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CHINA'S SPACE PROGRAMME - BORN OUT OF NATIONAL NEEDS, POISED TO SUPPORT GLOBAL PROGRESS

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Abstract: The 21st century is believed to become the Asian century. In the last decade China has introduced several economic and political initiatives which promote its rise as a global power. Embedded in its development and rise is the national space programme. Western observers tend to look at China's space programme as being small, slow, technologically less advanced, and not significant enough. Is that correctly reflected or what is it then? Is China's space programme able to support not only national advancement in science and technology but also support global societal progress? Which role does the New Silk Road project (One Belt – One Road, BRI) play in this process? How is space technology, embodied in the "Belt and Road Space Information Corridor", supporting the concept of a "community of shared future for mankind" and can it drive global solutions for society? The author, through consulting open-source information and performing in-depth analyses, looks to find qualified answers to these questions and will show how China – which until not so long ago was a developing country – has used science, technology and in particular space as a tool, as a strategic instrument for the comprehensive development of the society and economy. These facts and processes could be of importance for Serbia as well as South-East Europe.

Keywords: China, space programme, Belt-and-Road, Belt-and-Road Space Information Corridor, community of shared future.

1. THE BEGINNINGS OF CHINA'S EFFORTS IN SPACE

To understand any nations' space programme, it is necessary to take the societal and economic context into consideration. This is even more true for China, which conceptualised first space developments after World War II but profoundly reviewed its fundamental strategy for national space programmes at the turn of the millennium. Most important is, however, that at a time when Western nations in Europe, the U.S. and Japan enjoyed economic development and prosperity, the Chinese economy rode on a rollercoaster during the periods of "The Great Leap Forward" and the "Great Proletarian Cultural Revolution".

Initiated in 1958, “The Great Leap Forward” project was supposed to catapult China within 15 years into the league of leading industrial nations. After just 3 years, the economy of the country was broken. The following Five-Year-Plan brought some relief, until in 1966 the “Great Proletarian Cultural Revolution” took its course. The persecution of intellectuals and academics damaged a whole generation and with it most of China’s best talents. The economy during the “Cultural Revolution” did not completely stand still, but progress did. Only after the death of Mao Zedong in 1976 the situation could halt. China’s firsts in space are embedded into these dramatic decades of the nation’s post-war development.

1.1. DONG FANG HONG – THE EAST IS RED

As an outcome of the Korean War, China felt under nuclear threat and asked the Soviet Union for technical assistance in the development of its own nuclear capabilities including long-range missiles. The Chinese request was granted.

Later, the launch of Sputnik 1 on 4 October 1957 by the Soviet Union sincerely impressed the “Great Helmsman”, Mao Zedong. Such a satellite he wanted to have for his own nation, preferable with the support of the Soviet Union. For China, the underlying principle was to catch up with leading technology developments in the world rather than driven by a race as compared to the competition between the Soviet Union and the U.S.

The Chinese Academy of Sciences (CAS) set up a task force for the technical and scientific development of an indigenous satellite, connected to a long-term and comprehensive national satellite programme. CAS was fully aware of the relevance of satellites for the national scientific and technical development. Considering the low state of technology by that time in China, a satellite project would provide an objective and a motor for technological progress.

Despite the Soviet Union supporting China's military missile programme, there was no assistance in the civil space sector.

Worse, because of the “Great Leap Forward” too few allocated resources, material, and workforce made it impossible for CAS to succeed with a national satellite.

In 1961, after the “Great Leap Forward”, the Chinese leadership focused on the so-called ‘Four Modernizations’, among which was also science and technology. Despite that, the satellite work group within the CAS was still struggling.

In 1966 the “Cultural Revolution” deeply impacted the Chinese society and shook its foundations. Intellectuals were targeted and scientific institutions became places of conflict and violence. Under those circumstances, CAS and other institutions involved in space developments asked the Communist Party to protect their institutions with the help of the military. Mao approved and since that moment the Chinese space programme and the People’s Liberation Army were tied together and have remained in tandem until today.

After 12 years of hard work, impacted by economic and technical constraints and political and societal interference, China launched its first satellite Dong Fang Hong - DFH 1 on 24 April 1970. The 173-kg satellite whose only task was to transmit the

heroic Chinese song "The East is Red", was more of a propaganda instrument than the starting point for a solid, sustainable science programme. China, however, became the fifth nation in the world capable of placing a payload into orbit.

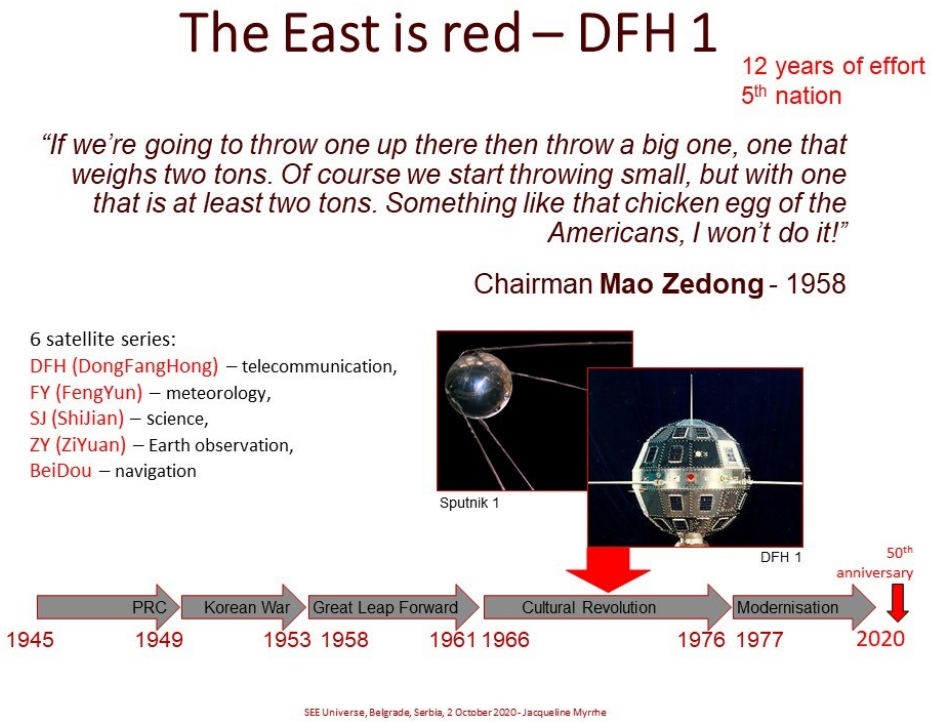

Figure 1: The launch of China's first satellite, the Dongfanghong-1 was a crucial milestone in the development of the nations' space capabilities.

