

Science and Technology Entrepreneurship for Economic Development in Africa (SEEDA)*

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Abstract— Entrepreneurship has been proven not only to be the impetus for growth and economic prosperity, but also serves as the foundation for the transformation of the modern economies. Equally, entrepreneurship has emerged as a viable option to spur local economic development in downturns. Nevertheless, entrepreneurs' ability to move technology from the scientific discovery stage to commercially successful products/services is central to that transformational process. Unfortunately, there is an apparent dearth of science and technology (S&T) entrepreneurship capital in Africa. The result is the near non-existent productive capacity of the continent, with very minimal potentials for value addition, with the resultant effects of low capacity for wealth creation and increasing levels of unemployment. In this paper, we propose the Science and Technology Entrepreneurship for Economic Development (SEEDA) initiative, which is to be patterned after the Science and Technology for Economic Development (SEED) initiative of the Ibero American Science and Technology Education Consortium (ISTEC) with the objective of creating new companies with technology expertise, business knowledge and market in Africa. In section 2, we introduce the SEED initiative, and in section 3 we situate it in the context of an African technology-driven development initiative. We conclude with recommendation in section 4.

Index Terms— Africa, science and technology entrepreneurship, technology and innovation management, socio-economic development, South Africa

1 INTRODUCTION

ENTREPRENEURSHIP is a burgeoning global phenomenon and its importance is recognised in modern business practices (Higher Colleges of Technology, 2010) as the entrepreneur is the single most important player in a modern economy (Lazear, 2002). The Global Entrepreneurship Monitor (GEM) hypothesised that the entrepreneurship conditions in a region will stimulate every entrepreneurial activity which in turn stimulates regional economic growth (Reynolds et al., 1999). The entrepreneur is an important engine for the growth of the economy (Khanduja et al., 2008; Blanchflower, 2007; Sriram and Mersha, 2006). Clearly, entrepreneurship is emerging as a viable option to spur local economic development in downturns (Beaulieu and Barefield, 2006) and entrepreneurship is frequently pinpointed as the most effective way for those without much experience or political clout to engage in their country's economic development (CIPE, 2010). For instance, OECD/EC (2013) maintains that entrepreneurship has become an important requirement for achieving sustainable and inclusive growth in Europe. This is according to the OECD is because, it has great potential for creating jobs and reducing unemployment, not just in the population in general,

but also among people who are vulnerable to social exclusion. Consequently, entrepreneurship has become a political priority in the EU since the launch of the Lisbon Agenda in March 2000. Consequently, within the last decades, entrepreneurship has ascended to the centre stage in the public policy arena of most countries as reflected in several major policy initiatives around the world (Reynolds et al., 1999).

Equally, science, technology, innovation and entrepreneurship have been proven, not only to be the impetus for growth and economic prosperity, but also serve as the foundation for the transformation of the new economy (Sankat, 2010). A large body of academic research and real-world business experience has established a clear connection between entrepreneurship, innovation and economic growth (Ernst and Young, 2009). Nevertheless, most importantly, moving technology from the scientific discovery stage to a commercially successful product is one of the major drivers of economic development in today's world order (Jordan et al., 2006). Unfortunately, there is an apparent dearth of science and technology (S&T) entrepreneurship capital in Africa, a situation that has led to the near non-existent productive capacity of the continent, with very minimal potentials for value addition, with the resultant effects of low capacity for wealth creation and increasing levels of unemployment. Based on the Science and Technology for Economic Development (SEED) initiative of the Ibero American Science and Technology Education Consortium (ISTEC), an initiative whose objective is the creation of new companies with technology expertise, business knowledge and market in New Mexico, Iberia, Latin America, and other participating countries.

The reason for this initiative (SEED) was predicated on the observed fact that among other things, the Ibero American region lacked current information for planning and developing technology; lack of expertise in the use of information; lack of international cooperation in developing the critical mass

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needed for projects and joint efforts; lack of interaction among universities, industries, governments, and international agencies; and lack of availability of technology. Nearly in all ages, Africa had shared most of the characteristic of Latin American countries and the Caribbean, and true to type, all the above observed short comings are vividly evident in the continent and in addition, Africa lacks technology and innovation management expertise; poorly funded higher education sector resulting to low rankings in the world's top universities ranking table; low levels of research, development and innovation (RDI) funding; poor intellectual property rights regimes; and weak regional and national systems of innovation.

The SEEDA initiative advocated in this paper among other things is to galvanise African governments, the organised private sector and the intelligentsia into a platform that will foster the creation of science and technology entrepreneurs for the technological and socioeconomic development of the continent. In such a platform so advocated, South Africa is suggested to be the node or gateway. South Africa the continent's biggest economy with capabilities in world class technologies, a vibrant manufacturing sector, has Africa's leading universities and been fairly consistent in producing some of the world's first 500 universities over the years and her University of Pretoria reputed to be having top project management expertise with the first Graduate School of Technology Management in the continent. This paper is therefore intended to lay in proper perspective, the SEEDA initiative, its objectives and the intended modes of operation, the nodal country as well as the university to set the stage for the development of S&T entrepreneurship for sustainable economic development of the African continent.

2 THE SEED INITIATIVE IN BRIEF

The Science and Technology Entrepreneurship for Economic Development initiative according to Jordan et al (2006), was a project of the Ibero-American Science and Technology Education Consortium. Started in 2004, the SEED initiative involves symposium where technology start-ups present their business plans to angel investors, venture capital firms from the region. The SEED project was a response from ISTEAC to tackle some of the challenges of the Ibero-American region, some of which included: -

- Lack of current information for planning and developing technology;
- Lack of expertise in the use of information;
- Lack of international cooperation in developing the critical mass needed for projects and joint efforts;
- Lack of interaction (lack of confidence) among universities, industries, governments, and international agencies; and
- Lack of availability of technology (Jordan et al., 2006).

