness the prowess of individuals at the Olympic Games, we can listen to latest news on the radio while driving in our cars. The ability to communicate easily and quickly with ships at sea, aircraft in mid-flight or a relative on the other side of the globe is a direct result of communications technologies developed for space.

...“instant and worldwide communications are the important part of this impact today...”

[J. Dorado]

...“ ‘Universal access’ means that billions of people all over the World are linked into a global network, whether they are at home, in the street, in a car, a ship or a plane.”

[J-C. Husson]

...“Clearly, the global reach of space-based satellite communications has affected the way the World sees the people.”

[R. Lubbers]

I believe that space activities are impacting society...

... in so many ways that it is difficult to innumerate them. For most people, however, their impact unfortunately goes almost totally unseen. There are the obvious ways, of course. When someone subscribes to a direct-to-home satellite television service, they are certainly aware that their programmes are being delivered by satellite, but how many television cable subscribers realize that, in most instances, the programmes they are watching were delivered to their cable company's 'head end' via one or more satellites? If someone is one of the unfortunately rather limited number of subscribers to a satellite telephony service such as Iridium or Globalstar, they know their service depends upon a constellation of satellites, but how many people would guess that when they make a call using their conventional cellular telephone, there is a great chance that the synchronization of their cell phone is dependant upon timing signals coming from another satellite constellation – the GPS navigation satellite system? If one uses a credit card to buy gasoline, they realize that their card number will be confirmed in real-time with their credit-card company, but most people would be surprised to learn that in many instances the confirmation is made using a VSAT satellite network.

In addition to tasks such as these, communications satellites today are being used to provide emergency communications when earthquakes or other natural disasters wipe out the local terrestrial infrastructure, to allow the detection and rescue of mariners, aviators, and hikers in distress, and to allow doctors in major medical centres to provide remote diagnosis, and

even remote assistance in treatment or surgery for medical problems occurring in remote areas.

The types of satellites being used for the direct and real-time benefit of mankind are, however, manifold, running a gamut including those designed for broadcasting and communications, Earth observation and surveillance, navigation, meteorology, and emergency detection. To a very real extent, however, scientific satellites, orbiting observatories, and planetary probes can have an impact on society that could be even more profound. What we learn about our own Solar System and about the rest of the Universe from such satellites will allow us to understand and more precisely determine how these were formed, and may help us also to predict whether and how they will ultimately end.

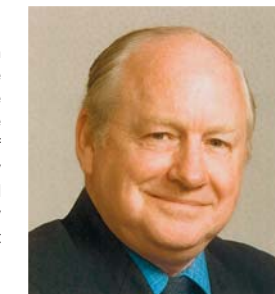
Planetary landers, such as those now on and planned for the future for the exploration of Mars, may allow us to determine if that planet ever harboured life, and an even more exciting thought, might demonstrate that life still exists there today. The social and religious impacts of such a discovery would certainly be of great consequence.

While communications satellites have shown themselves to be commercially viable, and hence now for the most part are being funded by private money, it is important that we in the satellite community make efforts to publicize the benefits of space for the other types of space projects, for only with such publicity and the acceptance of the general benefits that space can bring to all people, will many of the important future projects gain the support necessary to obtain public funding for their execution.

Mr Edward Wygant Ashford

President

Ashford Aerospace Consulting



Mr Robert David Briskman

Technical Executive
Sirius Satellite Radio Inc.

I believe that space activities are impacting society through...

... the provision of vital new technology, which has improved the life of everyone on this planet. As a founding engineer of NASA in 1959 and the Communications Satellite Corporation in 1963, I have seen the technology developed originally for space now commonly applied to medicine, telecommunications, manufacturing, navigation, entertainment, resource discovery, weather forecasting and a whole range of other important efforts benefiting the people of this World.

The benefits come in many forms, some direct like navigation using the GPS (Global Positioning System), while many come indirectly such as improved productivity from space-derived machining operations.

For the last 15 years, I have led the engineering efforts in the development of satellite radio, which even now in its infancy lets over two million subscribers enjoy over 120 channels of audio music and voice programming in their cars, homes and boats throughout the United States. Future space activities will continue these benefits on an accelerated basis.



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I believe that space activities are impacting society through...

With the question formulated this way, I would immediately answer that the impact of space activities is mainly through TV. This would obviously not be the answer that is expected, but it is a real fact and an important one not to forget.

