

**ANALYZING THE DEVELOPMENT PATHS
OF EMERGING SPACE NATIONS:**
Opportunities or Challenge for Space Sustainability?

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INTRODUCTION¹

The advent of emerging space nations—differentiated from established space nations in terms of both experience and capability—has changed the space environment dramatically. Growing access to space creates a variety of opportunities. For example, a technology transfer program—defined in this paper as an arrangement through which an established space actor facilitates the buildup of an emerging actor’s space program—can help promote best practices within the space community. Yet, it also raises new security concerns for the entire international space community as the space environment becomes more congested. Unless established and emerging actors agree on what constitutes acceptable behavior in space, their combined activities may threaten their continued use of this shared resource.

In this context, stakeholders have begun to engage in discussions over the long-term sustainability of space. Of note are the establishment of the United Nations (UN) Working Group on the Long-Term Sustainability of Space, and the inclusion of sustainability in the 2010 U.S. National Space Policy. Secure World Foundation co-founder and President, Cynda Collins Arsenault, described the two key components of space sustainability: “the first is the physical environment, which includes management of space debris, electromagnetic and physical crowding and congestion, and space weather...The second component is the political environment, and includes promoting stability and preventing conflict between nations.”

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Due to the distinct conditions of the space domain that force interdependences between all space actors, addressing space sustainability requires international engagement. Space debris is a particularly illustrative example, as one actor’s negligence or intentional action that creates fragments in Earth orbit poses long-term threats for all users. As evidenced by recent progress in efforts to address this issue, interdependence presents both opportunities and challenges for the advancement of space sustainability.

This paper centers on a key component of these efforts, by analyzing the dynamics of the civil space activities of six emerging space nations in three regions of the world: Africa, the Asia-Pacific and South America. It then considers both national and regional trends and, through an analysis of specific issues such as the potential adoption of the proposed *Code of Conduct for Outer Space Activities*, contributes to the ongoing and increasingly relevant discussion of space sustainability.

NATIONAL & REGIONAL ANALYSES

Asia-Pacific

India

Overview

- The first sixty years of India’s space program have focused on addressing the developing country’s domestic economic and social development challenges through remote sensing.

International Cooperation

- India’s initial space cooperative activities were mostly bilateral arrangements with the United States and Soviet Union to transfer space technology to India during the Cold War.

Development Path

- India's space launch capability can be traced to its technology transfer programs with the Soviet and American space programs in the early 1960s.
- India's space ambition continues to become more sophisticated as it grows, with a recent long-term vision of achieving the ultimate symbolic space activity: human spaceflight.

Malaysia

Overview

- Much of the driving inspiration to pursue space activities was motivated by former Prime Minister Dr. Mahathir bin Mohamad's vision to realize a knowledge-based economy for Malaysia by 2020.

International Cooperation

- Malaysia's first steps into space have utilized bilateral cooperation and microsatellite technology transfer activities with private companies in Europe and Asia.

Development Path

- In 2002, Malaysia established a formal civil space program known as Angkasa, which has since launched two successful microsatellites.
- In 2007, the first Malaysian in space was sent to the International Space Station aboard a Soyuz spacecraft through a fighter jet sale with Russia.

Asia-Pacific Analysis

Development Path

- India's development path to space is one of the first and most successful implementations of space technology transfer. Malaysia has not actively

engaged former Cold War actors for their heritage space technology, but instead has sought first steps through partnerships with microsatellite development companies.

Regional Coordination Mechanisms

- Competition between China and India for economic preeminence, as well as traditional rivalry between Japan and China, has served to delineate between countries in the region that work closely with China in space and those that do not.
- If space sustainability issues are discussed at a regional level, stakeholders should take into account the existence of two regional space bodies in the Asia-Pacific.

Asia Pacific Regional Space Agency Forum (APRSAF)

- APRSAF was established with Japanese leadership, but its participant list has swelled to include nations outside the Asia-Pacific region as well as international organizations.

Asia Pacific Space Cooperation Organization (APSCO)

- The Chinese-led APSCO has nine members, and far stricter membership requirements.

Shared Challenges

- For India, Chinese space cooperation with other countries means continued Chinese expansion into areas in which India might like to lead.
- Malaysia may be forced to make an important decision in the near term on which space power to align with in the region, particularly as the country looks to utilize launch

vehicle services from India, China, or neither of the two.

South America

Brazil

Overview

- Brazil has long considered space a natural step to pursuing national and international goals. The space program was established in the 1960s and has sought to promote: resource management, economic development, and international prestige. Its focus areas are remote sensing and launch infrastructure.