1.2. GEOSTATIONARY SATELLITE

After the end of the "Cultural Revolution" in 1976, Deng Xiaoping was responsible for education, science, and technology – the one of the "Four Modernizations" that he thought to be the most important.

Deng became famous in illustrating his idea in a 1978 meeting when he tried to persuade his comrades to go for a communications satellite programme by saying:

"If we invite a good teacher to give a lecture in the Great Hall of the People only 10,000 people can hear it, but if the same teacher were to give that lecture on television, and everyone had the equipment to receive it, that's a classroom of unlimited size." (Kulacki & Lewis 2008).

Deng Xiaoping succeeded in convincing his comrades and the GEO satellite programme went through. Ambitiously, it was also decided to develop a cryogenic upper stage, which led to a delay in the overall programme. At a certain point Deng wanted to buy a communications satellite from the U.S.A., however this initiative did not work out and the self-set deadline for a launch in 1980 was slipping. Again, the insight prevailed that instead of relying on support from other countries, China

must find and go its own way. Also, Deng was quoted as saying that China can buy one, two, three satellites, but at the end of the day, a big nation such as China cannot buy satellites forever if the country wants to make critical technological advancements.

In the second half of 1983 China accomplished the five major systems needed for geo-stationary access to space: launch vehicle, satellite, launch site, the tracking and telemetry equipment, and a network of ground stations.

China's first GEO satellite finally launched on 8 April 1984, making China the fifth GEO nation in the world and enabled space applications for economic development.

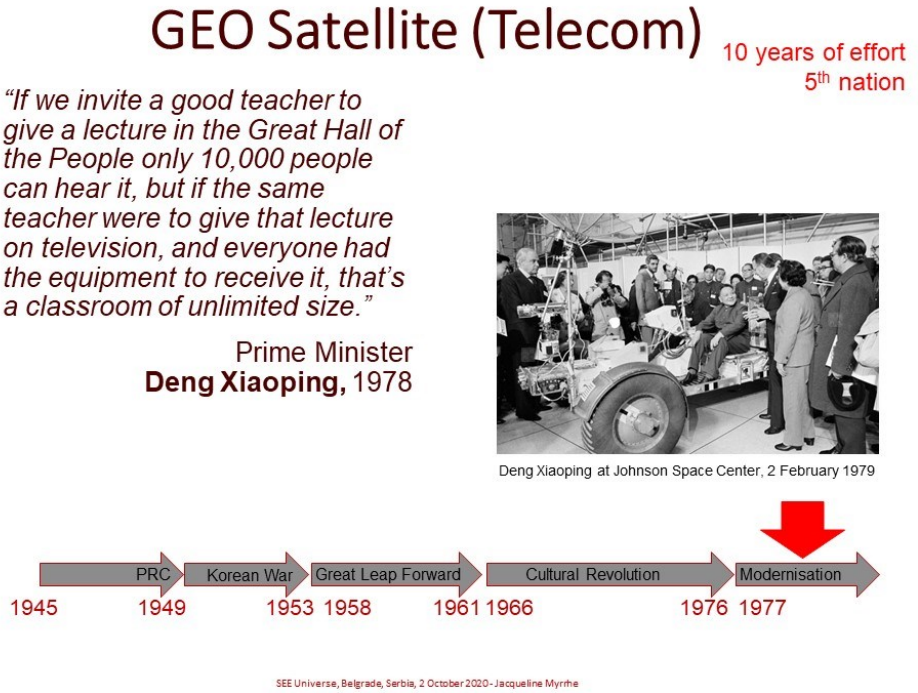

Figure 2: The launch of a GEO satellite showed that China had developed a strong launcher and the related ground segment for geostationary communication.

1.3. MANNED SPACE PROGRAMME

China's human spaceflight programme came late into being since its usefulness for the national and economic development was less obvious.

Deng Xiaoping was interested in space applications, but closed officially the manned space project in 1976:
China *"should not participate in the space race"* and instead we should *"focus our energies on urgently needed practical satellite applications."* (Kulacki & Lewis 2008).

On 23 March 1983, U.S. President Ronald Reagan held his SDI speech. In China, this speech led to discussions on what the role of science and technology is for a country's national development.

In April 1986, the legendary document: "An Outline for National High Technology Planning", the "Plan 863" was published and in October of the same year, the plan was approved, and budget allocated. From now on, the manned spaceflight programme served as an ambitious project that would develop a national space industrial infrastructure and promote the education of the required talent and specialists.

Finally, the Standing Committee of the Politburo approved the space station plan on 21 September 1992, declaring the Chinese Space Station (CSS) the core of China's human space flight efforts.[1]

In 2003 China would become the third nation in the world capable of human space flight.

10 years later, China fulfilled a big legacy of high symbolism when during China's fifth human mission Shenzhou 10, female crew-member Wang Yaping succeeded in turning Deng Xiaoping's vision of a classroom of unlimited size into reality. From aboard the Tiangong 1 space lab, she delivered a science lesson to 60 million Chinese students.