However, if the real question is how space activities impact on society, I would have to say that instant and worldwide communications are the important part of this impact today. I would also add that these communications we enjoy today have become an inherent characteristic of our developed society, one that cannot be lost without affecting very seriously our way of life.

Space systems provide these communications not only between people of different countries and continents, irrespective of whether they are on land or travelling by land, sea or air, but also between the Earth and people. Space systems are constantly monitoring the Earth, the characteristics of its atmosphere, the temperature of its oceans, the situation of the crops and many more parameters of interest to us, at each point and in a continuous manner, and they tell us those things we are interested in because they affect our lives and dreams. Space systems also tell us where we are and how to go to some place on Earth with an accuracy never dreamed of, which also improves our daily life. However, this is only a first approach to an answer.

A second one would tell us that space systems also allow us to communicate with other parts of our Solar System. Through different kinds of space systems we allow the Sun to communicate and tell us what can be expected on terms of changes in our atmosphere. Machines we have sent to other planets and moons of our Solar System can also communicate and tell us how they are and how they change. We can also receive improved communications from places outside our Solar System. It all allows us to understand our World and it will improve our future life. But this is only a second approach to an answer.

If we go deeper, we find that space systems open the door for us that will allow mankind to explore and eventually conquer the Universe, as was dreamed of by Konstantin E. Tsiolkovsky one hundred years ago, which will be a new era for mankind. But this is only a third approach to an answer.

It would be an interesting exercise to ask young people how they imagine a World without satellites, as well as what they imagine space systems can do for us in a future. They maybe know better. And this will also be a part of the answer.

Dr. Jose Dorado

Director
EN de CNM Bazán



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Mr Jean-Claude Husson

President
National Air and Space Academy

I believe that space activities are impacting society through...

... revolutionising our society, and that their full impact is rarely appreciated.

Their capacity to offer universal access to communication, information, positioning, weather forecasting, etc. provides us with a global vision of the Earth as a planet within a Universe whose contours are becoming ever clearer thanks to the various scientific satellites.

'Universal access' means that billions of people all over the World are linked in to a global network, whether they are at home, in the street, in a car, on a ship or in a plane.

The World has thus entered a new era in which access to information is paramount; innovative terrestrial techniques do of course exist, but space is the only technology permitting global cover, avoiding for example the digital divide for developing countries.

With geostationary satellites for communication and meteorology, constellations for navigation and communication, and Earth-observation satellites, space contributes to global safety, search and rescue, air-traffic management, terrestrial and maritime transport, natural risk management, telemedicine, etc., and plays a major strategic role in world-wide peacekeeping.

Using satellites to gain a better knowledge of our planet and how it is evolving will help to encourage sustainable development and facilitate the move

towards more humanistic management of the Earth.

Finally, human spaceflight has proved our ability to leave the Earth and live in space; this aspect may well be crucial to the future of mankind...



I believe that space activities are impacting society through...

... revolutionizing communications and navigation in the air.

This I can illustrate with a personal comment about what space activities have meant for me.

In January 1991 Richard Branson and I made the first and only crossing of the Pacific by hot-air balloon. Due to solar flares, we lost all communications for 10 hours and were flying completely blind. We did have an automatic satellite-tracking device (Tiros) on board, however, and since the envelope was metallised it could not pick up a signal. All we had was an HF transceiver and an Omega Navigator. Had we gone down, no-one would have found us in time.

In 1998, when Richard and I attempted the global circumnavigation flying from Marrakech to Hawaii, we had two satellite telephones, satellite data communication, real-time telemetry and the ability to send broadcast-quality video from inside the capsule. GPS navigation not only gave us instant positioning, speed and direction, but the control centre would have the GPS data only a few seconds later. In fact, radar coverage over northern China was so poor that our control centre in London had to tell Chinese Air Traffic Control where we were every 10 minutes.

Dr. Per Lindstrand

CEO
Lindstrand Technologies Ltd.



Prof. Drs. Ruud Lubbers

United Nations High Commissioner for Refugees

I believe that space activities are impacting society through...

... the global reach of space-based communications.

The quantum leap in satellite communications in the past decade has influenced the work of the UNHCR in several major ways. It has changed not only the way in which we communicate with our field offices and track refugee movements, but also how we communicate with the outside World.

