

Report

Space spin-offs: Making them known, improving their use[☆]

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Abstract

This paper identifies new ideas for using existing space technologies as spin-offs and considers the effectiveness of the use of such technologies for various industries and applications. It then explores the dissemination of knowledge and information about such spin-off technology and applications to various audiences. It proposes methods to improve the dissemination of such knowledge and information. The paper concludes with some recommendations on how the dissemination of information about space spin-offs can increase awareness and use of such technology and, in the long term, increase support for space activities. The perspective of this article is that of the world's various space agencies and the UN Committee on the Peaceful Uses of Outer Space (UNCOPUOS). It is recognized that truly effective spin-offs depend on the involvement of those outside the space arena, particularly the commercial, academic and governmental sectors. These sectors and the general public must see the value and cost efficiency of 'spin-offs' and of developing new technology and systems through space research programs or they will not succeed. This may require space agencies to stay more focused on research and to hand over functions and activities to these 'outside sectors' once 'seeds are planted'.

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1. Introduction

The Space Generation Advisory Council (SGAC), supporting the recommendations of the Vienna Declaration, has, in cooperation with the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS), contributed to the efforts of the Action Teams set up to implement the recommendations of the Unispace III conference. A conference was hosted for SGAC in Bremen from 26 to 28 September 2003, which helped galvanize efforts to develop SGAC and its projects. The project

results of the Working Group 'Improving the Sharing of Information on and Use of Spin-offs from Space Activities' are presented in this paper.

An increase in information on and use of spin-offs has a positive effect on future space budgets, which results in an increase in space activities, in turn leading to more spin-offs, as illustrated in Fig. 1. This paper approaches the spin-off discussion in two ways: first, by examining how to improve the sharing of information on spin-offs; second, by discussing how to improve the use of spin-offs.

2. Improving the sharing of information on spin-offs

This section focuses on improving the dissemination of information on spin-offs from space activities. Present communication links between space agencies, aerospace companies and technology companies are not satisfactory. While institutions for inter-communication exist, these are generally low profile. We argue that there needs to be an

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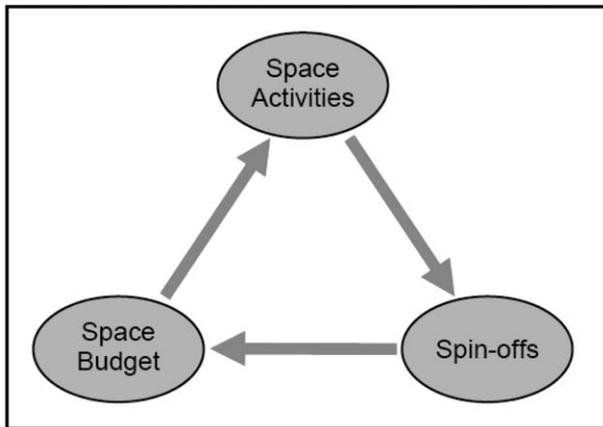


Fig. 1. Illustration of a simplified spin-off cycle.

improvement in information exchange and provision of channels for such improvement. In doing so, we take a structured targeting approach in this section, which considers that there are different sectors for such an outreach, and that actions must be surgically precise to achieve optimal effect. Within these categories, the section proposes action plans that can be taken for the better dissemination of information about spin-offs from space activities.

This entails identifying the audience for dissemination, and proposing techniques that are best suited to each category. For simplicity, the article proposes three broad categories of spin-off information target audience: government, industry and the general public.

It should be mentioned that it is assumed that there exists a basic interest in spin-offs within the target audience if spin-offs are ‘known’ and beneficial. As most spin-offs are, however, ‘unknown’ among government, industry and the general public, the following discussion is targeted at changing the ‘unknown spin-offs’ to ‘known spin-offs’. While some spin-offs have a direct economic benefit for industry, others may increase social welfare for the public or increase political acceptance for the government. To find the balance between effort and benefit for each potential spin-off related to the different target audiences is a challenging task which goes beyond the research presented in this paper. However, it should be emphasized that there is a need for consultation and further studies in this field.

2.1. Government

The importance of the dissemination of such information at governmental and policy decision-making levels cannot be over-emphasized. Without critical pressure for change at governmental levels, the dissemination of spin-off knowledge will be impeded. In this regard it is important to keep decision makers in executive and legislative levels up to date on spin-off availability and evolution.

