Evolving Role of Space Actors: from Space race 1.0 to 2.0 and a Model for Developing Economies

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Abstract-Space technology evolution continues to steadily draw inspiration from the private business sector. With older national space agencies changing their modus operandi towards outsourcing more of their activities, private companies that have come to be termed “new space” are stepping into the shoes left behind by the bigger government monopolies that participated in the first space race (1.0). This new paradigm is aimed at creating efficiencies in the end-to-end chain of space exploration activities such that governments can focus on the core aspects of space utilization while private space companies can provide needed services that support the work of governments. The liberalization of the space economy continues to push a new competitive national and international model between new space companies that is already evolving into the modern space race (2.0). For developing and new entrants into the space sector, the question then becomes one of either replicating the pathways of older national space actors or opting instead to adopt the new paradigm of divesting some of the core space mission operations to commercial entities that have proven capacity. Where this capacity does not exist, it becomes the prerogative of governments to encourage the building and sustaining of such capacity.

Keywords: space technology; new space; space race; economy; private business; capacity; competitive model; services; liberalization

1 Introduction

The history of modern space exploration has a long and interesting series of epochal events defining its past, leading up to the present state of affairs and promises to shape the future of the global nature of space exploration for years to come[Wikipedia Timeline]. Starting with the initial launch of the USSR’s sputnik which beamed its signals as it revolved round the earth, to the United states (US) response to that singular fact that USSR had beat them to getting into space, the nationalistic and subsequently militaristic underpinnings for a domineering or conquering of space engendered the start of a space race[Sachitanand, 2018]. Dubbed as space race 1.0, the primary goals were usually driven by fear of the intentions of the other side as against the need to harness the new and fledging technology of space exploration for purposes that were peaceful. However, well scripted attempts were made by both the US and USSR to openly court the hearts of the world by their public insistence on utilizing their newly acquired technologies for peaceful benefits of mankind. These attempts could not however cause a denial of the well-known fact that certain aspects of space exploration was amenable to dual use technologies which were not always benign. The space race 1.0 was principally driven by governments which held their monopoly on the levers of space exploration in quite absolute fashion.

However, as the US overtook the USSR in certain aspects of the space exploration due to changing economic fortunes that saw the US become more dominant and USSR weaker economically, the space race weakened progressively. With the eventual end of the Soviet Union, the primary need for space exploration shifted towards more humanitarian goals. This shift also spawned the need to seek more of collaboration than competition as it remains pertinent that space is indeed a common heritage of mankind and not limited to one particular nation. This pervasiveness and impact of space on the earth is non-discriminating and ubiquitous as it cuts across the manmade demarcations of national boundaries. This has resulted in a push for more collaboration and cooperation among the major space faring nations. Such cooperation not being limited to intergovernmental agencies but also being open to the new entrants coming from the private sector that have been described as the newSpace[Tsiao, 2008]. These newspace companies now taking up more roles which were traditionally being handled by national or governmental agencies and organizations [].

The national aerospace and space administration (NASA) of the US which had previously been the sole actor of the US tasked with everything space exploration concerning the US government were probably the first to articulate a policy around the need for private space entrepreneurs. With more government focus in space exploration now channeled towards scientific and educational goals, the incentives for making the process cost efficient started to take precedence over the need for big and elaborate missions that had end-to-end government participation. It was recognized that certain aspects of any space mission could be anchored and executed by non-governmental actors who have the expertise and ultimately provide a cheaper way to get to get-to and stay in space. This realization has prompted the birth and growth of space entrepreneurs who are beginning to carve out niches for themselves, thereby giving life to the policy of pluralizing

the space for space exploration participants. The evolution of this new model for space exploration has begun to see governments yield some aspects of their space missions to private companies. This is not just true for the US but examples abound from nations all over the world who see this model as the new paradigm for an affordable and sustainable venture into space for all types of missions that can be planned(near or deep space).

A look at the number of space agencies vs newspace companies shows a steady decline in the establishment of new national space agencies in the western hemisphere where more developed nations can be found as against the rise of private space companies which has been on the increase. What can be gleaned from this data is the fact that newspace companies have seen a remarkable proliferation among the more developed economies of the world. However, the reverse trend seems to be the case for less developed nations in the southern hemisphere and in Africa in particular where the trend is more of a move towards national space agencies [Ansdell etal., 2011].