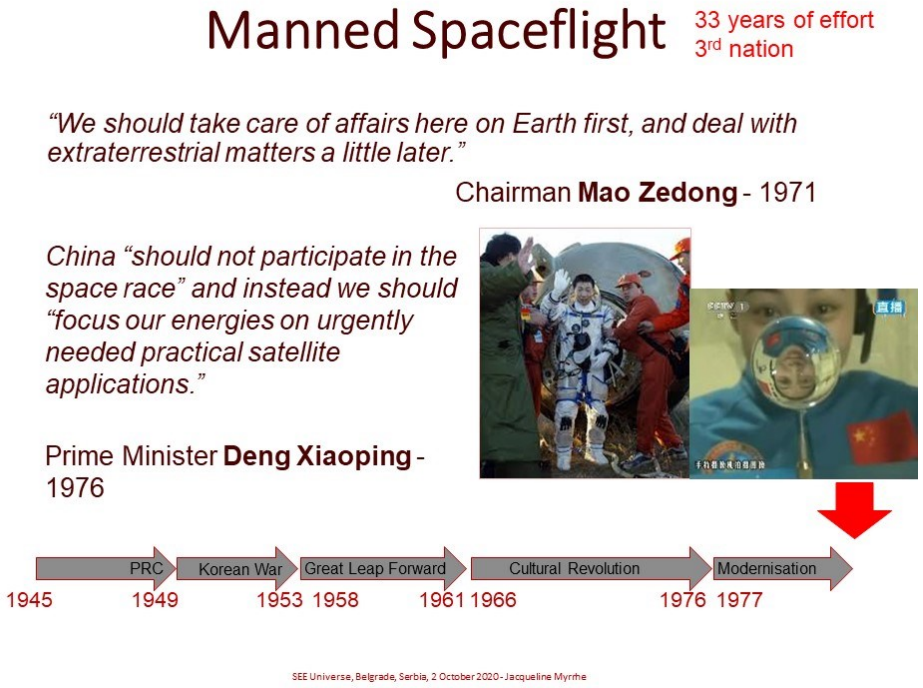

Figure 3: Becoming a human-rated space nation brought China the respect of other space powers.

[1] Kulacki, G: 2012, Why China is Building a Space Station, Union of Concerned Scientists.

2. CAESURA: THE ECONOMIC BOOM, WHITE PAPERS, AND ROADMAP 2050

The economic success at the turn of the millennium not only provided China with the self-confidence and self-esteem to go for big societal concepts, but was also the moment to give science, technology - and with it, space - a fundamental new orientation and direction to meet the needs of the future of the nation.

Since 2001, four "White Papers on Space Activities", published in parallel with the respective five-year-plans explained the achievements and objectives of the national space activities.[2] The most important message reads:
"The Chinese government has all along regarded the space industry as an integral part of the state's comprehensive development strategy…."

Additionally, in 2009, the document: "Space Science and Technology in China: A Roadmap to 2050" was published. Experts analysed the strengths and flaws of China's science community, the worldwide trends in space and technology, and came up with long-term goals and defined the steps necessary to achieve them.

Figure 4: Title page of the White Paper and the Roadmap 2050.[3]

[2] Carey, W.: 2012, No Giant Leap – A Review of China's Space Activities White Papers (2000-2011), GoTaikonauts! – All about the Chinese space programme, 4, 25-29.

[3] The State Council Information Office of the People's Republic of China – China's Space Activities:
http://english1.english.gov.cn/official/2005-07/27/content_17656.htm
http://www.china.org.cn/english/features/book/183672.htm
http://www.china.org.cn/government/whitepaper/node_7145648.htm
http://www.scio.gov.cn/zxbd/wz/Document/1537091/1537091.htm

The roadmap activity aimed at predicting the future developments of science and technology in accordance with the needs of the Chinese nation for the next 20-30 years. It was concluded that science and technology have
"to address the needs of both, the nation and society, the continued growth of economy and national competitiveness, the development of social harmony, and the sustainability between man and nature." (Huadong & Ji 2010)

Science, technology, innovation, and management must be interconnected with the economic societal base. Space must become a tool for the benefit of the Chinese society, and the achievement of the overarching goals and synergistic efforts as laid out in the roadmap.[4]

Furthermore, it was concluded, that growth by purely extending the economic production had reached its limit. China's economic and social development will largely depend on science and technology through scientific discoveries, through the realisation of so-called "Mega Projects" such as the Beidou navigation system, the High-Resolution Earth observation network, the ground station network, and through new inventions and technological innovation.

The strategic aims of the roadmap are in accordance with the principles of the White Papers. And here another highly interesting quote from the roadmap:
"The past 250 years' industrialisation has resulted in the modernization and better-off life of less than 1 billion people, predominantly in Europe, North America, Japan and Singapore. The next 50 years' modernization drive will definitely lead to a better-off life for 2-3 billion people, including over 1 billion Chinese, doubling or tripling the economic increase over that of the past 250 years." (Huadong & Ji 2010)

Figure 5: China has established a wide range of space activities, covering all relevant areas of a space nation.

[4] Carey, W., Myrrhe, J.: 2014, What if…? Searching for Evidence - An Attempt to Analyse the 'Space Science & Technology in China: A Roadmap to 2050', GoTaikonauts! - All about the Chinese space programme, 12, p. 31-38.

For making this happen, space science and space technology will be the best available tool.

What we witness today, is that China has developed a robust, comprehensive, and strategically oriented space programme to serve its overall national development.

The next, intriguing, question therefore is: What has worked on a national level - could that be applied globally?

3. ENTERING THE GLOBAL STAGE

After China had proven that space infrastructure and space technology is a successful driver for economic and societal development, it offered its space resources to other nations.

China initiated several space projects which ask for international participation and support the build-up of space capabilities in non-space faring nations and offer cooperation opportunities for advanced nations.

Examples for that are:

- United Nations Office for Outer Space Affairs, UNOOSA: access to the Chinese Space Station.
- Payload opportunities within the Lunar exploration programme CLEP.
- Support to African nations to train expert engineers, build satellite ground stations and satellite manufacturing facilities.
- Remote-sensing satellite constellation among the BRICS States (Brazil, Russia, India, China, South Africa).
- Small Satellite Project within the Asia-Pacific Space Cooperation Organisation, APSCO.
- Beidou Satellite Navigation System supporting the Belt-and-Road Region.