The rapid development of satellite technology in the 1990s has had a huge impact on the operational efficiency and safety of UNHCR staff working in remote and often dangerous locations. It has also helped UNHCR draw an unprecedented amount of attention to the cause of refugees, whose plight has been reported in 'real time' and brought live into the living rooms of millions around the globe.

Today, a UNHCR field worker armed with tiny battery-powered satellite phone or satellite Thuraya mobile phone can easily call for help from the most remote corner of the Earth. Messages that took a long time to transmit a mere 12 years ago, can now be passed on in just seconds. This, needless to say, can save the lives of both our staff and the people we are trying to help.

The past decade has seen a series of dramatic high-profile humanitarian crises from Northern Iraq to Bosnia to Rwanda to Kosovo to Afghanistan. These crises were accompanied by a veritable explosion in satellite and broadcasting



technology. What this means in practice is that humanitarian crises, even in such remote and volatile areas as Eastern Congo, are instantly brought live to viewers around the World. For example, daily television reports from wartime Bosnia grabbed the World's attention and presumably led to more generous financial and political support for the people uprooted by war and violence in the Balkans.

In 1994, 1.3 million Rwandan Hutus fled to what then was Eastern Zaire, fleeing the advance of Rwandan Tutsi rebels. The chaotic exodus led to an outbreak of cholera which killed tens of thousands of people in just a couple of weeks, creating a humanitarian disaster of biblical proportions. Hundreds of journalists equipped with state-of-the-art satellite communications descended on the small and sleepy town of Goma, which struggled to accommodate the refugees. For the first time in Africa's history, the plight of its people was reported live by western TV networks, causing outrage and stirring compassion around the World.

Clearly, the global reach of space-based satellite communications has altered the way the World sees the people that the UNHCR serves.

I believe that space activities are impacting society through...

... first, and foremost, their influence on children.

Human spaceflight is the most fascinating of all human activity. I would bet that the large majority of children today worldwide would choose to watch a space launch in person, rather than see any sporting event or other attraction. And, they truly can aspire to travel in space.

The children of today will determine the future of society. They will not be denied their destiny to be the first generation with personal access to spaceflight and for their chosen emissaries to personally explore Mars. In addition to these very personal and realistic aspirations of children, we are all on the threshold of mindboggling discoveries of Earth-like planets with intelligent life orbiting nearby stars.

At most, these revelations should be no more than a decade or two away when we emplace our super-powerful space telescopes at Sun-Earth Lagrangian Point Number 2, one and a half million kilometres away from Earth, directly opposite the Sun. From this vantage point we will have unobstructed, clear, disturbance-free views into the Universe.

In the meanwhile, the ongoing and future explorations by the Earth's robotic spacecraft at the planets and throughout our Solar System will continue to fascinate us with discoveries and get us closer and closer to answering the most fundamental of all questions: "How did we get

here and what will eventually happen to us?" These robotic spacecraft – now principally sent by Europe, the United States, and Japan – give us all the real context of our very humble place in the Universe.

Beyond the knowledge gained and our delightful robotic touring of our neighboring planets, there continues, of course, the very real spins-off of space-driven technology into all our earthly pursuits, from medical procedures unimaginable just a decade ago to tremendous power amplification of what many call music today.

Dr. William John O'Neil

Galileo Project Manager (Retired)
Jet Propulsion Laboratory (JPL)





Appendix

Contributors
Commission 6 Study Participants
International Academy of Astronautics
European Space Agency

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The Impact of Space Activities upon Society

project was conducted under the auspices of the International Academy of Astronautics (IAA) in cooperation with the European Space Agency (ESA). Within the IAA, the project was an initiative of Commission 6: Space and Society, Culture and Education under whose guidance an Academy Study Group was set up specifically for the purpose of developing this book. The current officers of Commission 6 are: Ivan Almar (Chair), Roger Malina (Vice Chair), and Arthur Woods (Secretary). Special thanks must go to Peter Jankowitsch who was the Commission 6 Chair at the initiation of the study.

The leader of the Academy Study Group, Peter A. Swan, would like to especially thank the members of the study group for their innovative thinking, reach around the globe and desire to contribute to an immense project. The Commission 6 Chairman would like to thank those members of the Academy who peer-reviewed the draft document for their insight and comments, which have gone towards improving the presentation and readability of the book.

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Peer Reviewers for the Impact Study were: John Hussey, Debra Lapore, John Rummel, Les Tennen, and Ron White.

