SPECIAL ARTICLE

China and Thailand Partnership in Center for Geo-informatics

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Abstract

China and Thailand have a long outstanding high-level diplomacy relationship in science and technology. In 2007, Her Royal Highness Thai Princess Maha Chakri Sirindhorn presided over the opening ceremony for the joint "Sirindhorn International Center for Geo-informatics" at Wuhan University. Additionally, Wuhan University and Ministry of Science and Technology of Thailand signed a Memorandum of Understanding, launching cooperation on the establishment of the joint "Sirindhorn International Center for Geo-informatics" in Thailand. The State Key Lab of Information Engineering in Surveying, Mapping and Remote Sensing of Wuhan University of China and Geo-Informatics and Space Technology Development Agency of Thailand were responsible for implementing the Memorandum of Understanding. In March 2015, a significant event took place in the presence of Her Royal Highness Thai Princess Maha Chakri Sirindhorn and two countries high-level officials in the opening ceremony for the joint "Sirindhorn International Center for Geo-informatics" in Thailand. The cooperation between the two countries further expanded in 2017 when Wuhan University, Burapha University of Thailand, and Geo-Informatics and Space Technology Development Agency signed a Memorandum of Understanding on "Sirindhorn International Center for Geo-informatics" Master Program. The highlight of the program is the scholarship program for Thais and international students from Southeast Asia, who wish to pursue doctoral research in the field of surveying and mapping in China. Moreover, China and Thailand agreed to organize Sirindhorn Conferences on Geo-Informatics jointly. Wuhan University and Geo-Informatics and Space Technology Development Agency have

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successfully held three Sirindhorn Conferences on Geo-Informatics. The latest conference was attended by more than 70 participants from 20 organizations in 10 countries. Nowadays, the joint “Sirindhorn International Center for Geo-informatics” has continuously succeeded in forming the fundamental collaboration between researchers in both countries. Numerous exchange research projects led to the positive satisfactory development of bilateral trade and investment between China and ASEAN countries.

Keyword: The Joint Sirindhorn International Center for Geo-informatics; Wuhan University; Thailand

I. Introduction

Science and technology cooperation between the governments of China and Thailand began in 1978. Both countries signed an intergovernmental agreement and established a joint committee on scientific and technological cooperation. In addition, high-level officials are bonded between China and Thailand. Her Royal Highness Princess Maha Chakri Sirindhorn, the Princess of Thailand, was the first Thai royal family to visit China. Her Royal Highness Princess Maha Chakri Sirindhorn is the third child of the former King Bhumibol and Queen Sirikit. Her title at birth was Her Royal Highness Princess Sirindhorn. Princess Sirindhorn has been awarded the Chinese Friendship Medal and visited China more than 50 times, facilitating deeper mutual understanding between the two countries. The princess first visited Wuhan University in 2007 and presided over the opening ceremony for the joint "Sirindhorn International Center for Geo-informatics" (hereinafter "SCGI"). She substantiated a Memorandum of Understanding signing between Wuhan University and Ministry of Science and Technology of Thailand, launching cooperation on the establishment of SCGI in Thailand. In 2012, SCGI was developed and integrated into the broader-based Collaborative Innovation Center on Geomatics of Wuhan University. In 2013, the princess paid her second visit and presided over the inauguration of the new site for SCGI at Wuhan University. On 9 April 2013, Her Royal Highness Thai Princess Maha Chakri Sirindhorn paid her second visit to Wuhan University and attended the inauguration of the new site for the joint Sirindhorn International Center for Geo-Informatics. Her Royal Highness Princess Maha Chakri Sirindhorn stated her opinion about SCGI during the inauguration ceremony. She praised China and Thailand for jointly carrying out outstanding advancement projects in the field of space and remote sensing-related sciences. Moreover, the princess shared a feeling of expectation and desire for SCGI. She hoped SCGI would make great efforts to become a world-class remote sensing research facility. In addition, SCGI would make scientific progress that led to the better use of satellite remote-sensing as an early warning system for climate change and natural disasters. Since 2013 China and Thailand have not only formulated purely academic cooperation but also started to business collaborate on space-related activities such as Global