Figure 6: Major initiatives with important space cooperation – from the left: Belt-and-Road (Beidou), CLEP (Chang'e), UNOOSA (CSS), APSCO (SMMS), BRICS (remote sensing).

3.1. UNITED NATIONS - UNOOSA

In March 2016, the United Nations Office for Outer Space Affairs UNOOSA and the China Manned Space Agency CMSA, signed a Framework and Funding Agreement to develop the space capabilities of UNOOSA Member States via opportunities on-board China's Space Station (CSS).

China offered:

- to use the CSS for experiment payloads or joint research;
- the joint development of modules, sub-systems, components, or other platforms;
- to train and fly astronauts;
- to share technical know-how[5].

In April 2016, Yang Liwei, China's first man in space told media on the occasion of China's First National Space Day:

"Payload has been reserved in the Chinese space station, due to enter service around 2022, for international projects and foreign astronauts. Upon request, China will also train astronauts for other countries, and jointly train astronauts with the European Space Agency. ... The future of space exploration lies in international cooperation. It's true for us, and for the United States too. China will not rule out cooperating with any country, and that includes the United States."[6]

On 28 May 2018, the First Announcement of Opportunity within the framework of the "United Nations/China Cooperation on the Utilisation of the China Space Station" was launched. China is taking over all cost for hardware upload and operations. The development of the experiments having to be covered by the applicant.

There were three possibilities for orbital experiments in the first round of opportunities:

- Conducting experiments inside the CSS by utilising experiment payloads developed by selected applicants.
- Conducting experiments inside the CSS by utilising experiment facilities provided by China.
- Conducting experiments outside the CSS by utilising payloads developed by selected applicants.

By the deadline in September 2018, a total of 42 applications were submitted from public and/or private organisations based in 27 countries. The science teams came from 60 organisations and were composed of 259 scientists and experts. The selection process and the implementation were jointly done by UNOOSA and CMSA.

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[5] QiMing, J.: 2014, Chinese Space Station CSS and International Cooperation, 57th session of the Committee on the Peaceful Uses of Outer Space – COPUOS https://www.unoosa.org/pdf/pres/copuos2014/tech-24.pdf

[6] Liwei Y.: 2016, Xinhua, China open to Sino-U.S. space cooperation, https://www.chinadaily.com.cn/china/2016-04/25/content_24813817.htm

On 12 June 2019 UNOOSA and CMSA published the result of the most comprehensive Announcement of Opportunity (AO) in the history of space flight, where all member states of the UN were eligible to apply. Nine experiments were accepted for entering the preparation and implementation process.

Currently, UNOOSA and CMSA are considering a second AO.

Has the Chinese Space Station the potential to become the World's Space Station?

3.2. CLEP – LUNAR EXPLORATION

On 3 January 2019, China's Chang'e 4 (CE-4) lunar mission soft landed on the far side of the Moon. For the first time in its lunar exploration programme CLEP, China accepted international payloads on a lunar probe. The Chang'e 4 lunar lander hosted the Lunar Lander Neutrons and Dosimetry (LND), a neutron dosimeter, developed by Kiel University in Germany and the rover the Advanced Small Analyser for Neutrals (ASAN), an energetic neutral atom analyser provided by the Swedish Institute of Space Physics (IRF). The Netherlands-China Low-Frequency Explorer (NCLE) and a small lunar optical imaging detector developed by King Abdulaziz City for Science and Technology (KACST) were mounted on the Queqiao relay satellite.

Following the success of the CE-4 mission, Liu Jizhong, Director of the Lunar Exploration and Space Engineering Centre of CNSA, announced on 18 April 2019 in Beijing the opportunity for international participation in the Chang'e 6 (CE-6) lunar mission.

CE-6 is the back-up mission for the Chang'e 5 (CE-5) lunar sample return mission which successfully returned lunar samples on 16 December 2020. CE-6's landing location and detailed mission profile is depending on the outcome of the CE-5 flight. The CE-6 orbiter and lander will each reserve 10 kg for instruments, to be selected from national academic organisations, private enterprises, and foreign scientific research institutions. France's National Centre for Space Studies CNES said in March 2019 that Chang'e 6 would carry French experiments.

3.2. FOCAC - FORUM ON CHINA-AFRICA COOPERATION

During the 1950s, advocated by the then Foreign Minister Zhou Enlai, China approached the developing world to promote diplomatic recognition and establish long-term relationships. Based on barters, China supported building industrial facilities, gave technical training and financial aid. Countries in South-East Asia, North and Eastern Africa benefited from that move.

Later, these exact countries became customers for the China Great Wall Industry Corporation's (CGWIC) scheme of "in-orbit delivery" – an all-round-package comprising the satellite, launch service, operation and often the needed training for domestic engineers.

These long-standing friendly relations between China and governments of developing countries are today the door opener for big-scale infrastructure projects and for closing the digital divide.

At the 2015 Summit of the Forum on China-Africa Cooperation (FOCAC) held in South Africa, the Chinese government promised to provide satellite TV capability to 10,000 African villages. Households in Nigeria, Rwanda, and Malawi were equipped with TV sets, satellite dishes, solar panels, and batteries to power the TV units.

China HEAD Aerospace Technology Co., and its subsidiary HEAD Technology France, built the commercial satellite ground station in Ethiopia for receiving data from the Superview satellites. Additionally, HEAD is also providing data processing software and training for Ethiopian engineers. Moreover, Addis Ababa, capital of Ethiopia, is home to the African Union (AU) Headquarters, therefore it is expected that the satellite ground station and data centre will be ideally placed to disseminate information to various African countries. The African Union adopted a policy on African space development in 2017 and declared that space science and technology could advance economic progress and natural resource management on the continent.