The International Academy of Astronautics

Aims: Foster the development of astronautics for peaceful purposes; recognize individuals who have distinguished themselves in a related branch of science or technology; provide a programme through which members may contribute to international endeavours; and cooperate in the advancement of aerospace science.

Founded: 16 August 1960, Stockholm, Sweden, during the 11th International Astronautical Congress, by Theodore Von Karman. A Non-Governmental Organization recognized by the United Nations in 1996.

Structure: The International Academy of Astronautics is based on the tradition of the great classical scientific academies of the 17th century in Rome, London and Paris, which fostered scientific enquiry and the exchange of ideas and new information in the earliest days of modern science. The Academy's beginning was led by Dr. Theodore von Karman, one of the most important figures in the evolution of rocketry, and the IAA's first President.

Members: The IAA is international in membership from approximately 65 countries. This diversity recognizes the global significance of astronautics and space exploration. Full, Corresponding and Honorary Members total 1078.

Activities: Encourage international scientific cooperation through scientific symposia and meetings. A major initiative of the Academy is the development of a series of 'Cosmic Studies' and Position Papers dealing with the many aspects of international cooperative endeavours in the

exploration and habitation of the Solar System and beyond; the space debris; the small satellites; declaration of Principles Concerning Activities Following the Detection of Extraterrestrial Intelligence, Lunar and Martian Exploration, etc.

More information about the IAA can be found at: www.iaaet.org



The European Space Agency is Europe's gateway to space. Its mission is to shape the development of Europe's space capability and ensure that investment in space continues to deliver benefits to the people of Europe. ESA has 15 Member States. They are Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom. Canada has special status and participates in some projects under a cooperation agreement. By coordinating the financial and intellectual resources of its members, ESA can undertake programmes and activities far beyond the scope of any single European country.

ESA's job is to draw up the European space plan and carry it through. The Agency's projects are designed to find out more about the Earth, its immediate space environment, the Solar System and the Universe, as well as to develop satellite-based technologies and promote European industries. ESA also works closely with space organisations outside Europe to share the benefits of space with the whole of mankind. ESA has its Headquarters in Paris and it is here that future projects are decided upon. However, ESA also has centres throughout Europe, each of which has different responsibilities.

- ESTEC, the European Space Research and Technology Centre, is the design hub for most ESA spacecraft and is situated in Noordwijk, the Netherlands.
- ESOC, the European Space Operations Centre, is responsible for controlling ESA

satellites in orbit and is situated in Darmstadt, Germany.

- EAC, the European Astronaut Centre, trains astronauts for future missions and is situated in Cologne, Germany.
- ESRIN, the European Space Research Institute, is based in Frascati, near Rome in Italy. Its responsibilities include collecting, storing and distributing satellite data to ESA's partners and acting as the Agency's information technology centre.

In addition, ESA has liaison offices in the United States, Russia and Belgium, a launch base in French Guiana, and ground and tracking stations in various areas of the World. In 2001, the total number of staff working for ESA numbered 1797. These highly qualified people come from all of the Member States and include scientists, engineers, information technology specialists and administrative personnel.

ESA's mandatory activities (space science programmes and the general budget) are funded by a financial contribution from all of the Agency's Member States, calculated in accordance with each country's gross national product. In addition, ESA conducts a number of optional programmes. Each country decides in which optional programme it wishes to participate and the amount of its contribution. In 2001 the budget was €2856.8 million. ESA operates on the basis of geographical return, i.e. it invests in each Member State, through industrial contracts for space projects, an amount more or less equivalent to each country's contribution.

The European Space Agency



ESA's governing body is its Council. Council provides the basic policy guidelines within which the Agency develops the European space plan. Each Member State is represented on the Council and has one vote, regardless of its size or financial contribution. The Agency is headed by a Director General, elected by Council every four years. Each individual research sector has its own Directorate that reports to the Director General. ESA's present Director General is Jean-Jacques Dordain.

The benefits of space exploration are not confined to scientists, engineers and astronauts. Space exploration also helps to improve daily lives. Some of the ways in which ESA's programmes benefit Europe and its citizens are: Strengthening and promoting European science, improving medical science, generating new technologies, promoting industrial development, protecting the Earth, assisting agriculture, developing more accurate weather forecasts, improving communications, creating accurate maps, improving navigation, increasing employment, and preventing the brain drain.

More about ESA can be found at: www.esa.int

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