Navigation Satellite System (hereinafter “GNSS”). Thailand is the first BeiDou Navigation Satellite System (hereinafter “BDS”) overseas client. In 2013, Geo-Informatics and Space Technology Development Agency (hereinafter “GISTDA”) of Thailand, The State Key Lab of Information Engineering in Surveying, Mapping and Remote Sensing of Wuhan University (hereinafter “LIESMARS”), and Wuhan Optics Valley BeiDou Holding Group Co., Ltd. signed an agreement to promote BDS services. That same year, two countries were joined to construct the facility for BDS in Thailand. The first tranche of three Continuously Operating Reference Stations (hereinafter “CORS”) was installed at GISTDA’s Space Krenovation Park (hereinafter “SKP”) and the surrounding area. Additionally, GISTDA also signed a Memorandum of Understanding with Wuhan Information Technology Outsourcing Service and Research Center. This Memorandum of Understanding has led to a collaboration between Thai space enterprises, initiated by GISTDA, and Geo-Spatial Information Technology Co., Ltd. In 2014, GISTDA and Geo-Spatial Information Technology Co., Ltd. signed a Memorandum of Understanding, launching a project on the feasibility study and business model for application of BDS in Thailand. The project drew the attention of various space firms in Thailand and trod the way for the development and production of BDS receivers in Southeast Asia. Based on China and Thailand's fundamental efforts to promote BDS, China has reached an agreement with Lao People's Democratic Republic, Brunei Darussalam and Cambodia to provide BDS-equipped infrastructure for government and military users in these countries.

II. SCGI

Since SCGI was established at Wuhan University in 2007, LIESMARS and GISTDA have formed solid top-brass governing bodies. SCGI sets four levels of administration units: Steering Committees (hereinafter “SC”), Board of Directors (hereinafter “BOD”), Scientific Advisory Committee (hereinafter “SAC”), and Working Executive Team. Her Royal Highness Princess Maha Chakri Sirindhorn is the honorary chairperson of SC. The co-chairpersons of SC comprise of Permanent Secretariat of the Ministry of Higher Education, Science, Research and Innovation of Thailand and President of Wuhan University. SC Members consist

of Chairman of GISTDA Executive Board, President of National Science and Technology Development Agency (hereinafter "NSTDA") of Thailand, Chairman of Academic Committee of Wuhan University, and Vice President of Wuhan University. SC secretariat includes Director of GISTDA and Director of LIESMARS. The SC Meeting is held once every two years. BOD is chaired by Director of LIESMARS and co-chaired by Director of GISTDA. BOD members include four members from each party. The Secretariat of BOD is to be appointed by Chairman. The BOD Meeting is held once every year alternatively in China and Thailand. Over the last 18 years, SCGI has carried out numerous activities under the guidance of SC and BOD. The highlight of the latest BOD meeting was a successful multilateral discussion on SCGI Master Double Program, BeiDou Natural Disaster Monitoring and Early Warning Technology Development and Application Demonstration, and Research and Development on GNSS. Achievements of the latest BOD meeting are derived from past collaboration relationships. LIESMARS and GISTDA have laid down countless work plans for SCGI. Both countries never stop exchanging resources and equipment. The 12th BOD was scheduled in 2024, to review the prospect activities of the joint centers among discussion of the committee from Thai side and Wuhan University. For example, GISTDA offered Thailand Earth Observation System (hereinafter "THEOS") Terminal for Wuhan University. On the other hand, China proposed a joint research project on spatial information shared service platforms, etc. There are academic exchanges, for instance, China provided Ph.D. scholarships for Thais to study at Wuhan University as well as arranged approximately 30 training programs such as the training course on spatial statistics, the training course on Synthetic Aperture Radar/ Interferometric Synthetic Aperture Radar, and training course on Power Network and PANDA Software for the management and processing of CORS. Wuhan University installed 2 CORSs at SKP of GISTDA in Thailand in 2015. During 2015 -2016, Wuhan University provided training workshops on Power Network Software, and hands-on training on Position And Navigation Data Analyst (PANDA) Software for GISTDA and Thai government officials. The key success of these exchanges between the two sides has shed light on further collaborative projects on implementing BDS in Thailand. But most importantly, the most significant relationship took place in the presence of Her

Royal Highness Thai Princess Maha Chakri Sirindhorn and two countries' high-level officials in the opening ceremony for SCGI at GISTDA's Space Krenovation Park in Thailand in March 2015, and the signed Memorandum of Understanding on SCGI Master Program in April 2017.