Not only will the further socio-economic development of Africa demand space data and applications in the downstream sector, but also climate change will have a bigger impact on the African continent than on others. For many African countries, space assets will enable them for the first time to monitor and evaluate the impact of human activity on their natural resources and the environment, as well as to assess meteorological situations in real-time.[7]

3.3. APSCO

The Asia-Pacific Space Cooperation Organisation APSCO, is an intergovernmental space organisation for the Asia-Pacific region. It is headquartered in Beijing, China. APSCO aims at capacity-building in its Member States, what includes the training of space experts but also focusses on space applications. Within APSCO, China is driving the use of space capabilities for socio-economic development. For that, the Small Multi-Mission Satellite - SMMS project - is one of its flagship projects.

China’s most modern Fengyun weather satellite is covering the territory of the APSCO Member States and the Belt-and-Road Region. Ground stations in APSCO countries support the reception of satellite data. In return, the data are available for all APSCO members.

[7] Harvey, B.: 2020, China, sanctions and spaceflight, GoTaikonauts! - All about the Chinese space programme, 29, pp. 28-31

3.4. BRICS PARTNERSHIP ON NEW INDUSTRIAL REVOLUTION

Next to Brazil, Russia, India, and South-Africa, China is one of BRICS' Member States – an association of emerging economic powers to find its place in a multi-polar world. This community of developing nations is home to 42 % of the world's population, contributes 18 - 22 % of global GDP, and has generated more than half of the global growth in the past decade, staying its most important engine.
The existing solid space cooperation with Brazil (CBERS programme) is considered a role model for other countries. During the BRICS Summit 2019 in Brasilia, the nations agreed on a "BRICS Partnership on New Industrial Revolution" to strengthen the digital economy and connectivity, among others.

Earlier, China's President Xi Jinping stressed in his speech at the opening ceremony of the 7th BRICS Business Forum on 3 September 2017 in Xiamen, China: *"BRICS is not a talking shop, but a task force that gets things done. Our goal is to build a big market of trade and investment, promote smooth flow of currency and finance, improve connectivity of infrastructure, and build close bond between the people. ... We should seize the opportunity presented by the new industrial revolution to promote growth and change growth model through innovation. We should pursue innovation-driven development created by smart manufacturing, the 'Internet Plus' model, digital economy and sharing economy, stay ahead of the curve and move faster to replace old growth drivers with new ones."* [8]

In their declaration after concluding the 9th BRICS Summit on 3 and 4 September 2017 in Xiamen, China, the BRICS Leaders stated:
"We will enhance joint BRICS research, development and innovation in Information and Communication Technologies (ICT) including the Internet of Things, Cloud computing, Big Data, Data Analytics, Nanotechnology, Artificial Intelligence and 5G and their innovative applications to elevate the level of ICT infrastructure and connectivity in our countries." [9]

While in 2015 the option of a joint BRICS space station was briefly discussed, the BRICS Science, Technology and Innovation Ministers signed in March 2015 a 'Memorandum of Understanding on Cooperation in Science, Technology and Innovation' where 'Space research and exploration, aeronautics, astronomy and Earth observation' are explicitly mentioned.[10] In the meanwhile, a solid cooperation project in the area of Earth observation is under way. Igor Komarov, Programme Director of Roscomos State Corporation explained in May 2016:
"The practical initiative, on which we are now working together with the BRICS countries, is a data exchange in distanced probing of the Earth, which will help in quicker responses to emergency situations, natural calamities, pollution and other

[8] Xi Jinping, 2017, President Xi's speech at opening ceremony of BRICS Business Forum, http://news.xinhuanet.com/english/2017-09/03/c_129695215.htm
[9] BRICS 2017, Leaders Xiamen Declaration
[10] BRICS 2015, Memorandum of Understanding on Cooperation in Science, Technology and Innovation

aspects. I believe, it will find rather prompt and very important practical use for the BRICS countries." [11]

Taking this initiative a step further, a BRICS space project, a joint satellite constellation comprising selected national satellite resources, is currently in the making.

3.5. NATIONAL CIVIL SPACE INFRASTRUCTURE – BEIDOU FOR THE WORLD

China's Civil Space Infrastructure comprises the integrated and coordinated space-based and ground engineering facilities which enable the utilisation of space resources to provide products and services in the fields of remote sensing, telecommunication, navigation and positioning, and other applications. The National Civil Space Infrastructure is considered to be of strategic significance for the overall modernisation of the Chinese nation and for the transformation of the society into an information-oriented and intelligence-oriented community. In parallel, it is indispensable for national security, and an enabler for scientific development, economic transformation, and the realisation of an innovation-driven society based on information application business on a large industrial scale.

The construction of the National Civil Space Infrastructure will be completed by 2025.

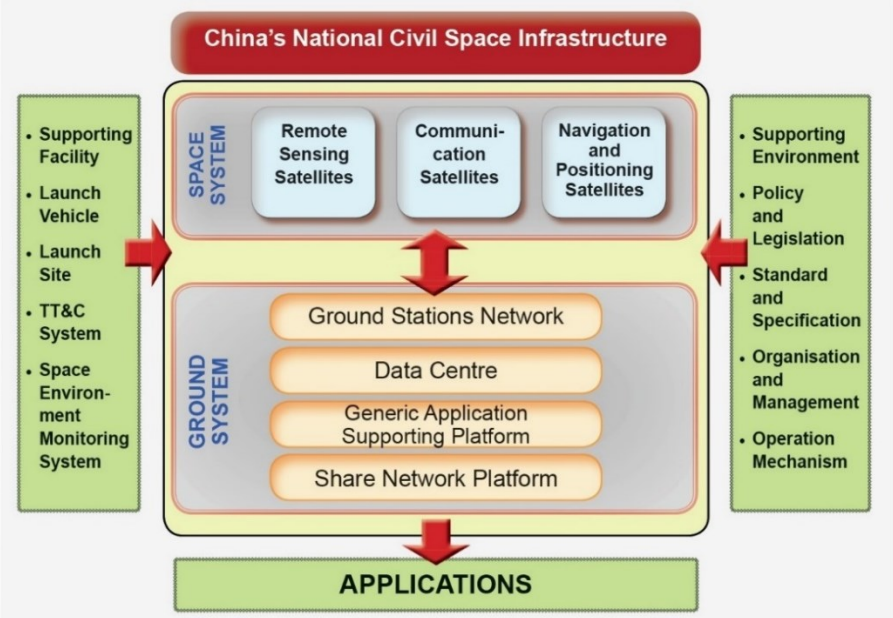

Figure 7: Overview of China's National Civil Space Infrastructure. Credit: CNSA/GoTaikonauts!

