CONSORTIUM FOR NATIONAL SPACE RESOURCES ACCESS (CNSA): A NATIONAL SPACE RESOURCES ACCESS STRATEGY IN DISRUPTIVE TIME

Meiditomo Sutyarjoko[1)], Yuliawan Cahya Pamungkas[2)]
PT. Bank Rakyat Indonesia (Persero) Tbk.
Email : [1)]meiditomo.sutyarjoko@bri.co.id
[2)]cahya_pamungkas@bri.co.id

ABSTRACT

Space technology development history goes way back to the World War II era fueled by the "space race". Indonesia is one of the early adopter of GEO satellite communication technology, and remain largely as satellite operator – albeit of the national program to master the space technology. Mastering space technology is not an easy task, and so far India is the only developing country that able to reach the rank #13 in the Space Technology Ladder. The space technology conservatism, particularly in the GEO satellite technology, that discourage innovations has been seen shifted due to recent structural industry change. The non-GSO satellite seems to lead the Disruptive Satellite Technology (DST) and has been self evidence on the start ups advancement in satellite industry. Increase in leverage as satellite operators, proposed to be achieved through the CNSA model should lead to a better rounded satellite coordination orchestration and more benefit for the satellite procurement processes. Aggregation of the satellite procurement processes, should benefit the procurement investment amount, technology transfer in the forms of training, program offset, or increase in local content should be less challenging, and for satellite operators who are the member of the consortium may only procure the satellite capacity as needed in their business plan.
Keywords: Space Resources, Space Access, Space Technology, Technology Disruption, Competitiveness

ABSTRAK

Sejarah perkembangan teknologi anatriksa kembali ke era Perang Dunia II yang dipicu oleh "perang antariksa". Indonesia merupakan salah satu pengguna awal teknologi komunikasi satelit GEO, dan tetap sebagai operator satelit - meskipun terdapat program nasional untuk menguasai teknologi antariksa. Menguasai teknologi antariksa bukanlah tugas yang mudah, dan sejauh ini India adalah satu-satunya negara berkembang yang mampu mencapai peringkat ke-13 dalam tangga penguasan teknologi antariksa. Teknologi antariksa konservatif, khususnya dalam teknologi satelit GEO, yang menghambat inovasi telah terlihat bergeser karena perubahan industri struktural baru-baru ini. Satelit non-GSO tampaknya memimpin Teknologi Pengganggu Satelit (DST) dan telah menjadi bukti diri pada kemajuan awal dalam industri satelit. Peningkatan pengembangan operator satelit, yang diusulkan untuk dicapai melalui model CNSA harus mengarah pada koordinasi orbital putaran satelit yang lebih baik dan lebih banyak manfaat untuk proses pengadaan satelit. Agregasi proses pengadaan satelit, harus menguntungkan jumlah investasi pengadaan, transfer teknologi dalam bentuk pelatihan, penyeimbangan program, atau peningkatan konten lokal harus kurang menantang, dan untuk operator satelit yang merupakan anggota konsorsium hanya dapat memperoleh kapasitas satelit yang diperlukan dalam rencana bisnis mereka.
Kata Kunci : sumberdaya antariksa, akses antariksa, teknologi antariksa, teknologi pengganggu, persaingan

1. INTRODUCTION

The development of international space technology, mostly driven by the post World War II (Allen, 1965; Chertok,B., 2005), lead by America and Russia in the 60s. Other countries, European countries, China, Japan, and India, also to join the space technology development slightly later, and recently United Arab Emirates also joined the group.

Indonesia as stated in the Rencana Induk Penyelenggaraan Keantariksaan Tahun 2016 – 2040 (Renduk Keantariksaan 2016 – 2040), which is part of the Presidential Decree (Peraturan Presiden RI No. 45, 2017), determined to build national capability in space technology that can internationally compete with the developed countries, it contributes to the man power development, economy, industry, safety and security, and green environment.

Indonesia history on space technology utilization went back all the way to 1976's when Palapa-A1, the first domestic telecommunication satellite, was launched from Cape Canaveral, Florida U.S.A. Indonesia was the second country after U.S.A., followed by Canada, to own such satellite. From the commercial telecommunication satellite operator point of view Indonesia has procured and operated for at least fifteen (15) geostationary telecommunication satellites (Table 1). Aside from LAPAN activities in the space technology, Indonesia activity in this field is mostly as satellite operator, with its core competency on procurement and operation of GEO satellites for telecommunication. LAPAN, since the formation of the institution on 27 November 1963 up to now, has been progressing in the area of remote sensing satellite technology development, such as the LAPAN Tubsat, A2, and A3. According to the Space Technology Ladder in Table 2 (Wood et.al.2008), the journey into ladder stage #13, as intended in the Randuk Keantariksaan 2016 – 2040, is still far to reach.

Budget is key for space technology development, obviously. Indonesia's intention to master the space technology do have this financial gap compared with its developing country counterparts (Table 3). Mohammed Bin Rashid Space Center (MBRSC) of Dubai, UAE this year alone putting some amount close to the prestigious European Space Agency (ESA) in order to support their first locally build Kalifahsat low orbit satellite for remote sensing. Kalifahsat is a one step above the Lapan A3 that are to be launched.

In order to close the budget gap, as stated in the Randuk, the government institution domination in the space technology development should be lessened. Involvement of the state own enterprise (BUMN), industry, and private companies shall be encouraged.