III. SCGI Master Program

In 2015, Her Royal Highness Thai Princess Maha Chakri Sirindhorn presided over the opening ceremony for SCGI in Thailand. In 2017, two years after SCGI was settled in Thailand, Wuhan University, Burapa University (hereinafter "BUU") of Thailand, and GISTDA signed a Memorandum of Understanding on SCGI Master Program. Under the Memorandum of Understanding, Wuhan University, BUU, and GISTDA agreed to cooperate on offering a Double Master Degree on Geo-Informatics and Space Technology under the supervision of SCGI to be held in Thailand. This Master Program offers two years of study in Master of Science Program in Geo-informatics. It provides an opportunity to study Remote Sensing, GNSS, Photogrammetry, Geographic Information System (hereinafter "GIS") as well as New Technology and Innovation such as Unmanned Areial Vehicle (hereinafter "UAV"), Environmental Model and Geospatial Big Data, etc. Students, who apply to this international program, will study in Thailand in their first year and study in China in their second year. The highlight of the program is the scholarships for Thais and international students from Southeast Asia, who wish to pursue doctoral research in the field of surveying and mapping in China. Graduate students who wish to pursue a career in academia can explore an opportunity to continue the world-class Ph.D. program in LIESMARS at Wuhan University. Additionally, SAC was set up in the same year. SAC has duties to provide technical and academic consultants to BOD and SC of SCGI. The first batch of SCGI Master Program students began in 2018. Since its start, the program has served a lot of Thais and international students in Southeast Asia. There are more than a hundred students applied to the program so far. It also secured Ph.D. scholarships for students from Cambodia. Achievements of the SCGI Master Program are derived from GISTDA's outreach programs such as ASEAN Research and Training Center

for Space Technology and Applications (hereinafter “ARTSA”). The concept of ARTSA is built upon GISTDA and SCGI’s objectives; (1) provide services in education and training, as well as awareness raising in Space and Geo-informatics, and (2) carry out research and innovations, as well as develop relationships in areas related to Space and Geo-Informatics for regional and worldwide. In 2016, GISTDA succeeded in establishing ARTSA under support from Sub-Committee on Space Technology and Applications (hereinafter “SCOSA”) and Committee on Science Technology and Innovation (hereinafter “COSTI”) of the Association of Southeast Asian Nations (hereinafter “ASEAN”). Since its establishment, ARTSA has successfully held more than a hundred capacity-building activities, under cooperation with international organizations such as United Nations Satellite Centre (hereinafter “UNOSAT”), United Nations Institute for Training and Research (hereinafter “UNITAR”), Asia-Pacific Space Cooperation Organization (hereinafter APSCO), etc., to improve personnel capacity on space technology and geo-informatics for ASEAN Member States. ARTSA was established by GISTDA to increase personnel capacity and strengthen a network of research collaboration on space technology and geo-informatics in Southeast Asia. Besides ARTSA has partnered up with global institutes and agencies such as United Nations' Economic and Social Commission for Asia and the Pacific (hereinafter “UNESCAP”) National Aeronautics and Space Administration (hereinafter “NASA”) of the United States, Japan Aerospace Exploration Agency (hereinafter “JAXA”), International Institute for Geo-Information Science and Earth Observation (hereinafter “ITC”) of Netherlands ‘University of Twente, etc. Key achievements from collaboration between GISTDA and those institutes and agencies came in the form of sponsorship for ASEAN research and innovation development. In addition, ARTSA strengthens the network of space and non-space actors across Southeast Asia. Besides providing knowledge-sharing services, ARTSA has co-organized international conferences and has offered joint research projects in space technology and geo-informatics. In the past few years, GISTDA and international partnerships have launched several funds to support science and innovation collaboration in ASEAN to tackle development challenges such as Climate Change on Agriculture, Food Security, and Regional Landuse/Landcover Management. But most importantly, ARTSA became a large learning hub in

ASEAN space community. Its clients expanded from regional government agencies to universities and private companies such as Department of Technology and Innovation of Lao People's Democratic Republic, Department of Planning and Statistics of Cambodia, Thailand Rice Research Institute, Chulalongkorn University of Thailand, Mandalay Technological University of Myanmar, etc. In 2018, SCGI Master Program was greatly introduced throughout the mentioned ASEAN space community that is being established by ARTSA. In the future, China will bear fruit that was built by SCGI Master Program based on the type of social network each graduate student cultivated. Furthermore, Wuhan University, BUU, and GISTDA were in discussion to initiate SCGI Ph.D. Program after the promising success of several batches of SCGI Master Program students and highly increased numbers of ASEAN participants in the latest Sirindhorn Conferences on Geo-Informatics in 2020.