[11] Komarov, I.: 2016, BRICS countries plan exchanging data of Earth satellite probing, http://tass.com/science/872101

One of the crucial components of the space infrastructure is the Beidou satellite navigation system (BDS) as an indispensable foundation for down-stream applications and integrated services. This includes smart technologies, a digital economy based on mobile communications, cloud computing, IoT, industry internet, Big Data, and block chain as its pillars. Combined with governmental policies, the Chinese administration expects self-employed businesses, flexible jobs, and new applications to be made possible.

In China alone, the wider navigation service industry generated in 2019 a turnover of 345 billion RMB (about 48.5 billion US$) and predictions state that it exceeded 400 billion RMB in 2020, with Beidou contributing 70 to 80 % of the total.[12]

After the national test run, the first users of Beidou were neighbours in Asia-Pacific and until 2018 countries along the Belt-and-Road and in neighbouring regions were served before the system went global by 2020. Beidou is positioned to support a so-called "downstream industry" providing space-based applications for economic, educational, communication or other purposes.

During a press conference of the State Council Information Office on 27 December 2019 in Beijing, the Director of the China Satellite Navigation System Management Office, Ran Chengqi, told the media that 5G technology will make it possible to establish before 2035 *"a more ubiquitous, integrated and intelligent navigation and timing system with comprehensive national positioning"*.[13]

It is worth mentioning that the Chinese government set up three mechanisms for international Beidou cooperation, encouraging commercial actors to follow: the China-Central Asia BDS Cooperation Forum, the China-Russia Satellite Navigation Key Strategic Cooperation Project Committee, and the China-Arab States BDS Cooperation Forum.

Comprehensive space infrastructure – like the Chinese Beidou satellite navigation system and the Russian GLONASS – are ready to feed space applications, essential for the realisation of the 'One Belt - One Road' endeavour. The Belt-and-Road initiative is complementary to the Eurasian Trade Zone, an initiative by Russian President Vladimir Putin. He confirms: *"For us, China is a key partner in the region."*

3.6. THE NEW SILK ROAD PROJECT - BRI

Since 1989, driven by security concerns, China embarked in Central Asia on a new neighbourhood policy, supporting the now independent post-Soviet States in economic development and social stability. The proclamation of the 'New Silk Road Economic Belt and Maritime Silk Road – One Belt-One Road' project (now called:

[12] Xinhua News Agency, China's satellite navigation industry output up 14.4 pct in 2019 http://www.xinhuanet.com/english/2020-05/18/c_139067354.htm

[13] The State Council Information Office of the People's Republic of China, China to complete Beidou-3 satellite system in 2020, http://english.scio.gov.cn/pressroom/2019-12/27/content_75561879.htm
Xinhua News Agency, China Focus: China to complete Beidou-3 satellite system in 2020 http://www.xinhuanet.com/english/2019-12/27/c_138661806.htm

Belt and Road Initiative - BRI) in 2013, is a consequent continuation of this strategic move. For the revitalisation of the bridge between Asia and Europe to address uneven global development - among other strategic partnerships - SCO and BRICS are of high importance.

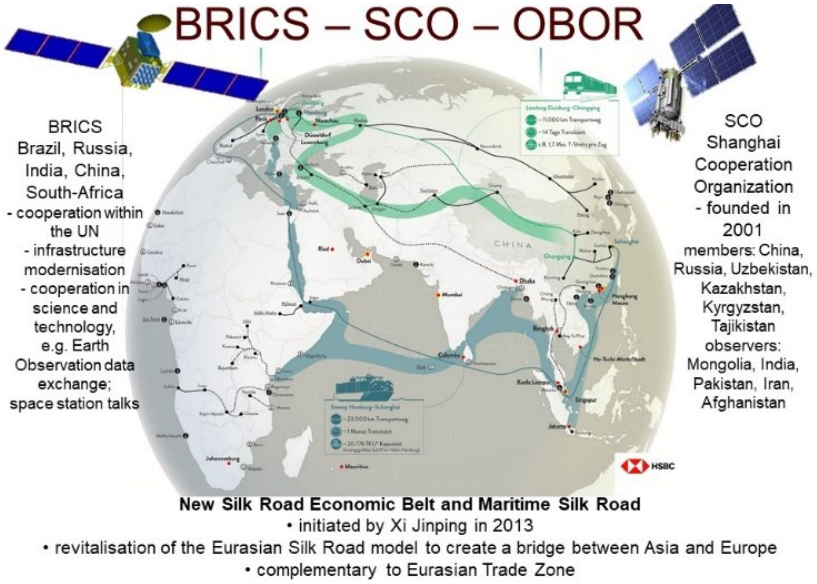

Figure 9: Overview map of the Belt-and-Road initiative.

The SCO – Shanghai Cooperation Organisation – is the biggest regional organisation to date. Its objectives are comparable to the Helsinki Accords/OSCE (Organisation for Security and Co-operation in Europe).

China's Minister for Foreign Affairs Wang Yi, stressed in March 2017 when talking to media:

"The Belt-and-Road is China's initiative, but it belongs to the world. The idea came from China, but the benefits will flow to all countries."[14]

3.7. THE VISION: CONNECTIVITY – A MULTI-DIMENSIONAL INFRASTRUCTURE NETWORK FOR A WORLD ECONOMY

The 'Belt-and-Road' mega-project of economic and societal development is perceived as a broad and multi-layered economic as well as geopolitical scheme. It comprises two main components, the overland connection, the so-called 'belt', consisting of a grid of several major economic corridors, major rail, fibre optic cabling, energy, and pipeline projects. The second main component, the sea-based 'road' covers maritime routes, ports, canals, submarine cabling and cargo handling

[14] Wang, Y.: 2017, Foreign Minister Wang Yi Meets the Press, Ministry of Foreign Affairs of the People's Republic of China, http://www.fmprc.gov.cn/mfa_eng/zxxx_662805/t1444204.shtml

infrastructure. Even new air routes and air travel hubs will contribute to a ‘Air Silk Road’. All of this encompasses the terrestrial infrastructure.