Provided that such approach can be implemented, one should not over look that there has been a very important shift in the space industry in the last several years (van der Veen, 2012). The disruption in space technology has been surfacing, triggered by the advancement in the scientific fields. The innovation in space sector is steadily increasing, influenced by the digital mindset that somehow fuel the "new space race" (van der Veen, 2012). Many new space companies start ups in Mojave California, similar to digital revolution in the Silicon Valley, had shown its value creation to venture capitalist, government institutions, and public. This gives new dimension on where and how the Indonesia space technology should set its creation and direction.

In doing so, the following issues demand some answers: How and what format should non-government institution involvement in the Indonesia's space technology development be taken place? Who should take the initiatives? Which direction should they go: the GEO satellite or LEO satellite? Can a synergy to the existing GEO satellite telecommunication operator be formulated?

2. LITERATURE REVIEW

2.1. Space Technology Development on Various Developed Countries:

At the beginning of the space era, countries developed their space policy for economy, military, proud, and dream in the space (Goldman, 1992). The attraction of space has born since the end of World War II, the beginning of the Cold War. Countries possessing long-range guided missiles technology have concern over United Stated that has nuclear and Radar technology. America initiated Manhattan Project to acquire rocket technology from German scientists, which causes concern to the Russian. In parallel, but independently, Russia made huge effort to collect, catalog, and reproduce German rocket technology after the World War II. Space has become the major part of the contest. The Space Race then begun in the late 50s and continue to be so until the end of the Cold War era (Chertok, B., 2005; 2006).

The early Soviet accomplishment in space exploration, after the launch of Sputnik in 1957 and the Yuri Gagarin 1961, were the benchmark of the Cold War. United States subsequently formed a governmental agency, the National Aeronautics and Space Administration (NASA), to conduct civilian space exploration and to strike an objective set by the United States President: "to land on the moon, before the end of the decade".

Different from the Russia and United States motivation, European Space Agency (ESA), with 22 Member States across Europe, able to coordinates the financial and intellectual resources of its member to undertake space program that can be accomplished beyond the capability of one nation. ESA initiated in 1958 by scientific community in Western Europe, who did not leave to the United States of Russia, purely for scientific organization on the space research.

Similarly, on later year (1969), India Space Research Organization (ISRO) was formed by India's Prime Minister – superseding INCOSPAR (India National Committee for Space Research) that was established in 1962. Isro's first satellite Aryabhata, was launched by Soviet Union on 19 April 1975. India initiated its own launch vehicle program serving various missions.

China space program is directed by the China National Space Administration (CNSA) and started since 1950s. The motivation was for defense against United States missiles. China will developed their space technology, perhaps launching more satellite per year than the Unites States. China has long term ambitions to exploit Earth-Moon space for industrial, and has been the most active and advanced space programs asides from United States.

From various developed countries in Asia, South Korea is the lagging one. South Korea decided to focus on selected area of space technology only in order to increase the competitiveness of Korea industry (Cho, 2002). South Korea situation is unique as developed countries, and somewhat has similarities with Indonesia. South Korea main problem includes (Damanik, 2017): (1) Space technology development is dominated by the government research institution, (2) Private company in space technology do not have financial support from the government, (3) Transfer of technology from the government research institution does not happen. In summary, initial intention of space development for each country is perhaps less rational, later on such intention shifted toward a more rational one as summarized in Table 4 (Damanik, 2017; Handberg, 2002).

2.2. Satellite Program in Developing Countries:

As developing country, Indonesia is the first country in the world that own its domestic GEO satellite for telecommunication purposes. Indonesia first satellite project started on 9 Juli 1976, when Palapa-A1 satellite was launched on Delta-2 rocket from the Kennedy Space Center, Florida. In less than a year later, on 10 March 1977, the second satellite namely Palapa-A2, was launched. Subsequently, Indonesia almost regularly launch the GEO satellites from time to time up to now. In average, Indonesia launch GEO satellite every 2 – 3 years.

The views of developing country to foster their capability on space through satellite programs can be classified into the followings.

First view is economic change. Economic change through evolution underlines this view, in such that developing country to learn on space technology is part of their process to improve their capability in order to improve their economic values (Richard, & Winter, 1982). This view presents that the set of new individual skills in the effort to learn the satellite technology will be needed, and such learning includes the ability absorb the tacit knowledge, in addition to the codified knowledge, on space technology that other already posses (Polanyi, 1966). Developing country may acquire space technology through training, technology licensing, technical consultations, equipment procurement, or forms joint venture with foreign partners. Through this interaction, developing country may be able to gain its economic values of space technology.

Second view is perceived political profile. Paikowsky (2009) states that developing country motivation to join into the space club countries is to increase their political profile. Country with space technology capability will be perceived to be on certain ranks in the space club pyramid (Paikowsky, 2009). Wood et. al. (2008) states that there are 13 ranking the ladder in the pyramid as shown in Table 2.

In general, developing countries want to be independent in mastering the space technology. One option is to own a satellite as a national program (Danamik, 2017). Many countries start with remote sensing satellite, scientific satellites, often on simpler LEO platform, and communication satellite on a more complex GEO platform.

Business and political barriers typically occurs when developing country is trying to acquire space technology from a more advanced technology provider from different country. Let alone the complexity of the technology itself, the conditions will be harder for any developing country to progress in the space technology on its own. What can one country do to increase its bargaining position to the satellite technology provider, in such that both business and technology can be acquired. Out of many developing countries, only India that has proven to be able to reach the highest rank, rank ke-13.