International Cooperation

- For Brazil, space cooperation, supports a foreign policy shift that de-emphasizes U.S.-Brazil ties and seeks greater autonomy through diverse international partnerships, particularly with developing countries and emerging powers.

Development Path

- As part of a larger strategy to harness science and technology for economic development, Brazil has focused on technology transfer activities to support the development of indigenous capabilities. Future success will depend on resource allocation and public support.

Venezuela

Overview

- The space program began in 1999 as part of an initiative to exploit science, technology and innovation for economic development within the Bolivarian socialist revolution. Its first program was highlighted for its

social component, as part of efforts to promote access to advanced technologies.

- Venezuela aims for indigenous satellite development to address both national and regional goals and is moving to develop its first remote sensing satellites.

International Cooperation

- Cooperation is a priority for technology transfer and capacity building.
- Bilateral engagement has been shaped by national policies: strengthening national sovereignty, promoting regional integration and favoring developing countries. According to Venezuela, China is its most important strategic ally in space.

Development Path

- While used to voice the socialist development strategy, space initiatives respond to clear national needs. Continued growth will depend on expanded international partnerships.
- Public support is of concern due to criticisms over spending priorities. This may increase the leadership's emphasis on the program's political and ideological justifications.

South America Analysis

Development Path

- Differences in scope and goals help explain most differences between the two programs. In addition, Venezuela seeks to advance its regional integration goals through technology-transfer projects. Brazil is focused on growing its position as

an international power with activities supporting power projection.

Shared Challenges

- Geographic conditions and a common economic and political heritage impact programmatic decisions. Emphasis on remote sensing applications supports the ability to manage resources for economic, social and political goals. Funding constraints hamper justifying other, seemingly impractical, space investments.
- Sustaining public support for space is a recurring problem. Links between space-based assets and the public services they provide is unclear and hampered by a lack of scientific literacy.
- The future stability and growth of space programs in the region is still a question. Unless concerted efforts are made for enhanced public and political awareness of national priorities secured through space, efforts could remain limited to niche pockets of activity and space programs will exist under constant risk.

Regional Coordination Mechanisms

The Space Conference of the Americas (CEA)

- CEA was created to build up space capabilities in the region. It has given voice to the creation of a regional space agency, but with varying levels of support. Continued development of national space programs may be a prerequisite for coordination efforts to succeed as the asymmetry between actors evens out and risk is better distributed.

Africa

Nigeria

Overview

- Nigeria justifies its space program by using space technologies and their applications to address socio-economic challenges and further national development.

International Cooperation

- To acquire its satellites, Nigeria used partnerships with Chinese and British companies that include training programs for Nigerians in satellite manufacture and operations.
- Nigeria is a prominent player in intra-African space collaboration.

Development Path

- While strategic partnerships have been key to the success of its space program, Nigeria does not have the domestic capability to build or launch satellites and will most likely continue using partnerships to further develop its program in the near term.

South Africa

Overview

- South Africa focuses on using satellite applications for national development (e.g., improving water management, diversifying exports).
- South Africa is the only African country to have built a satellite indigenously.

International Cooperation

- South Africa is a prominent player in intra-African space collaboration, as well as a notably active participant in the international space community.

Development Path

- South Africa's homegrown satellite manufacturing capabilities set it apart from other African nations; government support has been key to the industry's success.
- South Africa has used capacity building opportunities in other areas, particularly satellite operations, to capture knowledge exchange and later apply it to national activities.

Africa Analysis

Development Path

- Both Nigeria and South Africa use space applications to address national development needs and aim to establish indigenous space capabilities to promote regional leadership.
- Their paths toward establishing domestic satellite manufacturing capabilities differ: Nigeria partners with foreign companies to import expertise, while South Africa uses small satellite projects to build from the bottom up.
- Their common pursuit of regional leadership in space could weaken regional activities, while their shared challenges could encourage more cooperation.

Regional Coordination Mechanisms

- African space projects have typically involved non-African partners or have been run by a single African country. Recently, two purely intra-African initiatives have emerged.

African Resources and Environmental Management Satellite Constellation (ARMC)

- Nigeria, South Africa, Algeria and Kenya form ARMC; they aim to develop African-made satellites to address regional needs and build up regional capabilities. Although no hardware exists yet, ARMC has brought together key African space nations with top-down support from the highest levels of government, critical for program sustainability.