Source for dissemination: the government could serve as a source for dissemination of spin-off technology and evolution. This could then serve as a platform for interaction with space agencies and industries to work with Earth-based industries. A point of contact (POC) with the governmental institution for dissemination of space information, including information on spin-offs, would be required. This could then serve as an interface between the United Nations Office of Outer Space Affairs (UNOOSA), space agencies, government and the general public.

2.2. Industry

The space industry has evolved into a sophisticated web of small, medium and large companies. Each of these categories of company has its own challenges and strengths. The authors believe that there should be synergy among these companies, achieved through better dialogue and sharing of information about spin-offs. It is important that this cannot be limited to synergies between space companies but must extend to other companies that are interested in and capable of taking spin-off ideas from space to a commercial market.

- *Presentation of spin-offs:* Small companies have a challenge in finding funds and capital for the presentation of available spin-off technologies, e.g. at trade fairs. In this regard it is proposed that national or regional space agencies such as NASA, ESA and JAXA should aim to help promote such technologies for small companies. One such example is the ESA initiative for spin-off promotion through the TEST magazine. However, this magazine has a limited circulation and awareness level. The profile of such magazines must be raised through better publicity.
- *Advertising agency:* It is proposed that a not-for-profit advertising and relations agency should be set up by the governments of participating countries. The function of this agency would be to combine the respective departments of national and regional space agencies to publicize spin-off technologies, and provide a global platform for the dissemination of such information. It is, of course, conceded that this would be a longer-term goal, subject to considerations such as technology transfer policies. We thus propose that the UN Office of Outer Space Affairs should establish a directorate office to lobby for inter agency communication and cooperation in spin-off technologies.
- *Spin-off booth:* There is also a need to increase awareness of spin-off technologies in industry. It is proposed that there should be a spin-off booth at industry conferences and congresses. It is then likely that a domino effect will occur as long as one national or regional agency initiates this action. In creating a market for the geographic region for which it is responsible, this agency would then provide the seeds for the creation of competition for the spin-off market.

This would provide both the impetus and the pressure for other agencies to follow, so as to ensure that the industries that fall under their auspices do not lose out on the market opportunities available. Press releases of such events should also be made freely available to national and international media companies for better coverage of such initiatives. This will then maximize the net effect of this initiative.

2.3. General public

The dissemination of information about spin-off technologies to the general public is also of the utmost importance. This will allow greater support for national and international space activities, and a greater support for the funding thereof. There are several proposals for reaching the general public.

2.3.1. Children

- *Publicity in national educational systems*: Dissemination of knowledge and information about space spin-offs to children is a particularly significant step. First, it allows the outreach program to catch people while they are still young and thus enthusiastic and open to new ideas. Further, this allows the information also to reach their parents through word of mouth. In this regard, publicity about spin-offs in national education systems is useful.
- *Educational curriculum*: The importance of space spin-offs should be emphasized in the existing curricula, e.g. through science and mathematics classes in elementary and high schools.

2.3.2. Youth

- *'Trendy' approach*: For youth it is suggested that a disparate approach should be taken. We propose what we term a 'trendy' approach: the marketing of space spin-off products as a 'cool'.
- *Viral approach (word of mouth)*: A viral approach should be taken, where the information on spin-offs is spread by word of mouth or example.
- *Games*: Games and other virtual media can be used for the dissemination of space spin-off data profiles by creating a game for design and simulation.

2.3.3. Space enthusiasts

- *Spin-off news*: Space enthusiasts constitute a specialized group of people who are already interested in outer space and space spin-offs. For this group, it is proposed that news of spin-offs should be promoted, perhaps as a section in general e-magazines of space interest.
- *Astronomical events*: Astronomical events such as eclipses should be used to combine astronomical outreach with space spin-off publicity.

2.3.4. All groups

- *Press release commercials*: It is submitted that, for the general public, the popular media would be an important ally in disseminating knowledge and information about space spin-offs. Press releases could be composed for the news media.
- *Endorsement of public figures*: Public figures or celebrities can be invited to endorse certain space spin-off products.
- *Science-fiction movies*: Education about spin-offs can be made through science-fiction or action movies.
- *'Made through Space' logo*: It is proposed that a 'Made through Space' logo should be imprinted on space spin-off technologies and products to indicate its origin to the general public.
- *Spin-off corners*: There should be booths and corners about space spin-offs at space venues such as Space Park Bremen, for greater outreach to the general public.
- *Interactive online discussion groups*: These could include classrooms of people watching a live internet feed, or a sequence of discussions with universal translation for better communication.