Therefore, while traditionally the onus for space exploration fell to national agencies and governmental organizations that had sole monopoly to conduct all aspects of space exploration. These agencies representing the main space exploring countries include NASA (US), Roscosmos (Russia), UK Space Agency, JAXA (Japan), ISRO (India), ESA (Europe) have begun to shift their attention away from strict monopolistic objectives towards a more liberalized operating template that incorporates private new space companies [**Bill Canis**]. It must be acknowledged that while private space companies did not start in the recent past, it is only now that a coming of age and maturity of both business and technical sides of several private companies is beginning to come to equilibrium, driven in part by government support and also by maturation of several allied technologies that makes their entrance into the space business competitive.

2 Competition, Cooperation and Collaboration

Taking the US as the first example of this new model, several private space companies have now begun changing the participant coloration of space missions to one that is in certain aspects anchored by private companies. Moving away from the model where certain government contractors were created for the sole purpose of supplying government space programs with parts and expertize, the new model sees wholly owned private companies with interests in very diverse fields participating in the space exploration process[Assessment]. Usually, these companies employ their own funding sourced from other of their business lines and utilized in building space technology capacity[Bill Canis]. Examples of US companies that fit this description include famously SpaceX, Virgin Galactic, Blue origin, Orbital Sciences Corporation and Sierra Nevada Coop amongst the more popular ones. With a commonality among these companies being their ownership by individual entrepreneurs coming from other business walks of life such as entertainment, software, electronics, service industries. Recent experience shows that NASA has started outsourcing parts of its ISS resupply tasks to SpaceX. SpaceX on its part has prepared itself with continuous improvements to its launchers and flight services such that trust in its capability continues to grow[Reflections]. Such collaboration, although paid for by the government brings has shown its potential to lower significantly the long term cost of space missions for the US government.

With the end of the USSR, the emergent Russian federation operated its space missions using the agency of government that is now Roscosmos. Although operating a well-tested and tried launch and crew delivery infrastructure, the Russians have however slowly come to the same realization that for sustainable space exploration, they must ultimately yield space and ground for private entrepreneurs to take up certain parts of their space mission execution. Although initially without a coherent policy for private space actors, there is now an official opening of the space so that some private companies which have come to form the Russian newspace sector. Some of the more renowned ones are CosmoCourse (), S7 space (peaceful rocket launch), Lin Industrials (Small satellites), Sputnix (small satellite), startRocket (orbital billboards) have now started to take up certain aspects of the previously run government space monopoly [].

The narrative in Europe isn't much different. Although Europe has long had a collaborative approach to space exploration with several countries on the European continent being active contributors to the European space research organization (ESRO) which metamorphosed into the European space agency (ESA). This shared model his able to reduce the cost for any single country and also creates a model of cooperation that has seen to the successful launch of projects like the navigation satellite system called Galileo.

In Asia, where more developing economies can be found, the trend seems to still be centered around government agencies. However private space companies are also having a shot at replacing government monopolies. The China national space administration (CNSA) has been the mainstay of Chinese space activities for a long time. Patterned after the nationalistic role space agencies have always held, CNSA activities have usually been such as to burnish the national pride and image of china as a super power and space exploring nation that should not be taken for granted. Emphasis was on showcasing dual use technologies in order to awe their competitors and garner respect of other nations [] [J. J. Lee and S. Chung, 2011].

However as recent events in the US continues to unfold with the liberalization of the role players in space exploration and the obvious results from the newspace sector, china's evolving market economy continues to push towards entrance of private space companies.

China's newspace is taking shape with help from government and have already started to play roles that were previously the sole preserve of the CNSA. Some examples of these newspace companies in China include: LinkSpace, OneSpace, iSpace, LandSpace which are into various aspects of space launch segment. One of the benefits seen in the Chinese newspace sector rests with the low investment higher returns model that has seen some western newspace companies eying the Chinese mainland for a leveraging on this cheaper production model. An example of this is Elon Musk's SpaceX which floated the idea of moving production of its rockets overseas to mainland china []

In Japan which has long since been a major player as part of cooperation in the international space station (ISS), the state owned and run Japan Aerospace Exploration Agency (JAXA) is also taking up the liberalization model with private companies like interstellar which launched its MOMO 3 rocket into orbit, space is another company which is targeting lunar delivery missions and the well-known technology heavyweight, Mitsubishi that builds rockets for heavy lift.

Other Asian countries like South Korea has the state owned Korean aerospace research institute (KARI). However a deliberate policy by the Korean government has also taken effect encouraging private space companies to enter the space technology space and create South Korea's own newspace.

