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Article

African Growing Space Industry Challenges and Prospects

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Abstract: Space exploration and exploitation have become a necessary tool for industrialization, growth, and development of any nation. The role of space technology cannot be overemphasized in the development and industrial fortunes of most developed economies and has played a major role in the quick transformation of developed nations not only in Africa but all over the world. This article adopted multifaceted techniques, including case study and secondary data obtained from peer-reviewed journal articles, textbooks, reports from government publications, and other sources in the related research area, to identify the current space gaps in Africa. This paper addresses these gaps by providing an integrated review of the current status of Africa's space industry, identifying the principal challenges to its development, and evaluating future prospects within the broader context of sustainable development and the evolving global space economy.

Keywords: Africa, Space programme, African Space Agency, Space Economy, Satellite Technology, Commercialization, Sustainable Development

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1. Introduction

As the world becomes increasingly dependent on satellites and other space technology, new participants from every global region are joining the space club to reap the benefits expanding communication and navigation capabilities guiding policies with Earth observations, developing economies through growth in space ventures and deepening our understanding of the cosmos through exploration [1]. Consequently, countries are focusing on job opportunities, competitiveness, national security, and having a voice in the global governance of space activities. Africa not only has a growing interest in space, but African countries are realizing that there is strength in pooling their resources and efforts to grow the continent's outer space enterprise. The African Union [2] adopted the African Space Policy and Strategy, with the goal of creating an integrated African space programme that is responsive to the social, economic, political, and environmental needs of the continent. Another goal is to develop a regulatory framework that supports Africa's competitiveness in space while ensuring that Africa is a responsible and peaceful user of outer space. The space industry has grown from its roots in government-led missions to a dynamic sector brimming with private enterprises, ambitious ventures, and cutting-edge technology [3]. While the US and other advanced economies have traditionally led the space race, Africa is also leveraging the power of space technology for innovation development and societal benefits. In 2021, the valuation of the

African space industry was £16.16 billion and is set to grow to £18.77 billion by 2026. To date, African governments have invested over £2.3 billion in the space industry over the last seven years; this figure does not include private sector investment or grant activities [4]. Figure 1 shows the year-on-year government budget from 2018 to 2024.

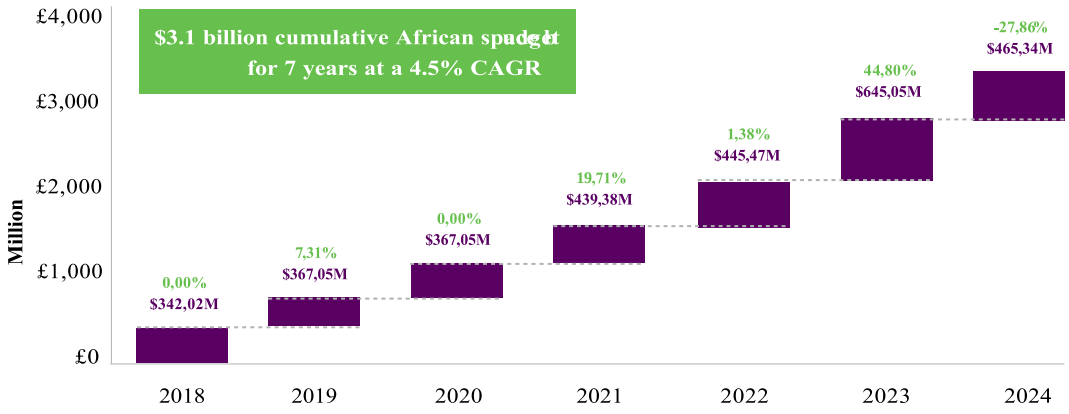


Figure 1. Space Industry Budgets - African governments (Space in Africa2024)

This trend shows the commitment of governments to continue investing in the development of the space sector, even in the face of other financial and economic challenges. Collaboration has been beneficial in unlocking the value of Africa's space industry. With over 400 space institutions across the continent and more than 25 national space programmes, Africa is actively working to harness the industry's social and economic benefits. From 2000 to 2023 and beyond. African nations entered into over 166 bilateral space agreements, involving more than 100 institutions from 32 countries globally. About 90% of these agreements are with international, non-African stakeholders, reflecting the continent's strong focus on global partnerships. In the past three years alone, 89 new agreements have been signed, signaling a rapid increase in collaborative efforts. Adetola, A. [5]. Space technology is a relatively nascent industry across most countries on the African continent; however, there remains a wide array of technologies developed and already in use in various applications. African companies or governments and shows the proportion of large and small satellites being used for earth observation and communication services, respectfully. Over 150 satellite ground stations are in operation in Africa. Space in Africa. The stations are used for receiving and processing data from satellites, supporting communication networks, providing internet connectivity, facilitating remote sensing applications, and enabling satellite-based navigation and tracking. Figure 2 outlines the distribution of satellite ground infrastructure available on the continent.



