Vietnam roadmap to master satellite technology

Anh Tuan Pham*

Director General of Vietnam National Satellite Center, Vietnam Academy of Science and Technology

Received 10 November 2016; accepted 3 February 2017

Abstract:

Vietnam has spent a considerable amount of money to install a satellite exploration program. This article presents the most important achievements of the implementation of this program in Vietnam and gives recommendations for supportive policies that will allow for the development of space exploration in the future.

Keywords: ***satellite technology, space technology, Vietnam National Satellite Center.***

Classification number: ***2.3***

Introduction

Space technology is considered by many as one of the key symbols of a country's technological power and competitiveness in advancing technologies, and acts as an important motivator for the development of further science and technology in a country. That is to say, space technology is the culmination of many different technologies with an ultimate goal of benefitting the economy and boosting the development of other technologies. As a developing country, Vietnam can certainly benefit from space exploration technology - both the economy and society would benefit through science and technology advancing activities that lead to programs that prevent and mitigate the effects of natural disasters and climate change; manage and grow natural resources, especially marine resources; develop agriculture; configure telecommunications and television infrastructures via satellites; and navigation applications of satellites. Moreover, through space exploration technology, a country can not only secure protection of the territory, the territorial waters, and the territorial airspace, but also protection of the national outer space achievements.

Policy of satellite technology development in Vietnam

With an understanding of the importance of space technology in the development of Vietnam, the government, in 2006, approved the "Strategy for Research and Application of Space Technology until 2020" [1] consisting of some major standpoints, which are:

- To widely popularize knowledge about aerospace technology through mass media, especially among pupils and students; to organize programs and textbooks for graduate and postgraduate subjects on aerospace technology; to formulate and apply on a trial basis, a mechanism for the recruitment, training, and use of talented professionals at home and abroad in association for research and market development; to send talented people to developed countries for training in aerospace technology funded by the state budget, so as to meet immediate demands and achieve the strategy's objectives; and to update achievements and retrain Vietnamese specialists on aerospace technology with cooperation from foreign countries.

- To continue participating in aerospace technology activities organized by the United Nations (UN) agencies, such as OOSA (Office for Outer Space Affairs), UN-ESCAP, UNESCO, etc., or by organizations in the ASEAN community; to consider and conclude projects on aerospace technology R&D with some countries which have favorable conditions.

- To build partner with countries that have compatible needs and offerings, especially those in Southeast Asia and Asia-Pacific. To research and form bilateral and multilateral agreements to support building and exploitation of infrastructures (ground stations, communication systems, and remote sensing satellites) and share remote sensing databases, especially in the warning of natural calamities and management of the environment.

- To create favorable conditions for overseas Vietnamese aerospace professionals to participate in research, work, and training activities for domestic professional personnel.

It is necessary to mobilize all economic sectors to invest in the implementation of the strategy for aerospace technology research and application. Budget and ODA loan capital shall be invested in the performance of research and testing, construction of key laboratories, overseas personnel training, and other necessary tasks. The State shall create favorable conditions to promote investment, support the results of aerospace technology research and application into

*Email: patuan@vnsc.org.vn

commodities, and introduce them into market.

The primary goal of the "Strategy for Research and Application of Space Technology until 2020" is to bring Vietnam to an above-average level in the region, with of the key objectives set as: constituting and completing the legal policies to support space technology research and application; constructing the space technology infrastructure; studying space exploration science and technology; and applying the resulting space technologies. To promote the actualization of this strategy, the Vietnamese government established Vietnam National Satellite Center (VNSC), operating under Vietnam Academy of Science and Technology (VAST), in 2011, to concentrate on the professional development and synchronization of infrastructure, technology skill, and human resources for satellite technology. After five years, VNSC has achieved the first recognizable steps towards mastering Vietnamese Earth observation small satellite technology.