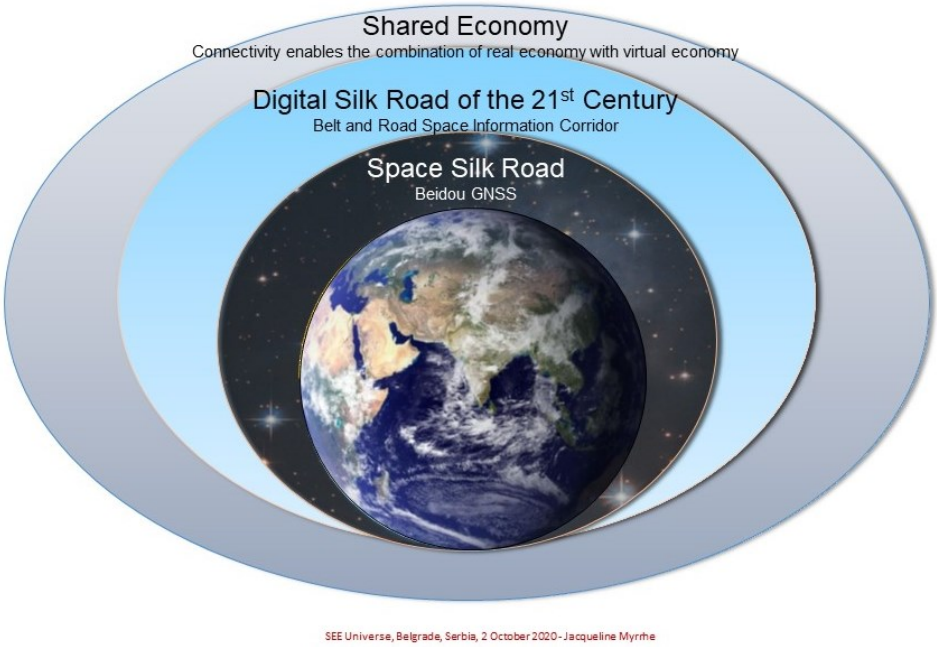

Figure 10: The ‘Belt and Road’ mega project can be defined as the terrestrial infrastructure, which will be complemented by space-based and space-supported assets, adding an extra dimension, an extra layer or shell, to the core project. Everything together enables the democratisation of a World Economy which not only empowers any person to master its existence, but also lives from the active participation of every single individual.
Credit: NASA, GoTaikonauts!

That terrestrial network is going to be supported and extended by space-based resources - the ‘Space Silk Road’. China’s Beidou satellite navigation systems will provide the ‘digital glue’ for the infrastructure on ‘terra firma’, as analyst Trefor Moss rightly described it.[15]

The ‘Digital Silk Road of the 21st Century’ comprises a ‘Belt and Road Space Information Corridor’ including several elements reaching from Earth observation, communications and broadcasting, navigation, ground, and application system construction up to space application product development.

‘Joint Laboratory Initiative’, ‘Science Park Cooperation Initiative’, ‘Technology Transfer Initiative’ and much more will enable a full integration of science and technology into a digital economy.

“China encourages the integrated development of the Beidou satellite navigation system and Internet+, big data, and cloud computing, supports the integrated

[15] Moss, T.: 2016, China’s ‘One Belt, One Road’ Takes to Space, https://www.wsj.com/articles/BL-CJB-29694

positioning and innovative utilization of satellite navigation together with mobile communications, WLAN, pseudo-satellites, ultra-wide band and Ad Hoc Network signals, promotes integrated development of satellite navigation and emerging industries such as the Internet of Things, geographic information, satellite remote sensing and communication, and mobile Internet, and encourages people to start their own businesses and make innovations, so as to vigorously upgrade the innovation capability of the industry."[16]

The state of global connectivity – enabled by this multi-dimensional infrastructure network, provides the basis:

- for mass participation in economic processes,
- for mass innovation,
- and consequently, mass entrepreneurship.

Such a model of a 'Shared Economy' *"could unleash everybody's potential… promote social equity and justice…"* as China's Premier Li Keqiang, pointed out at the Opening Ceremony of the 10th Annual Meeting of the New Champions in Tianjin, in June 2016.

"The sharing economy is one of mass participation. Greater economic globalization and the spread of the Internet have provided a big stage and broad space for entrepreneurship and innovation by the people. Through mass entrepreneurship and innovation, we will combine the innovation activities of the elites with the grassroots, the on-line with the off-line, and companies with research institutes, so that individual efforts of numerous market players will lead to greater synergy for innovation-driven development. If we could make full use of the Internet to efficiently match the massive amounts of information about supply with that about demand, we could then bring about cooperation among and sharing of R&D and professional expertise and skills. The sharing economy is something that everyone can take part in and benefit from."[17]

Imagine, all the people could be their own entrepreneur – their own bosses! Technology paves the way for every person on planet Earth to get connected - with just small hand-held devices - to the whole world and the global marketplace to make use of it for securing their existence. Technology becomes the ultimate tool, literally a hand-sized tool, to empower ordinary persons by adding their human ingenuity to set up their own virtual or real workshop, virtual or real production, any type of virtual or real service - independently and freely. Infrastructure enables the distribution of the produced items or services. The winner is the creator of the production and not only the manager or owner of a business.