Figure 2. Distribution of Ground Stations in Africa((Space in Africa, 2024)

The African Space Agency

One of the most important milestones in Africa's space development was the establishment of the African Space Agency (AfSA). The Agency was created under the African Union Space Policy and Strategy to coordinate continental space activities, strengthen collaboration among member states, and maximize the socioeconomic benefits derived from space technologies [6]. The African Space Agency (AfSA) seeks to harmonize national space policies, promote scientific research, facilitate technology transfer, strengthen human capacity development, and encourage international cooperation. The agency also aims to reduce duplication of investments by coordinating regional satellite programs and promoting shared infrastructure across African countries. Through AfSA, African countries are expected to improve access to Earth observation data, navigation services, satellite communications, and climate information. These services are particularly important for addressing challenges related to food insecurity, natural disasters, water resource management, public health, and environmental sustainability. The Agency further provides an institutional framework for engaging with international partners such as the European Space Agency (ESA), the United Nations Office for Outer Space Affairs (UNOOSA), the National Aeronautics and Space Administration (NASA), the China National Space Administration (CNSA), and the Indian Space Research Organization (ISRO).

Growth of Africa's Space Industry

Africa's space industry has expanded considerably over the past two decades, reflecting growing recognition of the strategic importance of space science and technology for sustainable socioeconomic development. According to UNOOSA [7], more than twenty African countries now operate space-related programmes, while over fifteen have successfully launched satellites for Earth observation, communications, scientific research, navigation, and technology demonstration. The establishment of national space agencies has been a major driver of this growth. Nigeria created the National Space Research and Development Agency (NASRDA) in 1999 to coordinate national space activities. Since then, the country has launched several satellites, including NigeriaSat-1, NigeriaSat-2, NigeriaSat-X, NigComSat-1R, and EduSat-1, supporting disaster management, environmental

monitoring, telecommunications, agricultural planning, and national security. South Africa has developed one of Africa's most advanced space programmes through the South African National Space Agency (SANSA). The country has invested heavily in Earth observation, satellite engineering, space weather monitoring, and astronomy, including its participation in the Square Kilometre Array (SKA), one of the world's largest radio astronomy projects. Egypt has emerged as another continental leader through the establishment of the Egyptian Space Agency and its role as host of the African Space Agency. The country has invested in satellite manufacturing, remote sensing, and regional capacity-building initiatives, positioning itself as an important hub for space science and technology in Africa. Other countries, including Algeria, Kenya, Rwanda, Ghana, Ethiopia, Angola, Morocco, Tunisia, and Mauritius, have also expanded their space programmes through satellite launches, international partnerships, and investments in Earth observation and telecommunications. Kenya's space programme has supported environmental monitoring and scientific research, while Rwanda has promoted satellite applications for digital transformation and precision agriculture. Ghana has strengthened national capacity through the Ghana Space Science and Technology Institute and university-led satellite projects. In addition to government programmes, African universities have become increasingly involved in satellite engineering, CubeSat development, and space research. Collaborative projects with international institutions have enabled students and researchers to acquire practical skills in spacecraft design, satellite operations, remote sensing, and geospatial analysis. These initiatives contribute to the development of indigenous expertise and reduce long-term dependence on external technical support overall, the expansion of national space agencies, increased satellite launches, greater investment in research and development, and the establishment of the African Space Agency demonstrate that Africa's space industry is entering a new phase of institutional maturity and technological advancement.