Infrastructure construction

VNSC, which belongs to the VAST, was established pursuant to Decision No. 1611/QĐ-TTg dated on September 16th, 2011, by the Prime Minister of the Vietnamese government. Over five years, VNSC has been successfully implementing its programs: developing the infrastructure for manufacturing small Earth observation satellites, technological research and development, satellite application, and human resource development for space exploration. A professional investment into the proposed roadmap is set to achieve the target of lifting VNSC to become an organization for the research and application of space technology, that can be comparable in the region, especially in satellite technology following the "Strategy for Research and Application of Space Technology until 2020" approved by the Prime Minister of Vietnam.

Currently as being executed by VNSC, the Vietnam Space Center project, is one of the biggest science and technology projects that has ever been organized and funded by the Vietnamese government and assisted with an ODA loan from Japan. The project focuses on three synchronous parts, which are:

- Constructing the infrastructure and facilities in the center to set the example as the top level in the South East Asia region, to be able to adapt with the rising demands of researching, implementing and applying space technology in Vietnam.

- Transferring technology used to observe Earth, specifically through small satellites using the Synthetic Aperture Radar (SAR) technique, which provides high resolution images and can operate in all weather conditions. These satellites are utilized to prevent and mitigate the influences from natural disaster and climate change.

- Developing human resources and modern technology skills being transferred from Japan, with the goal of being able to construct small earth observation satellites in Vietnam (Fig. 1).

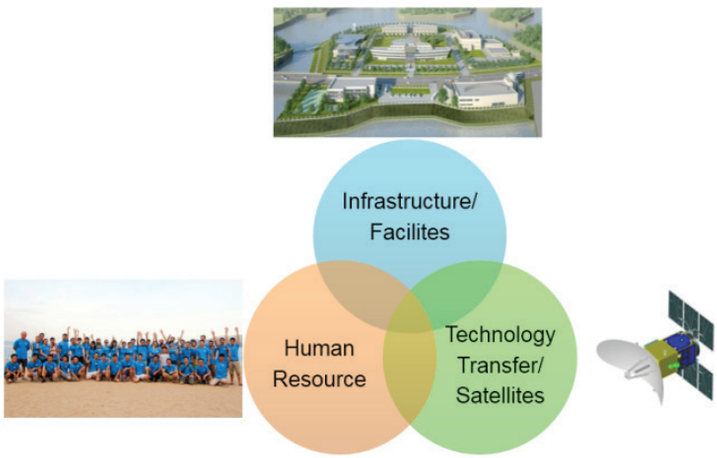

Fig. 1. Three main parts of Vietnam Space Center project.

The Vietnam Space Center, located in Hoa Lac High Tech Park (HHTP) in Hanoi City, will begin operations at the end of 2018, with an infrastructure that supports the design, implementation, integration, and operation of Earth observing small satellites. Besides, VNSC also simultaneously builds other supplements, such as the Space Application Center in Ho Chi Minh City (2019), the Center of Human Resource Development in Space Technology in Hanoi (2016), and the Nha Trang Observatory (2016) (Fig. 2).

Fig. 2. Four headquarters of VNSC.

Gradually master satellite technology

Though VNSC has been established not long ago, its key members and young scientists have been continuously

progressing to master satellite technology. After the success of developing PicoDragon satellites, VNSC has been doing other projects including NanoDragon, MicroDragon, and LOTUSat satellites following the designated satellite development plan (Fig. 3).

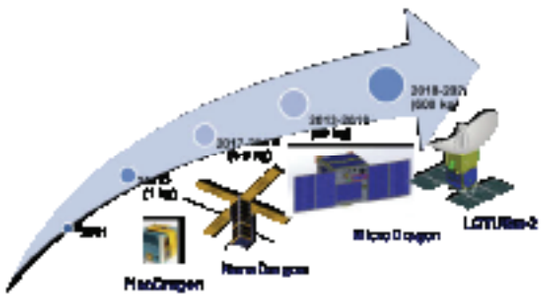

Fig. 3. VNSC's "Made in Vietnam" satellite development plan.