2.3. Changes in the Industry Structure

The space technology development has concentrated mainly on a conservative method of technology development, rather than breakthrough, radical or disruptive innovations (Summerer, 2009). One of the reason for this situation is the fact that the space technology requires long and costly development phases with strict performance and environmental requirements (van der Veen, 2012). Another reason that can justify this situation is the very high cost of space transportation. These two factors have resulted in very stringent quality and flight heritage requirements. This situation has created a paradigm, where usage of technologies of non existing flight heritage is discouraged and consequently new technologies do not gain flight heritage because they never get a change to be on flight (Szajnfarber, et. al., 2009).

However, between 1990 to the later years of 2000, there has been major structural change in the space industry globally. At least five major changes in the space industry were recorded (Damanik, 2017): (1) Consolidation in the space defense industry, (2) Violation in the Arms Export Control Act and the International Traffic in Arms Regulation (ITAR) by Boeing (was Hughes Space and Communication), and Space Systems/Loral, (3) SpaceX enterprenaurial move by Elon Musk (2002), (4) Iridium 22 collision with Kosmos 2252 (2009), and (5) NASA constellation project were cancelled due to budget cut. The structural shifts influences the global space industry in terms of space innovation. Space should not always expensive, and therefore innovation toward a more creative space solution starts to spurs.

The consolidation in space defense industry reduces the aerospace R&D spending from 5% to 2% from corporate revenue (Aerospace Industries Association, 2011). Number of space R&D personnel drops from 14.5% to 2.5% (Aerospace Industries Association, 2011). ITAR violations by Boeing and Space System Loral had incentivized the exponential growth of non United States manufactured satellite (Noble, 2008). The United States space industry therefore become under tremendous pressure to innovate to regain market shares. Space Exploration Technology, SpaceX, change the paradigm that United States launch vehicle is large and expensive. SpaceX replant the seed in the space industry that innovation in rocket technology remain open for the industry.

2.4. Disruptive Space Technology

Disruptive Technology term was first explained by Bower and Christensen (1995). It describes as a technology that emerges out of a niche market and becomes so dominant that it disrupts the status quo of a market and often leads to incumbent companies being pushed out of the market (Bower and Christensen, 1995). When technology starts to become attractive not only to the niche market, but also to the mainstream market, such technology is classified to be disruptive. This process is called as “low-end disruption” (Christensen, et. al., 2004). This event occurs because of disruptive technology (DT), through incremental technology improvements, becomes better (or the same) performance as the previously dominant technology while also having additional attributes that are valued by the niche market. When this happen, the new technology rapidly becomes the new standard and the old technology are pushed out of the market (van der Veen, 2012). DT typically radicals, not incremental.

Disruptive Space Technology (DST) is the successful technology that will disrupt the state-of-the-art of space technologies. However, disruption in the space technology has unique characteristics that is not exactly similar to the DT. Space technology innovation in general is incremental, due to risk averse culture in the space sector. Space technology innovation is highly constrained by operational requirements that are driven by environmental requirements constraints as summarized in Table 5 (van der Veen, 2012). The constraints of the space environment have lead to strict quality requirements, because single component failure may lead to mission failure. The strict requirement on quality demands strict testing requirements, proven flight heritage, high redundancy or diversity, strict quality assurance and control processes. Additionally, the low volume demand on the space hardware will increase the high cost structure. Not to mention on the tight regulation on ITAR, health, and import / export, the space sector really hard for start ups.

Non GSO trend with large number of satellite constellations becomes more and more apparent going forward, one example of this system is OneWeb (Figure 1). The satellite weight less than 150kg with satellite to be build will be around 900. Every three weeks, there will be launch for OneWeb. Non GSO innovations also spurs multi platform satellite innovation. Table 6 summarizes many start ups companies that has and its funding already secured purely through private sectors. This situation will be the push factor for more and more SDT. The “new space race” has started. Particular to the BIU of the non GSO satellite system, before the WRC19, single satellite BIU golden period shall be maximized by any of Indonesia operator. One Indonesia satellite operator shall take this golden period opportunity in order to secure one constellation of a non GSO system.

3. SPACE TECHNOLOGY MARKET MODEL AND CONSORTIUM FOR THE NATIONAL SPACE RESOURCES ACCESS (CNSA)

What should key players on space technology market do in the disruptive period? Key players in space technology market forms an ecosystem, consisting the Public Customers, Institutional Customers, Satellite Operators, Space Manufacturer / Industry, Research and Academia, and Government (see Figure 2).

From the initiation to the maturity of the satellite filing process, Damanik (2017) suggested another model (Figure 3). In the current satellite filing process from planning to real operation, the responsibility of the administrators and the satellite operators is combined. Accountability of any filing to be successfully coordinated to reach the notification status timely becomes ambiguous. Damanik (2017) therefore proposes a two layers process that can clearly differentiate the scope and accountability of the administration and the satellite operator during the satellite filing processes (Figure 4).

Expanding Figure 2, the ecosystem view within the Indonesia key players in space technology, incorporating multiple domestic satellite operators and international satellite operators, the complication on the domestic ecosystem will become visible (Figure 5). Complications during satellite coordination can and do occurs between domestic satellite operators, as each domestic satellite operator has unique business interests when it comes to coordinate with international satellite operator(s). Such interest may not always in line with the administration strategy overall when it comes to concluding a satellite coordination. Revisiting the several questions raised in the early part of this paper: How and what format should non-government institution involvement in the Indonesia's space technology development be taken place, perhaps the concept of CNSA is ready to be introduced (Figure 6).