3. Improving the use of spin-offs

There are many examples of ideas on how to utilize space technology in ways for which it was not originally intended to benefit people in everyday life. How these ideas arise and the path from an idea to a commercially viable product is not clear, however. The purpose here is therefore to establish ways to formalize this process, making the development of spin-off space applications a commercially viable, timely and routine activity.

The challenge is twofold. The first problem is identifying more such ideas and understanding how to identify these ideas more easily. The second, and probably more important challenge is ensuring that these ideas are more readily and rapidly taken on board commercially, so that they see application sooner and are more widely available to the community. Finally, some examples are given.

3.1. Generating spin-offs ideas

One of the most important factors in the generation of new ideas from space activities is to take an interdisciplinary and multicultural approach. It is well known that most new ideas come from the boundaries between different areas. As systems become more complex, people have a tendency to become more specialized in their expertise. So there needs to be an emphasis on education in multi-disciplinary areas (mechatronics and double degrees are now popular) and on bringing together people from different backgrounds with similar interests. What is

required for young people to make a significant contribution, is as follows:

- specific funding for young people to apply ideas from space technology to Earth applications—start-up funding scheme,
- a business plan competition specifically for space spin-off technologies,
- interdisciplinary meetings to bring together people from diverse backgrounds (engineering, commercial, legal, design, marketing) with a social setting but outcome focused,
- employment of a facilitator specifically to inform people in industry about new technologies, including an online bulletin about new patents for space spin-offs,
- changing the attitudes of young people in academia to increase their focus on commercialization and their interaction and networking with industry.

3.2. Realizing spin-offs ideas

The second part of the challenge—how to ensure that these ideas are taken on more rapidly and readily in a commercial context—is relatively straightforward if viewed from a business or entrepreneurship perspective. The process of evaluating a new idea for market viability, whether it be a spin-off of a space technology or otherwise, is not, as commonly believed by many scientists, engineers or other technical experts, a piece of magic. The process is a relatively straightforward one that needs to be embedded in the education or professional development of those technical experts who are typically responsible for the generation of the ideas. The systematic and objective evaluation of an idea in terms of factors such as its market interest, potential competition, degree of completion and various other factors can be completed rapidly for a large number of ideas.

Young people need to be very closely involved in the development of spin-off ideas for several reasons. First, because of their personal bias and self-interest. Second, because young people are often more creative and less constrained in their investigation ideas and are therefore free to identify new spin-off opportunities. Third, because young people are generally more closely involved in ongoing research. This knowledge of the most current research and technology developments will feed into the identification of new spin-off activities. On this basis, the authors make the following recommendations for encouraging young people rapidly and readily to take space technologies into other areas.

- A small facilitation team should be developed to identify a range of the current research and technology in space applications.
- A facilitation group should convene a forum of young people from diverse backgrounds to discuss these ideas and try to identify spin-offs.

- The forum of young people would be separated into smaller groups centered on an idea that they have developed and thus now have ownership of. Each group would develop a sound business plan around their idea. Entrepreneurship workshops would be conducted to educate the groups in the principles of assessing an idea for viability and bringing it to fruition. These workshops could be held before or after major aerospace conferences.
- A competition should be held to assess the various business plans developed by the groups. The best ideas would be awarded seed funding to: (1) develop a prototype to demonstrate the idea, (2) develop a business plan based on the recommendations of the facilitators, (3) develop promotional material, and (4) take idea to incubators, venture capitalists or candidate companies.

Who would make up the facilitator group is an important question. There are a number of options that may be viable. For instance, the facilitator could be the International Space University (ISU), which has all the appropriate resources and personnel. Such a program could be financed by a grant from industry or a space agency and by a participant's fee. The facilitator could also be a group of dedicated people with the appropriate mix of expertise, ideally composed of people from a range of backgrounds with differing levels of experience and with diverse networks. Another alternative, which would be highly desirable, is for a new or existing company to take on the role of facilitator, to provide the funding for the business plan competition and to share the profits of the idea with the group members.