On October 19, 2013, the Pico satellite "Made in Vietnam" named PicoDragon, with a mass of 1 kg and developed by young Vietnamese researchers and engineers from VNSC, was successfully deployed into orbit from the International Space Station (ISS). Afterward, VNSC's ground segment and other ground stations around the world were able to record the signals from the satellite. This was an important milestone showcasing PicoDragon as the first Vietnamese satellite that successfully operated in space. Based on the success of the PicoDragon project, another satellite development project named NanoDragon satellite, was proposed to launch during the three years of 2017 and 2019, with a mass of 4 to 6 kg, and the purpose is to navigate ship locations using the Automatically Identification System (AIS) for ships.

Additionally, VNSC has collaborated with Japanese universities to develop the MicroDragon satellite project [2], a satellite with a mass of 50 kg, in Japan as an essential part of the overall Vietnam Space Center project. Through this collaboration, 36 engineers from VNSC have been sent to five universities in Japan to study masters level space technology courses, whilst simultaneously participating in the designing, manufacturing, and testing of the MicroDragon satellite with instruction from their Japanese professors. As a result from this breakthrough project, Vietnamese engineers not only have opportunities to grasp the basic knowledge about satellite technology, but also have the chance to be involved in the practical implementation of a micro-satellite and gain experience through the satellite development project. The main mission of the MicroDragon satellite is to observe the coastline of Vietnam in order to determine seawater's quality in order to determine the most suitable area for aquaculture. Currently, the satellite is in the design and integration phase, and will be completed in September, 2017 aligned with the schedule. The satellite is expected to be launched into orbit in the beginning of 2018 by the Japanese Epsilon rocket.

Finally, two satellites masses of approximately 600 kg, which employ the modern technique SAR (Synthetic Aperture Radar) in order to provide high resolution images and operate in all weather conditions, the LOTUSat-1&2, will be developed as part of the Vietnam Space Center project. The development plan of LOTUSat-1&2 is divided into 2 phases. To be specific, LOTUSat-1 will be manufactured in Japan with the participation of Vietnamese engineers, and LOTUSat-2 will be implemented and tested by VNSC's engineers at the Satellite Assembly, Integration and Test Department (AIT) in Hoa Lac. The second phase will be the achievement that shows the local development of the Earth observational small satellites from Vietnam. In present-time, the LOTUSat-1 satellite is in progress of contractor selecting and is expected to start manufacturing in the beginning of 2017.

In order to master satellite technology in 2020, simultaneously with the satellite projects, VNSC has deployed other important research and applications via the "National Programs for Earth Observation Satellite Development in Vietnam Until 2020". For example, VNSC proposed and successfully implemented the project of "Research and development of a high accurate attitude determination and control system simulator for Earth observation satellite" and participated in a national level branchy topic about designing, manufacturing and launching rocket models (Fig. 4).

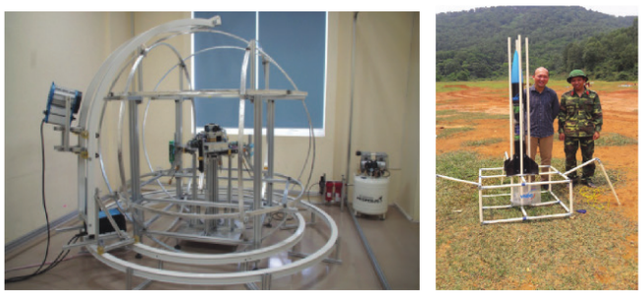

Fig. 4. Outcomes of satellite development researches in VNSC.

Concurrently with the process of moving forward to master satellite technology, the investment in the application of satellite technology is carefully focused. The goal is to bring the application and the benefit from satellites to help boost the development of the country through practical contributions: forest and agriculture management, climate change and environment analysis, natural disaster prevention and mitigation, and marine economics development. As indicated on the plan, there will be 32 officials from VNSC, appointed to participate in the educational program about satellite imagery application and satellite operation of the LOTUSat satellites, starting in 2017.

On the other hand, VNSC has actively encouraged activities and fundamental research of space science and astrophysics. An excellent research team, which includes researchers who hold doctoral degrees and is led and consulted by Prof. Pierre

Darriulat, has been developed. In the upcoming time, VNSC will continue activating the observatories in Nha Trang and Hoa Lac with the modern equipment from Vietnam Space Center, aiming to strengthen the activities of space science researching.