Extending the layers concept into the Space Technology Market Model, the same approach will have several advantages. The orchestration of strategy during the satellite coordination can be done under one-entity accountability; in this case will be the administration. Aggregation of the satellite procurement processes, will increase in leverage of the Satellite Operator to the Satellite Manufacturer / Technology such that procurement investment amount may be reduced, technology transfer in the forms of training, program offset, or increase in local content should be less challenging, and for satellite operators who are the member of the consortium may only procure the satellite capacity as needed in their business plan. Member committing to the capacity prior to launch will have lowest investment amount. Remaining investments amount of any uncommitted satellite capacity before the launch, if any, shall be equally distributed to the member of the consortium. Such ideas is basically consistent with the trend of the satellite

4. CONCLUSION

The non-GSO satellite seems to lead the Disruptive Satellite Technology (DST) and has been self evidence on the start ups advancement in satellite industry. The "new space race" seems has been started. Indonesia as one of the early adopter of GEO satellite communication technology, should take the golden opportunity on non GSO filings and BIU before the WRC19.

Increase in leverage as satellite operators, proposed to be achieved through the CNSA model should lead to a better rounded satellite coordination orchestration and more benefit for the satellite procurement processes. Aggregation of the satellite procurement processes, should benefit the procurement investment amount, technology transfer in the forms of training, program offset, or increase in local content should be less challenging, and for satellite operators who are the member of the consortium may only procure the satellite capacity as needed in their business plan.

5. ACKNOWLEDGEMENT

The authors would like to thank the Head of Centre Aerospace and Policy Studies - LAPAN who facilitated the issuance of this program and to all those who have provided suggestions and inputs so that this paper can be published.

BIBLIOGRAPHY

Aerospace Industries Association, 2011, Facts and Figures 2004/2005.

Allen, J.G., 1965, Historical and Philosopical Background of the Space Age.

Bower, J.L & Christensen C.M., 1995, Disruptive Technologies: Catching the Wave, Harvard Business Review, 43-53.

Chertok, B., 2005, Rockets and People, Volume I, Washington DC, Office of External Relations.

Chertok, B., 2006, Rockets and People, Volume II, Washington DC, Office of External Relations.

Chertok, B., 2009, Rockets and People, Volume III, Washington DC, Office of External Relations.

Cho Hyun-Suk, 2002, A Study of Science and Technology Policy in Korea: Searching for New Policy Idea, Science and Technology Study.

Christensen, Anthony, & Roth, 2004, Seeing What's Next, Boston, MA, Harvard Business School Publishing.

Damanik, G., 2017, Membangun Tol Angkasa Untuk Memenuhi Kebutuhan Kapasitas Satelit Nasional, UKSW.

Goldman, N.C., 1992, Space Policy: An Introduction, IOWA State University Press.

Noble, M., 2008, Export Controls and the United States Space Power, Astropolitics, 6 (3), Sep - Dec.

Paikowsky, D., 2009, The Space Club Policies and Politics, Proceeding of the International Astronautical Congress, Daejon, South Korea.

Peraturan Presiden RI No. 45, 2017, Rencana Induk Penyelenggaraan Keantariksaan Tahun 2016 – 2040.

Peraturan Presiden RI No. 49, 2015, Lembaga Penerbangan dan Antariksa Nasional.

Polanyi, M., 1966, The Logic of Tacit Interference, Philosophy.

Richard, N. and Sidney Winter, 1982, An Evolutionary Theory of Economic Change, Cambridge, Massachusets, Harvard University Press.

Summerer, L., 2009, Specifics of Innovations Mechanism in the Space Sector, Proceedings of the XXth ISPIM Conference, the Futrue of Innovation, Vienna, Austria.

Szajnfarber, Z., Grindle A.T., & Wiegel A.L., 2009, Instantiations of Government Space Innovation Systems: A Comparative Analysis, Proceedings of the International Astronautical Congress (IAC), Daejeong, South Korea.

Undang-Undang RI No. 21, 2013, Keantariksaan.

Van der Veen, E.J., et. al., 2012, Disruptive Space Technologies, International Journal of Space Technology Management and Innovation, July – December.

Wood, Danielle, and Annalisa Weigel, 2008, The Use of Satellite-Based Technology in Developing Countries, Cambridge, Massachusetts Institute of Technology.

Table 1: Indonesia's Telecommunication Satellites History

Launched Year	Satellite
1976	Palapa A1
1977	Palapa A2
1983	Palapa B1
1984	Palapa B2
1987	Palapa B2P
1990	Palapa B2R
1992	Palapa B4
1996	Palapa C1
1996	Palapa C2
1997	Indostar 1
1999	Telkom 1
2000	Garuda 1
2005	Telkom 2
2007	Lapan Tubsat*
2009	Indostar 2
2015	Lapan A2*
2016	BRIsat Lapan A3*
2017	Telkom 3S
2018	Telkom 4**
2020	Palapa E**

Note:
* Non GSO, Non Telecommunication Satellite
** Planned to be launched.

