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Report

Capacity building in space technology development: A new initiative within the United Nations programme on space applications

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ABSTRACT

Since 1971 the UN Programme on Space Applications, implemented by the Office for Outer Space Affairs, has been organizing workshops, symposiums and expert meetings and providing training opportunities in the practical applications of space technology. In 2009 the Office launched the Basic Space Technology Initiative (BSTI). The BSTI encompasses a range of activities in support of capacity building in space technology development in response to the growing interest of academic and governmental organizations in many countries to establish basic, indigenous capabilities to develop nano- and small satellites. Considerations such as the education and training of experts, the creation of required testing and building infrastructure, opportunities for international cooperation and the applicable legal and regulatory frameworks are therefore of particular interest to these organizations. The BSTI aims to assist them with their efforts. This paper describes the origins of the initiative, the activities that have been conducted to date and the work planned for 2011 and beyond.

1. Introduction

As a result of discussions at the first United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE), held in Vienna in 1968, the UN launched a Programme on Space Applications [1]. This provides support for capacity building related to the use of space technology and its applications to all member states of the UN, independent of their economic development. The programme is implemented by the United Nations Office for Outer Space Affairs (OOSA) in Vienna [2,3]. Initially focusing on the applications of space technology, such as satellite communications, Earth observations and positioning and navigation services, the programme has subsequently been complemented by activities in the space science field through the launch of the Basic Space Science Initiative (BSSI) [4].

Starting from the mid 1980s the international space community has been increasingly interested in micro and small satellites that can be developed by small teams in university-like environments, and in the opportunities they offer for countries with limited space budgets to engage in space technology development activities. In response to this development the Programme on Space Applications organized several events related to micro and small satellites [5–7]. A background paper on small-satellite missions was prepared for the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III), held in Vienna in July 1999 [8]. Within the framework of the Technical Forum of UNISPACE III the UN, in cooperation with the International Academy of Astronautics (IAA), held a workshop on small satellites at the service of developing countries [9,10]. As a result of this workshop, OOSA and IAA have since 2000 organized workshop sessions on the theme of small satellites at the service of developing countries as part of the annual International Astronautical Congress (IAC).

The operationalization of space applications further accelerated in the years following UNISPACE III and, with the barriers to accessing space applications, being lowered, countries that had previously only been users of space applications or that did not have the resources required in the past to engage in space technology development activities, are now increasingly interested in mastering these underlying technologies. The definition and successful promulgation of simple standards for nano- and small-satellite platforms, such as the CubeSat standard, and the miniaturization of consumer-electronic components that are replacing more costly and sometimes less capable space-qualified components, have contributed to this trend as they have resulted in a reduction of the overall cost of space technology development. Satellite development is now also in the realm of countries and organizations that in the past have been excluded from such activities because of their limited budgets for space activities.

In response to this growing interest in nano- and small-satellite platforms and in line with the mandates given to it by its member

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states, in 2009 OOSA launched the Basic Space Technology Initiative (BSTI) [11–13]. BSTI encompasses a range of activities in support of capacity building in space technology development.

2. Basic space technology initiative

The BSTI's overall mission is to enhance access to and use of space applications in support of policy and decision making for sustainable development by building capacity in basic space technology development. In pursuing this goal, the initiative has the following underlying objectives:

- To respond, under the framework of the United Nations Programme on Space Applications, to the interest in many countries to establish indigenous capacities in basic space technology development.
- To address the growing role of nano- and small satellites for education, basic space science and for operational applications.
- To assist countries with their efforts to ensure compliance with the relevant legal and regulatory frameworks and promote the use of appropriate standards where applicable.
- To promote international cooperation and information exchange in capacity building in basic space technology.

As mentioned earlier, a particular focus of BSTI's capacity-building activities is related to the development and operation of nano- and small satellites. The potential benefits that can be derived from the implementation of programmes dedicated to the development of these satellites can go beyond the benefits of the actual applications enabled by them in the following ways [10,14]:

- The conceptual design, detailed development, manufacturing, launch and operation of a small satellite can be conducted within a time frame that is much shorter than the usual programme or project duration involving larger-sized satellite platforms. Nanosatellites have gone from conceptual design to launch in periods of as little as six months. Such projects are extremely flexible and allow graduate students to follow a satellite project from its conceptualization through to its operational phase.
- Nano- and small-satellite programmes open the door for developing countries with limited space budgets to participate in space activities, enabling them to establish basic capacities for the development of space technology tailored to their specific needs and objectives. The necessary investment required for the infrastructure and for the development of the actual hardware is relatively modest and – as has been demonstrated in many cases – affordable for organizational units such as university institutes.
- System engineers, mission designers, industrial engineers and programme and project management specialists can be trained and educated in methods of space mission design. The skills of these experts are easily transferable and required by many other industries, thus benefiting industrial sectors other than the aerospace sector.
- Technical capabilities can be acquired in the areas of miniaturization, microelectronics and micro-manufacturing, with potential spin-offs for other industrial sectors such as the medical, consumer electronics, robotics and entertainment sectors.
- The services and technologies developed for nano- and small-satellite programmes create opportunities for the establishment of commercial businesses. There are several examples of space technology companies being established as a result of experience gained in nano- and small-satellite programmes, including in developing countries. Nano- and small satellites are becoming tools for commerce, as their capabilities have increased and their cost has been reduced, yielding a return on investment. This is significant in so far as it may motivate countries to subsidize the development of space technology and encourage the establishment of companies that could support a local high technology industry.
- Nano- and small-satellite programmes create new opportunities for international space cooperation. For cooperation to be equal and fully beneficial to all parties, each partner has to offer capabilities and knowledge of interest to the others. Thanks to their comparatively fast technology innovation cycles, nano- and small-satellite programmes offer a relatively level playing field for both new entrants and established players. While it could take years or even decades to establish the capabilities required for developing larger satellites, new players can catch up relatively quickly with the developments in the field of nano- and small satellites. The experiences gained and lessons learned in the development of such satellites are in many cases also directly applicable to the development of larger craft. This is also the case with the infrastructures required for the development of small satellites, which can often be adapted or upgraded for the purpose of developing larger satellites.
- Nano- and small-satellite programmes provide a reference frame to generate short-, mid- and long-term plans and perspectives for space technology development and serve as a stepping stone to enhance a country's space capacity. They are also ideally suited as a starting point for bringing together a country's academic, administrative and industrial sectors and for making use of their synergies in defining and implementing the initial phases of a space programme and a national space policy.
- Space technology development activities demonstrate the benefits of space technology, while its applications, focus the attention of government and industry and serve to rally and encourage the people uniting behind a programme and project.
- Benefits can be derived from the actual operational use of nano- and small satellites in many fields, as well as in space science and research and technology development.

3. BSTI work programme

The BSTI work programme has been developed in close consultation with space technology development experts from around the world. It is based on five pillars or core activities that provide enough flexibility to adapt and modify the programme, should the need arise. The five core activities are discussed below.

3.1. Basic activities

BSTI organizes a series of UN workshops and symposiums on basic space technology, including a series of three UN–Austria–ESA symposiums on small-satellite programmes for sustainable development [15–17]. The first two symposiums in the series were used as an opportunity to discuss the objectives and workplan of the BSTI with participating space experts from all over the world and to define the future activities to be conducted as part of the initiative. The third and final symposium, held in 2011, focused on the managerial, legal and regulatory issues of small-satellite programmes.

A website dedicated to the initiative has been created and a mailing list to disseminate relevant information been set up [13]. BSTI aims to provide nano- and small-satellite developers with assistance with respect to relevant legal and regulatory matters, such as the registration of satellites with the UN and the voluntary