Human resource development and International collaboration

In the short term, with the aim of being able to train young researchers in space technology, in 2012, VNSC and the University of Science and Technology of Hanoi (USTH) signed an MOU to develop a space technology bachelor, master, and doctoral program for students. In 2013, VNSC and the University of Engineering and Technology - The Vietnam National University in Hanoi, signed the collaboration agreement, supporting the training of bachelor students specialized in space technology. In 2015, VNSC also collaborated with the International University - The Vietnam National University in Ho Chi Minh City, in an educational program for human resource in Space Science and Technology, and support internship environment to students. Besides, VNSC has signed the Memorandum of Understanding with five universities in Japan (the University of Tokyo, Tohoku University, Hokkaido University, Keio University, and Kyushu Institute of Technology) followed by the trainings for 36 VNSC's master degree students for the Vietnam Space Center project.

Considering Vietnamese society, education is an absolutely essential element in the dissemination of space technology to the population. In 2013, the Asia Pacific CanSat contest was organized for the first time in Hanoi by VNSC. The contest attracted many students with electronic engineering backgrounds from both Vietnam and Japan. In 2016, within the events to celebrate the fifth year anniversary of VNSC, a CanSat competition "Hanoi, beauty from the air" was launched to create a new, innovative approach, a new space for Vietnamese youth in studying about satellite technology, as well as to arouse the unlimited creativeness of the young engineers focused on a huge applicability of this technology sector in life. Furthermore, VNSC organizes an annual "Space Day" festival to promote space technology and youth application. Activities were especially held at the Space museum in Hoa Lac High-Tech park, along with the Planetariums under the Vietnam Space Center project, will be put into service at the end of 2017 to universalize the knowledge and to evoke and develop the passion of the youth, the pupils and the students about space technology (Fig. 5).

Regarding international collaboration, VNSC has actively participated in international cooperation activities with NASA (The United States), JAXA (Japan), ESA (Europe), CNES (France), KARI (Korea). Moreover, being authorized by VAST, VNSC has become involved and is now an official member of several space organizations, including the International Astronautical Federation - IAF (since 2012), the Committee on Earth Observation Satellites - CEOS (since 2012), the

Fig. 5. CanSat teams 2016.

Group of Earth Observations - GEO (since 2014), the Asia-Pacific Regional Space Agency Forum - APRSAF. These collaborations have contributed in ranking up Vietnam on the world space technology map.

After five years of operation, with many inclusive, synchronized and active solutions, starting with 31 members at the beginning, VNSC has developed a robust team with the total number of 125 members including 13 PhDs, 47 masters, and with 87% of members under 40-year-old. Investing in the modern, synchronistic infrastructure, through the Vietnam Space Center project, in 2020, VNSC is striving to become a modern center of science and technology for the nation, specifically: possesses the space technology infrastructure which is on top in the South East Asia region; masters technology in order to be able to manufacture "made in Vietnam" earth observation satellites; up to 300 young researchers and staffs who are professionally well educated both inside the country or abroad. This will ensure the high quality human resource, which is fundamental to space technology development in the future.

In the near future, two SAR satellites under the Vietnam Space Center project are expected to ensure that the whole territory of Vietnam and the region around its coastal line are carefully observed throughout various weather conditions with high resolution images showing occurrences. The earth observation satellites and the infrastructure, the facilities, the equipment on the ground segment shall contribute in: decreasing 10% of the damage influence Vietnam from natural disasters and climate change, seemingly equal to 0.15% of the annual GDP of Vietnam (approximate 200 mil. USD); supporting to marine rescue activities as well as marine resource economics developing; participating in protecting the society - economy benefit, marine and space environments.

Based on the adaptive convergent investment and the adequate attention from the Government, as well as the orientation and support from VAST, VNSC is believed to complete the aligned plans, involve in achieving the target of the "Strategy for Research and Application of Space Technology until 2020".

REFERENCES

[1] Decision No. 137/2006/QD-TTg of the Prime Minister on approving the strategy for research and application of cosmopolitan space by 2020.

[2] https://vnsc.org.vn/en/projects/vnsc-training-project-in-japan/.