Table 2: The Space Technology Ladder

Ladder Stage	Capability
13	Launch Capability: Satellite to GEO
12	Launch Capability: Satellite to LEO
11	GEO Satellite: Build Locally
10	GEO Satellite: Build Through Mutual International Collaboration
9	GEO Satellite: Build Locally with Outside Assistance.
8	GEO Satellite: Procure
7	LEO Satellite: Build Locally
6	LEO Satellite: Build Through Mutual International Collaboration.
5	LEO Satellite: Build Locally with Outside Assistance
4	LEO Satellite: Build with Support in Partner's Facility
3	LEO Satellite: Procure with Training Services
2	Space Agency: Establish Current Agency
1	Space Agency: Establish First National Space Office

Table 3: Various Space Technology Budget

Country	Institution	Space Budget* (Billion USD)
U.S.A.	NASA	19.3
European	ESA	5.8
UAE	MBRSC	5.2
China	CNSA	3.0
India	ISRO	1.4
Indonesia	LAPAN	0.62

Note: * Yearly Budget, based on latest year info in public domain.

Table 4: Shifts in Space Development Intentions

Category	Begining	Present	Future
Military	Military in Space	Arm Force Support Arm Force Enhancement	Space Control Arm Force Apps
Scientific	Space Science	Earth Science Astronomy	Planets Asteroids Environment
Civil	Human Spaceflight	Space Shuttle Space Station	Human Habitation Human Exploration
Commercial	Technology Development	Commercial Apps	Economic Competitiveness

Table 5: Space Environment Constraint

Space Environment
High-energy radiation
Extreme Temperature
Large and Frequent Temperature Variations
Micrometeorid and Orbital Debris Impact
Vacuum Environment
High g-Force during launch
Microgravity environment
Limited opportunity for repair after launch.

Table 6: Space Environment Constraint

Space Start Up Company	Secured Fund (USD Million)
Space Pharma	1 – 2
Rocket Lab	4.9
Spire	70
Nova Works	42.6
Effective Space Solution	100 (DP)
Astroscale	7.7
Space IL	22.4
Moon Express	31.5
AxelSpace	15.8
Xcom Aerospace	20

Figure 1: One Web Plan

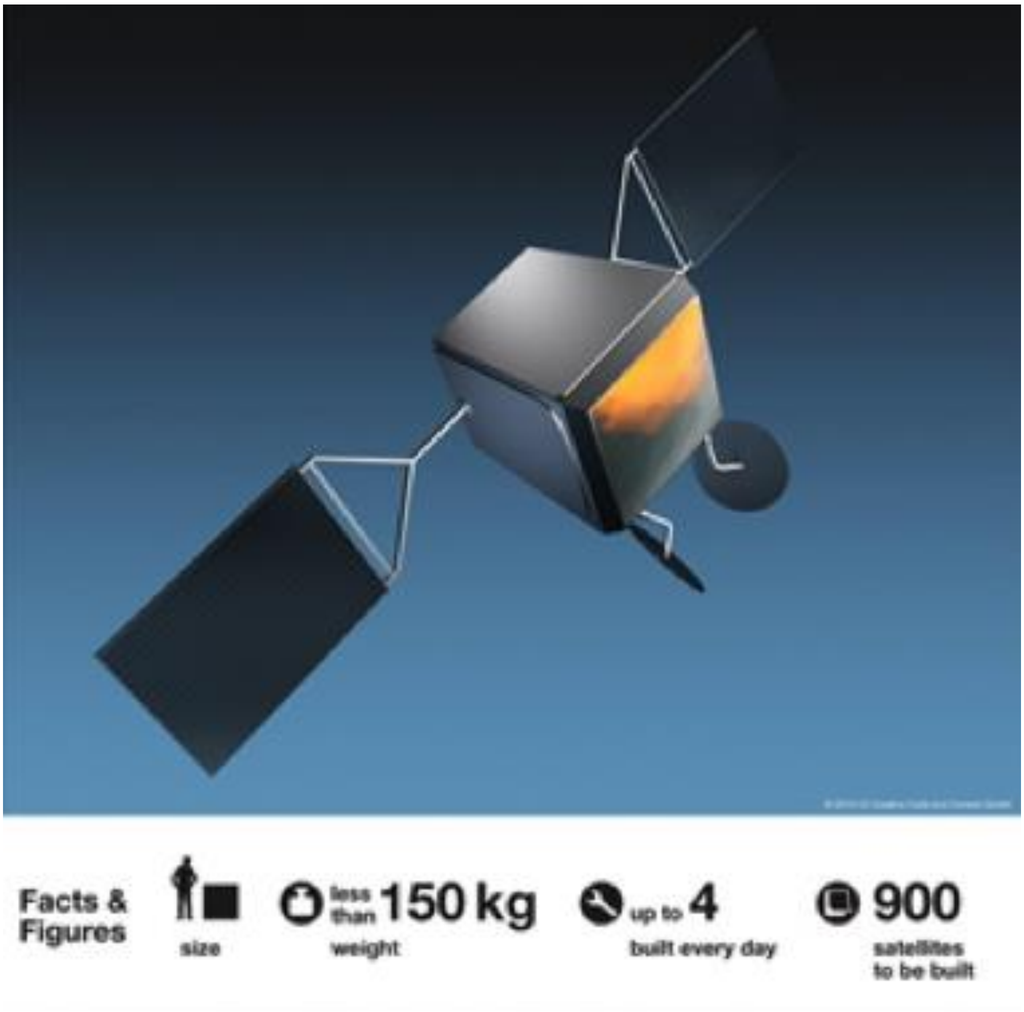

Figure 1: One Web Plan (continued)