IV. Sirindhorn Conferences on Geo-Informatics

LIESMARS and GISTDA not only co-developed the SCGI Master Program but two sides co-organized Sirindhorn Conference on Geo-Informatics under the supervision of SCGI. Sirindhorn Conference on Geo-Informatics is an international conference that aims to provide a forum to exchange ideas and experiences on space technology and geo-informatics through applications as well as exchange study cases and practical experiences. The first Sirindhorn Conference on Geo-Informatics was successfully held in 2015 at SKP, in Chonburi Province, Thailand. The second Sirindhorn Conference on Geo-Informatics was successfully held in 2018 at Centara Government Complex Convention Centre in Bangkok, Thailand and the latest Sirindhorn Conference on Geo-Informatics was successfully held in 2020, in the format of online and onsite webinar, at SKP, Chonburi Province, Thailand. Even though the latest conference was held in the format of an online webinar due to the COVID-19 pandemic, the conference was attended by more than 70 participants from 10 countries and 20 organizations. The highlight of the latest conference was the keynote speaker, Professor Chen Ruizhi, currently the Director of LIESMARS who presented on the very interesting topic of “Precise Indoor Positioning for COVID-19 Contact-

Tracing". His session also provided the key lecture on the trend and new technology in geo-informatics along with indications of future directions. Achievements of the Sirindhorn Conference on Geo-Informatics are shown by the increased interest of audiences each time it was held. Additionally, there is an increased amount of further conducted collaborative research projects between China and Thailand. In recent years BDS gained attention from many Thai researchers, and many research projects in the area of GNSS by using BDS in combination with other systems, to test increases in area precision have been carried out in Thailand. There was an attempt by GISTDA's researcher to propose a project on Research and Application Demonstration of Key Technologies for High Precision Seamless Positioning with Smartphones Based on BDS in 2020. In addition, there was cooperation between Thai and Chinese, led by GISTDA and a group of professors at Wuhan University, on using BDS to increase the precision of Precipitable Water Vapor in near real-time in 2017. The outcome of this project could lead to endless collaboration between China and Thailand for precision agriculture businesses such as Weather Monitoring Systems and Forecasting for Agriculture. Weather monitoring and forecasting in agriculture need a combination of accurate data collection, therefore it requires a robust network of weather monitoring stations, including ground-based and satellite-based sensors. There is an opportunity for high-resolution satellite images from the series of Chinese earth observation systems such as Gaofen and Jilin-1 to be used, combined with BDS, to produce survey maps and software for water management or rain prediction development in Thailand (Besides cooperation with Wuhan University, GISTDA has cooperated with various Chinese space technology agencies such as China National Space Administration, China Satellite Navigation Office, Chinese Academy of Science - Institute of Remote Sensing and Digital Earth, China Centre for Resources Satellite Data and Application, Satellite Surveying and Mapping Application Center of National Administration of Surveying Mapping and Geo-information, etc.) Achievements of the cooperation led to the exchange of remote sensing satellite data ground systems and laid a solid foundation for the next step in the commercial space cooperation between the two countries and Southeast Asia. In addition, Kasetsart University of Thailand and China Centre for Resources Satellite Data and Application

successfully established the receiving station and processing system for Huanjing-1A satellite in 2011. Approved by the Thai royal family and government, on July 9, 2011, the ground receiving and processing system was officially named "Princess Chulabhorn Remote Sensing Satellite Ground Station". GISTDA and China Centre for Resources Satellite Data and Application successfully established Thailand node of the China-ASEAN satellite data sharing service platform in 2018. The platform was established for China-Brazil Earth Resources Satellite-04 satellite data sharing so that ASEAN countries can use China's low and medium-resolution remote sensing satellite data. Moreover, GISTDA has a plan to establish Sirindhorn International Academy of Innovation to expand SCGI's innovation partnership in China. Last but not least, BDS commercial business opportunities will arise in Thailand in the next few years. The fact that a huge number of Chinese electric cars have been consumed in Thailand and Southeast Asia, will lead to the development of a surrounding industry such as autopilot intelligent driving systems for high-end electric vehicles (hereinafter "EVs"). China's electric cars have made serious inroads in Southeast Asia in recent years. Around 75 percent of the region's electric vehicle market is made up of Chinese vehicles. The sales of China's Wuling Air electric vehicles increased by 65.2 percent in 2023, becoming the second most purchased electric vehicle brand in Indonesia. Last year, China's BYD remained the best-selling electric vehicle brand in Singapore. So far, however, China's EV companies have had their greatest successes in Thailand, which accounts for the majority of electric vehicle sales in Southeast Asia. At this moment in time, Chinese reshaped Thailand's auto industry, as EVs makers from China brought in their suppliers. China surpassed Japan as Thailand's top foreign investor in 2023, led by BYD's investment, set up a new facility in Thailand that will start producing 150,000 passenger cars per year from 2024, some of which will be exported to Southeast Asia and Europe. If commercial space activity is the bottom line between China and Thailand in the near future, SCGI is the perfect center to start a business proposal to support China's car navigation system. For example, both sides can establish a feasibility study and research project to exchange information on driving test applications as well as carry out BDS driver examination and training system., etc. Presently, GISTDA has successfully established GNSS innovation center at SKP.