3.3. Spin-offs applications

Human spaceflight is an area where the potential for spin-off ideas to be generated is particularly high. In the following, a number of exciting prospects for spin-off applications are presented. These ideas give a brief indication of the types of possibilities that exist, further development of which could see their widespread application.

3.3.1. Telemedicine (human spaceflight)

NASA has demonstrated that an astronaut with no medical background could be trained in 2 h to obtain adequate ultrasound imaging with remote guidance [1]. This protocol could be used to train non-experts in remote sites to utilize portable ultrasound for trauma and airway assessment. However, there are limited opportunities for transferring this protocol to terrestrial clinical settings.

Recommendation: Create specific funding mechanisms in order to facilitate the transfer of telemedicine protocols for medical care in remote terrestrial sites.



Fig. 2. Bed-rest study (ESA).

3.3.2. Immobilization countermeasures (human spaceflight)

Long-term immobilized patient populations (e.g. paraplegics) are practical terrestrial models for space biomedical research, since they experience similar physiological changes to the ones experienced by astronauts in long-duration spaceflight as a result of being confined to prolonged bed rest, as shown in Fig. 2. This population represents a significantly larger sample size than the research populations currently being evaluated at long-term bed rest study facilities. The added benefit of conducting research on this population is the concurrent evaluation of the efficacy of innovative space countermeasures for prolonged immobilization on Earth.

Recommendation: Approach the long-term immobilized patient populations to participate (under ethically approved conditions) in appropriate research studies on countermeasures for long duration spaceflight. Request support from funding programs for terrestrial and space medicine programs since space countermeasure research could benefit both populations.

3.3.3. Remote sensing (earth observation systems)

One underutilized application of remote sensing is for public health. Remote sensing offers significant advantages in monitoring diseases that are influenced by environmental factors (e.g. vector-borne diseases) [2].

Recommendation: Increase the use of remote sensing for public health by providing free or low-cost processed images for disease surveillance to developing countries.

3.3.4. GIS programs (global positioning systems)

Geographic information systems (GIS) applications are highly useful programs for monitoring, tracking, studying and controlling diseases. An example is shown in Fig. 3 [3]. GPS could provide geo-referencing data for GIS programs for health applications [4].

Recommendation: Provide low-cost and rugged GPS devices to field health workers who are collecting data in remote and unmapped areas.

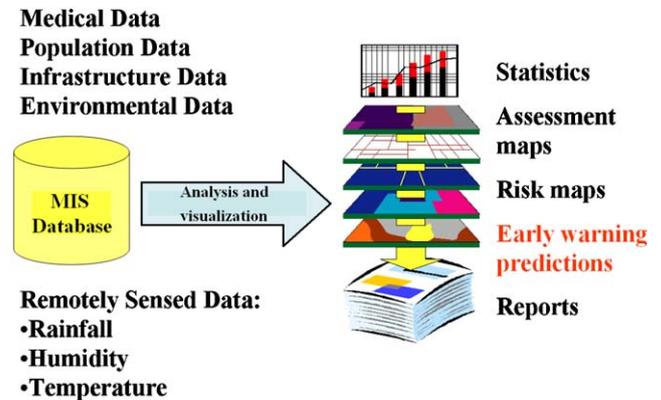


Fig. 3. HI-STAR's Malaria information system.

4. Conclusion

Space spin-off technologies contribute significantly to non-space applications and industries. Information sharing about spin-offs is important because it helps to promote awareness about the indirect benefits of space activities in our everyday lives. Closely tied to this is the need to directly improve the generation and take-up of ideas for spin-offs from space.

This article has proposed several methods to improve the sharing of spin-off information among policy makers, industry and the general public. Such methods will increase public support for space missions and activities. Furthermore, the results of this study show that there is much more potential for the use of spin-offs from space activities than the myth of the Teflon pan suggests.

However, the barrier to realization of the ideas and strategies discussed in this paper is that space agencies are not—or cannot be—totally ‘customer oriented’ where government’s, industry’s and the general public’s needs are concerned. Spin-offs are a positive side effect of space activities, rather than the main objective of space agencies.

As a next step, it is recommended that a ‘joint working group’ with representatives from industry, government and the general public—beside the space agencies—be started. Its purpose would be both to understand the customer needs of these groups and, related to this, to comprehend the limitations of space agencies in satisfying these needs. Once there is a detailed analysis, the ideas and strategies to change the current situation can be implemented.

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