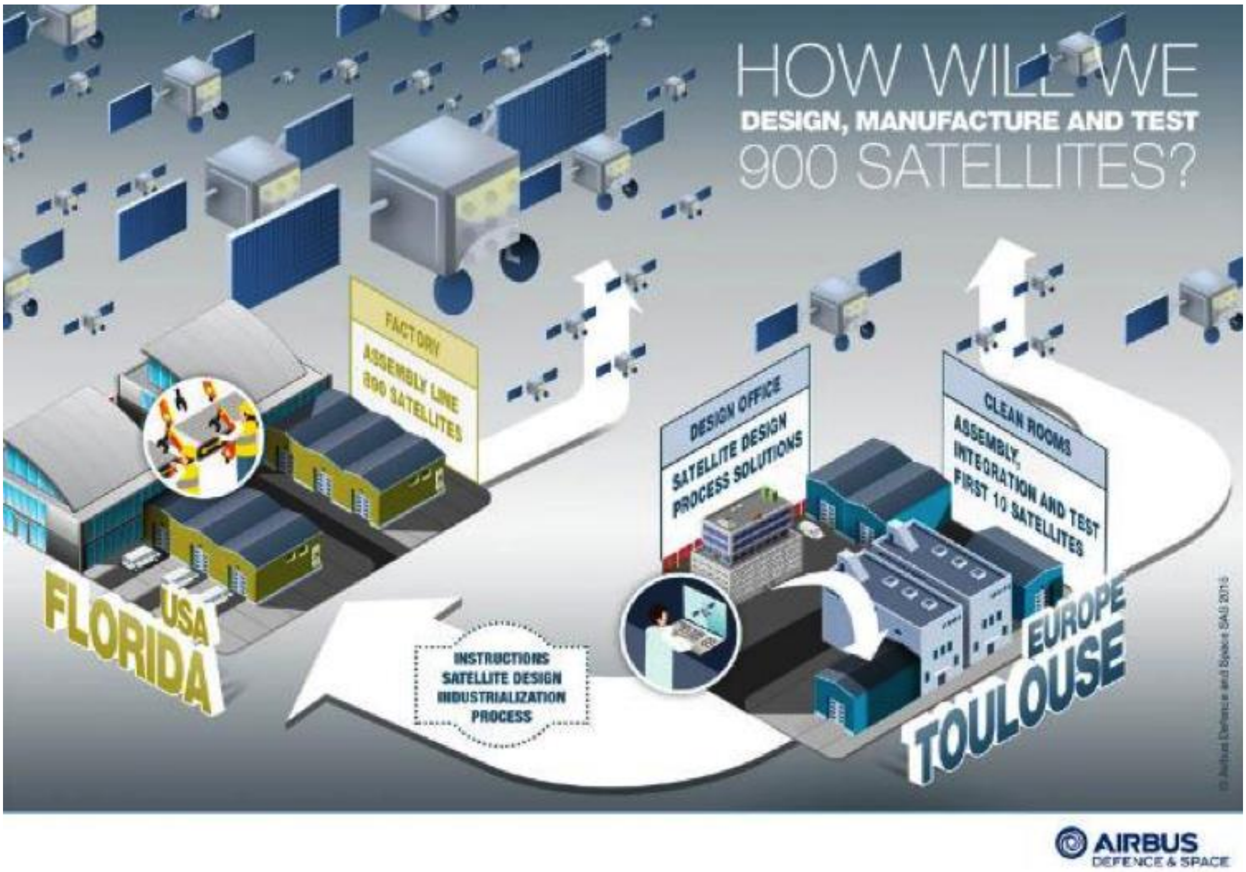

Figure 2: Space Technology Key Players

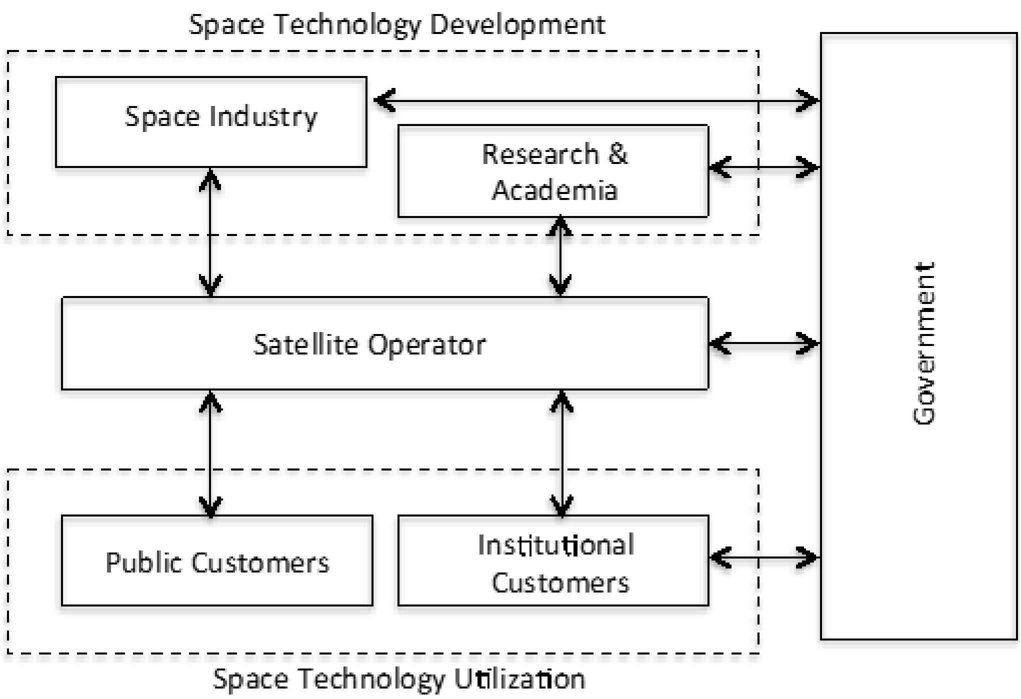

Figure 3: Current Satellite Filing Process

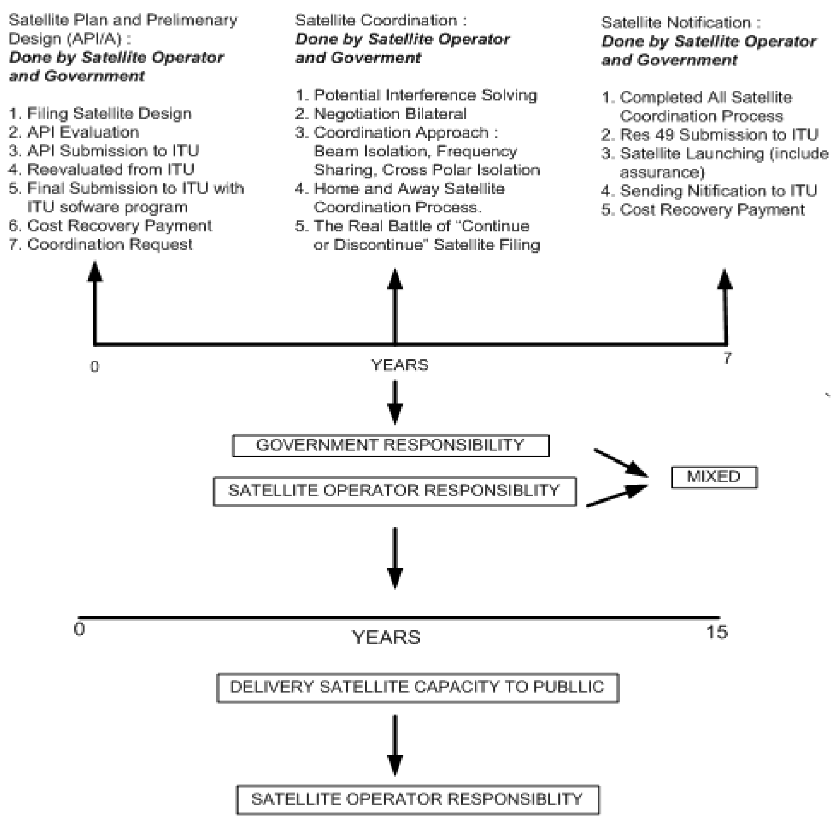