African Leadership Conference on Space Science and Technology for Sustainable Development (ALC)

- ALC is a regional forum for African decision-makers and space professionals to exchange information in a non-technical, high-level manner that emphasizes the benefits of space technology for Africa's sustainable development.

Shared Challenges

- A key driver of regional space initiatives in Africa has been the application of satellites to address common challenges facing developing countries, such as managing scarce resource and large populations that are dispersed over vast and underdeveloped territories.
- Africans often lack understanding of how satellites aid socio-economic development. Finding political and public support for investing limited resources in space projects challenges African space bodies that are just beginning to find their footing.

CASE STUDY: THE DRAFT CODE OF CONDUCT FOR OUTER SPACE ACTIVITIES

This section serves as an exercise in applying the previous analysis to an existing mechanism for addressing space sustainability: the European Union's proposed draft *Code of Conduct for Outer Space Activities*. The Code outlines acceptable behavior in space, recognizing that the environment's growing use creates security and sustainability concerns that necessitate the establishment of a shared understanding. The Code also includes consultation mechanisms to enhance transparency and information exchange; it has no enforcement or verification mechanisms, consistent with its purpose to preserve the space environment, rather than restrict it.

Although the Code has European origins, its content largely reaffirms existing legal frameworks, declarations and principles for space activities that have been widely vetted by the international space community. The Code also serves as a basis for consultations with third parties, and invites other nations and space-related organizations to adhere to its contents.

As both South African and Nigerian space programs focus on addressing national development needs, their attention to space sustainability remains limited. Nonetheless, South Africans actively participate in space sustainability talks at the international level, for example by chairing the UN Working Group on the Long-Term Sustainability of Space. Nigerians attend international space forums that feature discussions on space sustainability, indicating that they are staying informed. For the foreseeable future, however, actively addressing space sustainability on national or regional levels will likely take a second seat to the national development priorities that remain the primary focus of African space programs.

India's growing interest in space for soft power purposes suggests a willingness to address space sustainability issues, as space powers are expected to confront such matters. India has already acknowledged the space debris issue, stating that any anti-satellite weapon it constructs will not create fragments in Earth orbit. However, recent public statements from Indian space officials suggest that serious hesitancy, if not outright opposition, toward the Code exists on the subcontinent. The rationale for Malaysia's space program, along with its engagement in regional and international space organizations, suggests it may consider the Code even though no public statements have been made directly on the issue. China's stance on the Code may influence the adoption by some space nations in the Asia-Pacific, such as India, though less politically influenced countries like Malaysia may pay little regard to China's stance.

Brazil and Venezuela have strikingly similar attitudes toward space sustainability issues, with specific concerns over underlying principles and appropriate forums. Both have indicated a keen understanding of space sustainability, with a Brazilian official, José Monserrat Filho, describing it as those steps that allow human space activities to develop in a way that is "not wild, not destructive, not uncontrolled, but orderly, studied, calculated, rational, predictable, preserving natural resources so that these can be used both by those who live today as by the future generations." Their attitudes toward these issues also suggest that both countries see the voluntary Code as only a first step toward the development of a binding treaty for consideration within the UN. Although these similar views may facilitate interaction with South America on further development of the Code, their concerns appear to conflict with those of established space actors and could create lasting challenges.

These views of emerging space nations appear to vary on the Code. For those that are receptive, this is encouraging as a primary benefit of the Code is its role as a guide for emerging space nations that are just learning to operate in space. Indeed, by providing consultation mechanisms, rather than enforcement mechanisms, the Code serves as a constructive mechanism through which more established space nations can engage and educate these emerging actors without appearing overbearing.

THE UNITED STATES & EMERGING SPACE NATIONS

An interesting theme emerging from this research was the nature and extent of U.S. cooperation with emerging space nations. The United States has limited its bilateral partnerships with the actors under study, focusing primarily on projects that avoid technology transfer due to U.S. national security concerns. This is in stark contrast to other established space nations, including China and the United Kingdom, which have actively engaged in programs specifically designed to transfer space technologies to emerging space nations.

Technology transfer programs have been an important feature of nascent space programs. Each of the six nations examined in this study used some form of technology transfer program to aid the development of their space capabilities, often serving as the foundation for follow-on efforts.

These programs take a variety of different forms, most notably government-to-government bilateral agreements and commercial contracting. For example, Indian engineers worked with the United States and the Soviet Union during the 1960s to enable its indigenous launch vehicle and satellite capabilities. Malaysia and Nigeria have each partnered with Surrey Satellite Technology to develop their first

civil satellites, while Nigeria and Venezuela procured their first communications satellites through the China Great Wall Corporation. Such commercial contracts often include extensive training for local scientists and engineers in areas such as satellite manufacturing and operations.