Prospect of African Space Industry

The African space industry is a rapidly growing sector valued at over $22 billion that focuses heavily on utilizing space-for-earth applications like telecommunications, remote sensing, and agriculture. Space in Africa [8]. About 59 satellites have been launched by African nations, with an estimate of 110 African satellites launched by 2030. South Africa and Egypt are the leading African countries with satellites in space driven by their historic satellite capabilities and strategic applications in the telecommunications industry [9]. South Africa is the largest player in Sub-Saharan Africa, having launched 12 satellites, displaying its capacity for satellite deployment and signifying its leadership in African space technology. According to current plans, 24 countries in Africa will have launched a satellite by the end of the decade. The African space sector has experienced rapid expansion due to the establishment of national space agencies such as the National Space Research and Development Agency (NASRDA) in Nigeria, the South African National Space Agency (SANSA), and the Egyptian Space Agency (EgSA) [10]. The launch of satellites for communication, navigation, and Earth observation has strengthened socioeconomic development across the continent [11]. Furthermore, the establishment of the African Space Agency (AfSA) reflects the African Union's commitment to fostering regional cooperation in space science and technology [12]. The future of Africa's space industry is promising. Increasing demand for satellite-based communication, Navigation, earth observation, and climate services are expected to drive further investment. The expansion of commercial space activities, stronger regional cooperation through the African Space Agency, and advances in artificial intelligence, data analytics, and satellite technologies provide new opportunities for innovation. Space technology will continue to play a critical role in disaster risk reduction, climate change adaptation, precision agriculture, environmental monitoring, and digital connectivity across Africa.

2. Materials and Methods

This paper adapts various approaches to identify the current African growing space industries, its future prospects, and challenges in Africa. The work conducts a thorough study of the literature,

academic papers, and selected review of space research publications. Based on a comprehensive analysis of secondary data. Relevant information was also obtained from peer-reviewed journal articles, books, conference proceedings, government publications, policy documents, and reports produced by international organizations. Key sources included publications from the African Union, the African Space Agency, the United Nations Office for Outer Space Affairs, the Organization for Economic Co-operation and Development, the World Bank, and national space agencies such as the National Space Research and Development Agency, the South African National Space Agency, and the Egyptian Space Agency. Collected literature was analyzed using thematic content analysis. Information was categorized into major themes, including the evolution of Africa's space industry, institutional development, commercialization, technological innovation, challenges, opportunities, and policy interventions.

This study adopted a qualitative review research design based on secondary data analysis to examine the growth, challenges, and future prospects of Africa's space industry. A systematic review of existing literature was conducted using peer-reviewed journal articles, books, conference proceedings, government publications, policy documents, institutional reports, and publications from international organizations. The review focused on literature published between 2019 and 2025 to ensure that recent developments in Africa's space ecosystem were adequately captured.

3. Results and Discussion

Findings reveals that despite the significant progress made by African countries in developing their space capabilities, the continent continues to face several structural, financial, technological, and human resource challenges that hinder the growth of its space sector. These challenges have their roots in historical, economic, and institutional factors and continue to limit Africa's competitiveness in the global space economy, some of these challenges includes:

Lack of Funding

Insufficient and inconsistent funding remains the greatest obstacle to the development of Africa's space industry. Compared with major space-faring nations such as the United States, China, Russia, and India (Fig. 3). African investment in space activities remains relatively small [13]. According to the African Space Industry Annual Report **[**14**]**, African governments collectively allocated approximately US$465 million to national space programmes in 2024, representing a 27.86% decrease from the previous year due largely to currency depreciation across several African economies [15]. Between 2018 and 2024, African governments invested approximately US$3.1 billion in space programmes, excluding expenditures on major communication satellites and external donor contributions. Limited domestic investment affects satellite development, research infrastructure, launch capabilities, and capacity building. Consequently, many African countries continue to rely heavily on foreign funding, international partnerships, and development agencies for financing major space projects.

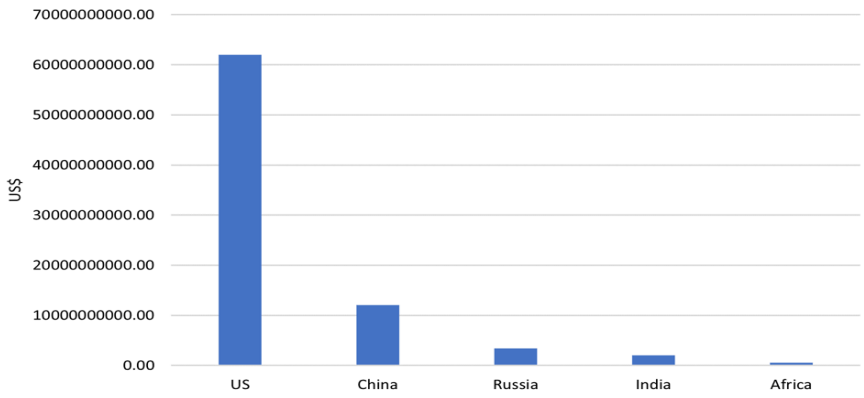


Figure 3. A comparative graph of space program budgets in the US, China, Russia, India, and Africa Source (Statista)