Figure 4: Two Layers Satellite Filing Process

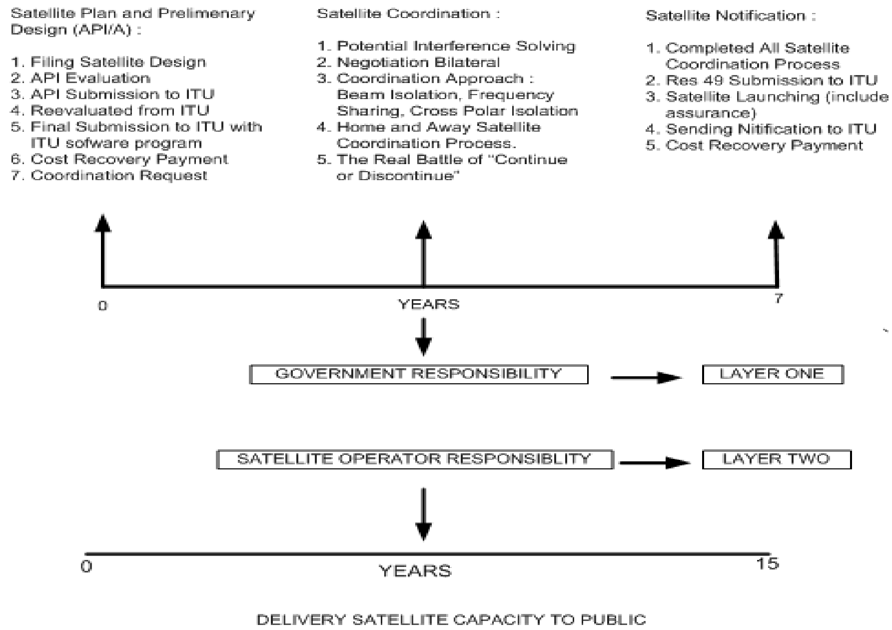

Figure 5: Space Technology Key Players on Domestic and Foreign Boundaries

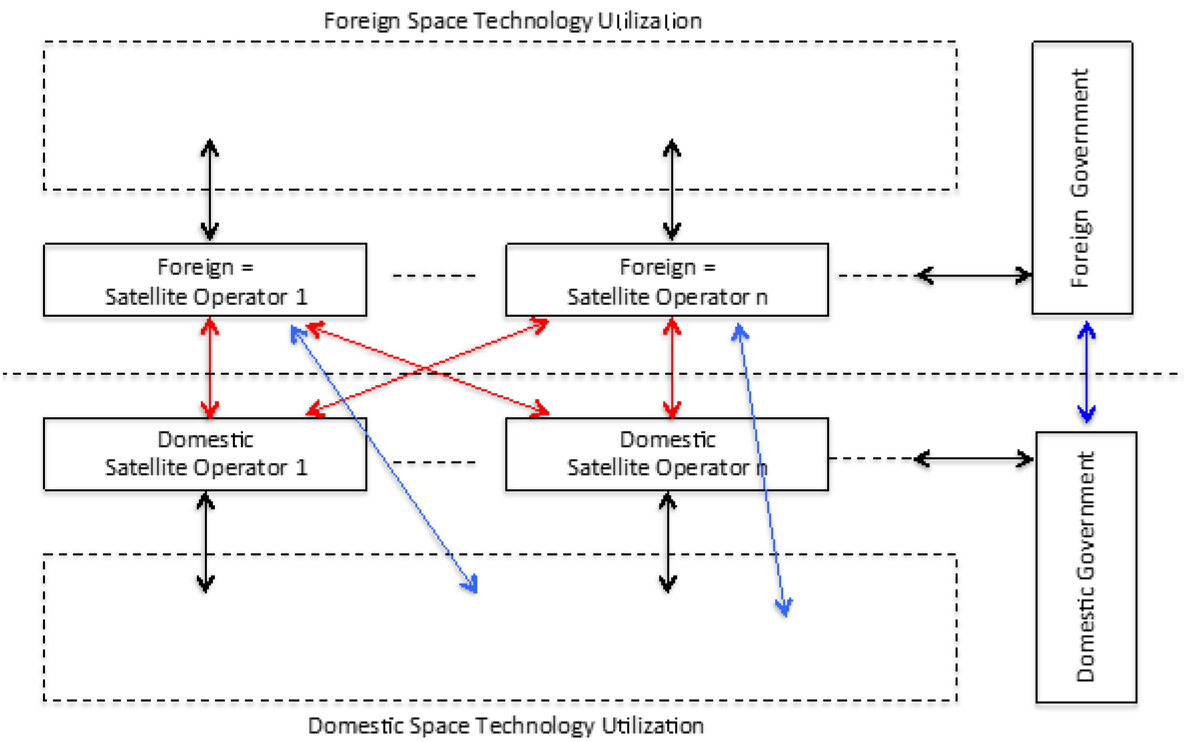