With the growing proliferation of space capabilities in the post-Cold War era, emerging space actors now have a variety of partnership choices when developing their nascent space capabilities. While China's participation in such partnerships is increasingly clear, the United States has had few technology transfer programs with emerging space nations in the last decade. In trying to pinpoint the reasons for this vacuum, certain U.S. policies, such as current export controls, discourage, if not outright prevent, U.S. participation in technology transfer programs that have been a hallmark of the development of emerging space actors. The U.S.-Brazilian space relationship, for example, was soured when Brazil demonstrated intentions to develop indigenous launch capability; motivated by nuclear proliferation concerns, the United States put pressure to prevent the initiative. While scientific cooperative activities still continue, the United States has stepped back as a major partner of Brazil's emerging space program.

While these U.S. policies aim to prevent the transfer of sensitive, potentially dual-use space technologies, they also preclude a valuable avenue for the United States to relay space sustainability norms to the increasing number of actors that are just learning to operate in the space environment. Indeed, technology transfer programs do far more than simply move hardware across borders; they also export mature spacecraft design, manufacturing and operational approaches. For instance, in the aftermath of the 2003 Alcântara launch center disaster, Russian experts pinpointed

safety at the launch pad as a main concern and have since cooperated with Brazil to bring the facilities up to standard.

Proliferation of best practices and responsible behavior in space can be made possible through these technology transfer programs. By playing a comparatively smaller role in such activities while other countries move forward, the United States is missing a significant opportunity to advance space sustainability in a manner consistent with U.S. policies.

CONCLUSION

As space sustainability issues are relevant to all space actors, their promotion should be addressed on an international level. Part of this requires forging an understanding of the rationale and development paths of all space actors, in particular emerging ones. After analyzing three regions of emerging space activities, this paper has shown that opportunities and challenges exist in engaging these actors in the promotion of space sustainability.

Important similarities across all three examined regions offer opportunities for space sustainability advancement. A prime example is their shared need for remote sensing satellites, regardless of differences in the rationales or development paths of their space programs. These countries now recognize the value of remote sensing satellites to national development, and thus understand the negative repercussions that would occur if these capabilities were lost. For example, a space debris impact resulting in the destruction of an emerging space nation's remote sensing satellite could be a serious setback to national development efforts; these countries often have only one remote sensing satellite and lack the resources to launch a replacement spacecraft in the near term.

Another key trend among emerging space nations is their reliance on international partnerships when developing their space programs. In this diverse environment, cooperation assumes a different form from the Cold-War era, as there are more opportunities for interaction. This provides emerging actors with added freedom to choose from a variety of partners to advance their space programs. Space activities are no longer isolated; developments in Africa, Latin America or Asia-Pacific are not limited to these emerging regions, but result from complex interactions taking place all over the world. Such diversity opens avenues of potential risk, but also creates opportunities for interaction between emerging and established space actors, particularly in sustainability discussions. While the United States has played a limited direct role in the emergence of these space actors, greater involvement in technology transfer programs may help promote responsible behavior in space.

These emerging actors also share common challenges that threaten young space programs, such as lack of public awareness and questionable long-term political support. Such challenges make the space activities of emerging space nations particularly vulnerable to funding cutbacks or cancellations. The need to stay on track in order to avoid exacerbating these risks could drive compliance on space sustainability issues, even in the absence of more traditional mechanisms for enforcement, such as binding laws or market forces.

Differences among these emerging space nations equally inform discussions on space sustainability. These countries feature a variety of motivating rationales for participating in space activities, as well as differing technical capabilities, even within each region. These differences must be taken into account when engaging emerging

space nations in space sustainability discussions, as they will dictate the specific issues most relevant to their space programs.

Lastly, regional dynamics could also have significant potential to affect space sustainability. The regional space coordination mechanisms examined in this paper illustrate varying degrees of political alignments and operational philosophies: South America's forum is unlikely to lead to a regional space agency in the near future, while the Asia-Pacific remains divided between two established cooperation entities; Africa is just starting several initiatives in a coherent manner with high-level government support. Unstable

political, economic and social environments within these regions also pose challenges to the survival of younger space programs, as well as their ability to take on space sustainability actions. Nonetheless, the universal recognition among all six countries that space is important for national development helps to promote space sustainability.

All of these considerations must be taken into account in the promotion of space sustainability measures, in order to ensure the continued and expanded use of a limited resource upon which more actors are becoming increasingly dependent.