Economic dependencies – the biggest killer of creativity and motivation – are taken away and the traditional dialectic contradiction between capital and labour is

[16] The State Council Information Office of the People's Republic of China, China's BeiDou Navigation Satellite System, June 2016, http://www.scio.gov.cn/zfbps/ndhf/34120/Document/1480623/1480623.htm

[17] Keqiang, L.: 2016, Address by Premier Li Keqiang at the Opening Ceremony of the Tenth Annual Meeting of the New Champions, http://english.gov.cn/premier/speeches/2016/06/28/content_281475381438561.htm

fading. Science and technology are democratising economy, most likely the global economy. This could become the optimistic vision of a human future for all people, or as Chinese Foreign Minister Wang Yi put it during a press conference in Beijing in May 2017: *"the magnificent goal of constructing a community of shared destiny for mankind."*[18]

3.8. SUMMARY

A hallmark of China's space programmes is that the nation found its own pace on the way to space. Based on its special conditions over the last 70 years, it has not joined the predominant space race between the United States and the Soviet Union.

China's political leadership strongly believes that a robust space programme can promote innovation, technology development, and educational benefits. Based on that, China has set sail on a highly visible, moderate-cost space programme aimed at showing world-class capabilities and contributing new knowledge to the global science community.

China's economic growth will not indefinitely translate via low labour costs. Economic growth of the future will be defined by science, innovation, and technological creativity. Space is one of the best tools for this.

China welcomes the challenges of the market for space science applications and to make best use of it. Consequently, it is joining the competition in the space industry, in particular in satellite manufacturing and launching but most of all in the down-stream applications.

China is incorporating into its space programme comprehensive international cooperation and more involvement in international organisations.

4. WHAT CAN SERBIA LEARN FROM THIS EXPERIENCE?

Until today, space is still considered as the playground of elitist high-tech nations with excessive financial means.

However, the space race of the Cold War era is history. Unprecedented cost reduction in satellite manufacturing, the acquisition of space data and its use in down-stream applications has brought space to private consumers services. The competition of the 21st century is an economic one. Nations strive for a solid foundation in the context of globalisation where everything and everybody is interconnected. And for that challenge, science, technology, and inventions are the tools to enable economic growth and wellbeing of a people. Space exploration cannot and should not be done for the sake of its existence. It has to be interconnected with the economical societal base in order to advance progress and development, as well

[18] Yi, W.: 2017, The Two Major Platforms of the "Belt and Road" and G20 Can Coordinate and Facilitate Each Other, Ministry of Foreign Affairs of the People's Republic of China, http://www.fmprc.gov.cn/mfa_eng/zxxx_662805/t1465540.shtml

as master the digital revolution. Space science and technology have become transformative forces like never before.

Any nation, but smaller nations in particular have to redefine the traditional approach to growth because growth by extending the industrial production is missing the point in a world where resources become scarce, and the side effects of energy production mainly based on fossil fuel are accelerating climate change which threatens mankind's existence. Growth can be interpreted as growth in knowledge, growth in efficiency, growth of recycling rate and sustainable closed-loop processes. Important is that this new type of growth is the modern 'fuel' for progress. From this fundamental change of interpreting the economy, a country like Serbia can start to analyse its existing strengths, available resources and existing gaps and compare them with the trends in the world. In a next step it could be examined how space science and space technology will serve as the best available tools for the modernisation and the further overall development of the Serbian nation.

Apart from the further socio-economic development which will demand space data and applications in the downstream sector, other societal areas will and have to benefit from space. One of the most pressing challenges today is climate change. Countries, with agriculture dominated regions will face a bigger impact from increasing extreme climate conditions. Climate is a global phenomenon and global processes are best monitored from space. Likewise, global solutions are well supported by space-based infrastructure, be it satellite data, communication network or navigation. Fitting those aspects into a strategic approach could make Serbia fit for the future, establish its place in a multi-polar world.

Flexibility can be achieved by setting long-term goals and intermediary steps on how to achieve them, so that the process can be adjusted if needed.

Another question worth considering is whether Serbia's geographical location brings any specific benefits. Its central position on the Balkan, its former role in hosting the capital of Yugoslavia and the historical close relations with neighbouring countries bring advantages. How can they be used as a leverage to knot tight neighbourhood relations for win-win outcomes? Among the resulting benefits could be the participation in international space projects to support the build-up of space capabilities with hands-on projects but declared as national projects to establish a showcase and gain experience.

There is no other way than the government taking responsibility to conceptualise a strategy and policies for that. What profound effect the directed support and commitment of the state has, is nicely comprehensible with the example of China. For that, the foundation in Serbia is prepared as has become evident during the SEE Universe conference organised by SERBSPACE from 30 September to 2 October 2020.

The event brought together a broad spectrum of national stakeholders which exchanged their opinions on the importance of space and space applications for Serbia.

The discussions in the different panels took stock of the available space expertise, resources, and high degree of professionalism in Serbia. Many space research projects are already existing – more than expected.

Among the representatives of the academic community, it was agreed that the Serbian science community would like to see a broader, more recognised, and more coordinated approach regarding national ambitions for space. It was set forth that there are many interesting initiatives ongoing which would lead to more and better results if synergies could be established.

The main take-away of the industry panel was that all players would like to see more support for high-tech applications to establish high-end production and integrated applications based on space resources be it navigation, Earth observation, Internet of Things, or interdisciplinary processes and finally set up an overall national development plan for Serbian space applications.

It has to be noted that a solid astronomical grass-root landscape has been emerged over the past years in Serbia. Teachers, space amateurs and space educators are involved in space projects and gave some insights into what else could be achieved should Serbia go for a national space development programme. Also, several international speakers provided their experience of what other nations do to promote space and to make best use of space for the overall development of the society and economy. Andrea Boyd, the speaker from Australia even outlined a strategy of how to create a national space agency. All those experiences are of high value for Serbia to learn from.

SERBSPACE shall initiate a broad dialogue among all interested national parties to take advantage of the momentum created by SEE Universe. It should be aimed at aligning existing projects in an overarching, strategic way. Already established and well running projects, research and capabilities should meet governmental interests for a strong Serbian development of a future-oriented economy. For that, SERBSPACE shall initiate a discussion with the responsible Ministries but also across Ministries to initiate the drafting of a national roadmap for space.

SERBSPACE shall establish SEE Universe as an annual conference and a national and regional platform for the exchange between space experts, decision, and policy makers, as well as the general public.

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