Figure 6: Consortium for the National Space Resource Access (CNSA)

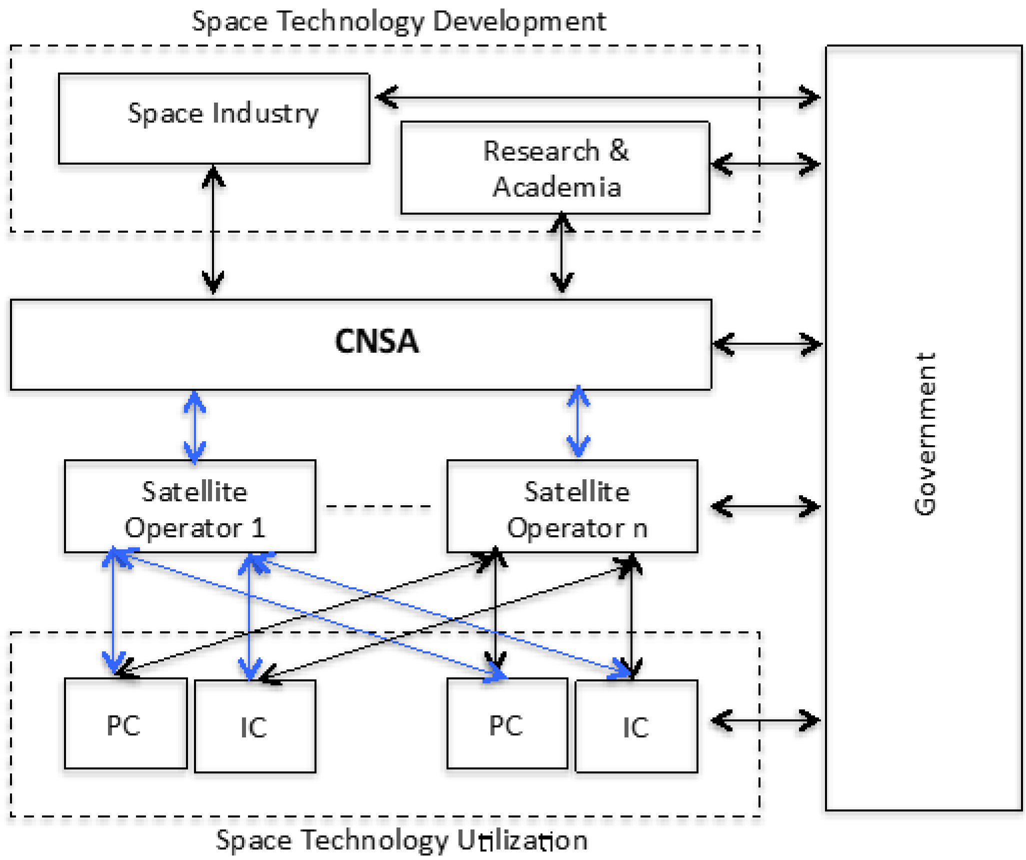

Figure 6: Consortium for the National Space Resource Access (CNSA) (continued)