Limited Space Infrastructure

Africa also faces significant infrastructural limitations. The continent possesses relatively few operational facilities for spacecraft development, satellite testing, launch operations, and mission control. Although Africa hosts approximately eleven known launch facilities, only three are currently operational. Consequently, African satellites are almost exclusively launched aboard rockets operated by foreign agencies or commercial launch providers in Europe, Asia, Russia, India, or the United States. The absence of indigenous launch capabilities increases project costs, creates scheduling dependencies, and limits strategic autonomy. Furthermore, no African nation has yet conducted a human spaceflight program due to the enormous financial, technological, and operational requirements associated with crewed missions.

Challenges in Space Data Utilization

While Earth observation satellites generate large volumes of environmental, agricultural, climate, and disaster management data, many African institutions lack the technical capacity to effectively process, analyse, and apply these datasets. According to Kimani [16], although Africa has access to extensive satellite-derived information, many meteorological agencies do not fully utilise these datasets because of inadequate technical expertise, limited computing infrastructure, and insufficient training. The under -utilization of satellite data has significant consequences for disaster risk reduction. For example, Tropical Cyclone Idai, which struck southeastern Africa in 2019, caused more than 1,500 deaths and widespread destruction across Mozambique, Zimbabwe, and Malawi [17]. Improved satellite-based weather forecasting and early warning systems could substantially reduce the loss of lives and property from such disasters. Similarly, lightning-related fatalities remain common in several African countries, including Kenya, highlighting the need for enhanced operational use of space-based meteorological information.

Shortage of Skilled Human Capital

Human capital development remains another major challenge confronting Africa's space industry. The continent experiences shortages of scientists, engineers, satellite designers, remote sensing specialists, data analysts, aerospace lawyers, and space policy experts. According to the African Space Industry Annual Report, Africa's space workforce comprises approximately 19,000 professiona**ls**, compared to more than 183,000 employees in the United States space sector. The shortage reflects limited educational opportunities, inadequate research funding, and the migration of highly skilled professionals to developed countries. Building a sustainable African space ecosystem, therefore, requires substantial investments in higher education, research institutions, technical training, and professional development across disciplines, including aerospace engineering, artificial intelligence, remote sensing, satellite manufacturing, space law, and diplomacy. Equally important is the need to retain skilled personnel through competitive salaries, career advancement opportunities, and improved research environments.

4. Conclusions

As a source of national pride and human achievement, harnessing the benefits of space for Africa by Africans becomes imperative if Africa must quicken and sustain its industrialization. However, considering the resource constraints faced by many African nations and the common challenges shared by most African countries, it has become pertinent to propose the creation of a common space agency driven by the multiplier effects of synergy, efficiency, and cost cutting an Africa-wide space agency styled after the European Space. Agency should form a viable and practical tool for establishing Africa as a continent of spacefarers and space technology experts. Although Africa's space industry has experienced remarkable growth over the past two decades, significant obstacles remain. Limited funding, dependence on international partners, inadequate infrastructure, underutilization of satellite data, and shortages of skilled professionals continue to constrain the continent's ability to fully harness the socio-economic benefits of space technology. Addressing these challenges through sustained investment, stronger regional collaboration, human capital development, and improved policy implementation will be essential for achieving Africa's long-term

space ambitions and enhancing its contribution to the global space economy. To fully leverage the benefits of the space sector, African countries need to focus on institutional development and strengthening, investment in education, promoting private sector participation, and fostering international collaborations. By prioritizing space-based solutions to address sustainable development goals, building a solid regulatory framework, and enhancing satellite infrastructure. African governments should increase investment in space research and development to build indigenous technological capacity. Greater emphasis should be placed on STEM education and workforce development to address shortages of skilled professionals Governments should also encourage public–private partnerships, strengthen national space legislation, Member states should promote local satellite manufacturing, and enhance regional cooperation through the African Space Agency.

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