3 Space Environment Joint Venture (SEJV) Agreements

Joint venture initiatives has been a business model employed by nations and multinationals. The space equivalent is the Space environment joint venture (SEJV) agreements between nations and multinationals that has been another model for successful collaboration and cooperation in space. The SEJV initiative can be defined as an international cooperation agreement which requires more than the provision by one state of opportunities to foreign states for participation in space activities planned and supervised by the inviting state [Christol, 1975]. Rather the SEJV requires the collaboration and more than casual participation of the consenting participants in the JVA. These SEJV are usually targeted at peaceful uses of space. Several successful initiatives of this kind have over time proved their utility and created immense benefits to the participating countries. Examples such as Space Station Intergovernmental Agreement (IGA) which formed the basis establishing the ISS with 15 nations [St-Arnaud et al, 2013] [ISS program].

Other broader initiatives include; The Agreement Relating to the International Telecommunications Satellite Organization of August 20, 1971, 5 which had entered into force among 86 states as of January 1, 1974; The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies of January 27, 1967,6 which had been signed by 90 states as of May, 1974; The Agreement on the Rescue of Astronauts, the Return of Astronauts, and the Return of Objects Launched into Outer Space of April 22, 1968, 7 which had been signed by 79 states as of May, 1974; The Convention on the International Liability for Damage Caused by Space Objects of March 29, 1972,8 which had been signed by 71 states as of May, 1974[Christol, 1975].

The case of India is another interesting example of joint agreement whereby the initiating party was the United Nations development program (UNDP). Here India needed to accelerate its educational infrastructure into the villages and hinterlands that were otherwise inaccessible and the UNDP gave it the needed assistance to acquire the needed satellite for communications and remiote sensing[Ansdell et al., 2011]. This move evolved into the setting up of the Indian Space research organization (ISRO) that today boasts of being one of the few or only government owned space agencies to have an almost 100% success rate of first launches for its missions while operating under a lean budget[]. With increase in revenues and economic improvement, India has itself began its space sector liberalization drive with newspace companies springing up and creating a niche for themselves in launch capacity, small satellite development and space certified equipment manufacture. Examples of these space startups include Exceedspace, Dhruvaspace, Kawa, Xovian, Earth2Orbit (E2O), Astrome, TeamIndus and Bellatrix.

4 Conclusion

Summary of the activities in the newspace sector drawn from the referenced developed and developing countries shows that a number of trends exists. Firstly, this trend is evidenced by the increasing economic fortune of the mentioned countries such that the need for knowledge based economy assumes greater importance. Space technology with its minute margin for error and cutting edge requirements is a prime example and component of such knowledge based economy. Such industries necessary to bring about this model in Africa is grossly lacking or relatively absent. This goes to stress the import that Africa's' underdevelopment has caused, with almost no real representation in the field of space technology exploration being indigenously African. Most African space ventures has been at the behest of more developed nations that usually build, transfer and even operate such

space assets sometimes on behalf of the acquiring nation. Africa's capacity in space must be ensured to exist and thrive for a new space Africa to emerge [Onuh et al., 2019].Where individual African nations operate their own space asserts, the design, development and sourcing of components are wholly supplied or procured from more developed economies, thereby tipping the scales again and continuously in favor of the provider of the service and reinforcing the notion that emphasis on knowledge based economic paradigm ultimately wins. This is the direction nations in Africa must take if they are to be taken seriously and given a place on the table.

Secondly, the knowledge–based economic paradigm means riches and revenues for the countries involved. Estimates for space technology Industry revenues, was valued at US$ 360 billion in 2018, and is projected grow at a CAGR of 5.6%, to value US$ 558 billion by 2026. Principally the demand for Nano-satellites and re-usable launch vehicle systems is anticipated to be driven by the massive investment made by countries like US, China, Russia and the European Union in the development of next generation satellite systems and the large scale procurement of such systems by countries like Saudi Arabia, India, Japan and South Korea. The United States is the largest spender in the domain with China, European Union, India, Russia, Japan and South Korea anticipated accounting for the bulk of spending [Market Report, 2018]. Again Africa will be losing out on cashing into the huge revenues that will accrue from space technology incubation unless something significant is done to buck the continued trend of over dependence on foreign technology. Maybe, the Indian paradigm of working with the UNDP to create space venture agreements that impact specific areas of Africa's economy will be a workable proposition. Areas that can gain from such infusion of support include, education, health, agriculture, security[UNOOSA].

Lastly, the role of newspace companies that are rooted in the culture of capitalist, market driven operating principles means that competition will be rife and eventually drive the cost of space exploration downwards [Reflections][Assessment]. This competition has been described as Space race 2.0[], where while more collaboration will be seen between nations, less of collaboration and more competition will be encountered among the companies making up the newspace technology space. Ultimately a developing continent like Africa has to consider jump starting its own newspace from homegrown components and actors for a sustainable participation in any SEJV. The way to achieve this for Africa must be through concerted government policies and actionable templates that are constantly fine-tuned for efficient delivery of set targets.

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