Additionally, LIESMARS and GISTDA have cooperated to set up the GNSS Working Group, to act as a permanently organized body of people to push forward joint implementation research projects, and the development of a BDS-based application service ecosystem in Thailand.

V. Conclusion

SCGI are the joint research centers for Geo-informatics that settled in China and Thailand. The first SCGI was established at Wuhan University in 2007, and the second SCGI was established at SKP in 2015. SCGI was established under the intention of Thai Princess Maha Chakri Sirindhorn who presided over the opening ceremony of these joint research centers. Thai Princess intends to enclose relationships and exchange of personal knowledge between China and Thailand, especially in areas where Thailand lacks expertise such as Remote Sensing and Space Technology. Besides Remote Sensing and space technology, as well as infrastructure and services in the space domain such as GNSS and Indoor location-based service. Thailand has sent scientists to join explorations by the Chinese National Antarctic Research Expedition since 2016. This cooperation was one of the initiatives of SCGI. Presently, GISTDA is cooperating with Chinese Antarctic Center of Survey and Mapping of Wuhan University to elaborate further on potential projects that Thai scientists could participate in with China. LIESMARS and GISTDA have been working together to develop a SCGI annual action plan and implemented it from the beginning. On 10 April 2017, Wuhan University, BUU and GISDA signed a Memorandum of Understanding on SCGI Master Program. The program offers study master's degree in Space Technology and Remote Sensing with researchers and experts in Thailand and China. Besides Master Program, the most crucial event was Sirindhorn Conference on Geo-Informatics under the supervision of SCGI. Since it started, the co-organized events between China and Thailand have drawn attention from audiences that are not only students and researchers but also governmental officials from ASEAN countries. Many successes from the joint centers have continuously helped further exchanges between the two countries. For example, Wuhan University installed 2 CORSs at SKP of GISTDA in

Thailand and provided necessary training workshops for GISTDA and Thai government officials. At present, several achievements from the academic collaboration under SCGI between China and Thailand come out in the form of joint implementation research projects, and the development of a BDS-based application service ecosystem in Thailand. It may be said that a lot of BDS constructed and research projects in Thailand would not have been implemented if SCGI had not been established. Moreover, many success stories between China and Thailand in the arena of space and remote sensing-related sciences are derived from Thai Princess Maha Chakri Sirindhorn ‘s intention for SCGI establishment. Thailand is one of the world's luckiest countries because the royal family has strongly supported science diplomacy. Thai Princess Maha Chakri Sirindhorn always puts herself as the special ambassador for her country. She saw through the future that personal relationships are the key to building bridges and enhancing the multilateralism benefits. Nowadays, SCGI does not merely serve educational services, it also resulted in a strengthened personal network between the two countries. And most importantly, the network has been further expanding in Southeast Asia through ARTSA’s programs. The programs include hands-on training, research and development of innovation, and information sharing. SCGI has continuously fostered a group of top-talent students in Geo-informatics for the region. There are so far 35 students from Thailand and other countries graduated from SCGI Master Program (and 16 students are ongoing studying at SCGI). Most importantly, the group of top-talent students will enhance an opportunity for international cooperation between China and ASEAN countries. In the future, LIESMARS and GISTDA are going to shift the paradigm of many collaborative projects to supply commercial purposes. Transformation of SCGI’s strategy would lead to serving Belt and Road Initiative (hereinafter “BRI”) of China. Since 2013 China has been expanding its network of partnerships through BRI. BRI-related outreach has also involved delivering infrastructure and services in the space domain, including in GNSS sector. The so-called Space Silk Road (also known as the BRI Space Information Corridor) plans to connect various parts of the globe with Earth observation, communications and positioning, navigation, and timing (hereinafter “PNT”) services. By promoting BDS, China’s global GNSS system, China is seeking to

embed its space ecosystem in BRI countries, and beyond. To support China's strategy such as BRI, SCGI has not only been collaborating with China but also has leveraged its educational services to project power and influence internationally, especially for the Southeast Asia region. If every China governmental entity is committed to carrying out the wishes of BRI, it can cooperate with LIESMARS and GISTDA (under SCGI) based on its strategic international partnership programs. Through cooperating with SCGI, Chinese stakeholders from different backgrounds and levels will benefit from GISTDA's business matching services across the ASEAN community.

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