Among other things, leveraging on the New Mexico capabilities in science and engineering at the University of New Mexico (UNM), Sandia and Los Alamos National Laboratories along with the Management of Technology Programme at the Anderson Schools of Management, SEED sought to build a new model that blended business expertise and technical knowledge to benefit the economic, social and cultural devel-

opment activities in Ibero America, New Mexico and the US by way of enhancing the international research and education agenda of US and Ibero-American universities and scientific institutes through technology commercialization activities.

While the broader objective of the SEED initiative is to create new companies with technology expertise, business knowledge and market from all participating countries, the aim of the programme was to:

- a) Develop research programs investigating technology forecasting and assessment processes across international markets by developing new and novel market research procedures and tools for technology-based products across international markets;
- b) Identify and examine research technology entrepreneurship issues in Ibero America across all scientific disciplines with emphasis on information technology, wireless communications and biotechnology. Issues to be covered include: drivers of technology entrepreneurship in different regions; drivers for country entrepreneurs to look for international markets; differences associated with country demographics, economy, size, or other parameters; and how to encourage more technology entrepreneurs to target international markets;
- c) Support technological entrepreneurs in the US and Ibero America to meet international market needs and support product development for international markets. This will include establish product development activities at universities, test their capabilities to support actual cases of tech entrepreneurs that are looking at international markets, and develop market research in new international markets;
- d) Support the establishment of Management of Technology (MOT) programs that can work with the engineering, science and technology organizations to increase technological entrepreneurship activities;
- e) Identify and examine the intellectual property issues in Ibero-America, which includes examine intellectual property laws and their economic effects in different countries, suggest policy directions in these countries that support the establishment of intellectual property positions and strategies that support technology-based commercialization; and
- f) Create a collaborative effort between UNM and Ibero-American universities to effect necessary changes (Jordan et al., 2006).

3 THE AFRICAN SITUATION

According to a report by Consultancy Africa Intelligence written by Furphy (2010) "to date, the African economy has largely been overshadowed by Asia in the East and to a lesser extent, Latin America in the West. However, hidden in plain sight, Africa has begun to emerge as one of the world's fastest growing economic regions." The same report also painted a success story of Africa's GDP growth gathering momentum, expanding increasingly rapidly through 2008, and that Africa's collective GDP in 2008 was US\$ 1.6 trillion and that it was roughly equal to that of Brazil or Russia; and equally quoted Dominique Strauss-Kahn, Managing Director of the International Monetary Fund (IMF) as enthusing that Africa is back.

The report equally indicated that Africa's economic success has arisen in part to resources boom, though, further growth was said to have come from additional sectors including financial services, technology, media, telecommunications logistics services, transportation, retail, trade and manufacturing.

As promising as the above report sounds, the Global Competitiveness Report 2009-2010 of the World Economic Forum (WEF) categorises nearly all African economies as still being largely factor-driven, relying heavily on unskilled labour and resource extraction. This portend that most Africans may not have the DNA of innovation and entrepreneurship, for according to Friedman (2008) when money can be extracted from the ground, people simply don't develop the DNA of innovation and entrepreneurship. Conversely, of the about 30 African countries cited in the report, only South Africa was said to be an efficiency-driven economy, while Algeria, Botswana, Egypt, Libya and Morocco are said to be transiting from factor-driven economies towards efficiency-driven economies (WEF, 2009). However, by 2013, other African countries - Mauritius, Namibia, Tunisia, and Swaziland have equally joined South Africa in the efficiency-driven economies category (WEF, 2013). This clearly demonstrates Africa's lack of the six elements favouring entrepreneurship: regulatory framework; market conditions; access to finance; R&D and technology; entrepreneurial capabilities; and culture, a view point supported by the Organisation for Economic Co-operation (Ernest and Young, 2009). In like manner, the Global Entrepreneurship Monitor report of 1999 mentioned that in most entrepreneurially active countries (i.e., U.S., Canada and Israel) entrepreneurial activity is an integral and accepted feature of economic and personal life; and on the contrary, entrepreneurship through enterprise creation remains a structural and cultural anomaly in entrepreneurially less active countries (Reynolds et al., 1999). Culture in this context refers to kind alluded to by Dan Senor a co-author of the book, "Start-Up Nation: The Story of Israel's Economic Miracle" when he opined that a key lesson from Israel's success story as start-up nation is that innovation comes from a wider culture that fosters both innovation and entrepreneurship (Kramer, 2010).

Besides the above, Africa had shared most of the characteristic of Latin America and the Caribbean earlier mentioned in nearly all ages. Some of those shared features are: lack of technology and innovation management expertise; poorly funded higher education sector resulting to low rankings in the world's best universities ranking table; low levels of research, development and innovation (RDI) funding; poor intellectual property rights regimes; and weak regional and national systems of innovation.

Understandably, Africa lags behind many other countries on all other main indicators of socio-economic development (Ahmed, 2006). But all said and done, the most worrisome situation is the apparent dearth of S&T entrepreneurship capital in Africa, a situation that has led to the near non-existent productive capacity of the continent, with very minimal potentials for value addition, with the resultant effects of low capacity for wealth creation and increasing levels of unemployment. Accordingly, capacity is insufficient even to stay meaningfully connected to global advances in science and technology; and opportunities to transfer and adapt

knowledge - the same knowledge that is producing concrete benefits elsewhere - remain mostly unknown and vastly underexploited in Africa (The Smith Institute, 2005).

Affirming the above claim, Juma (2007) maintained that creating links between knowledge generation and business development is the most important challenge facing Africa. While the UN Millennium Project (2005) stated that the shift from largely domestic activities to more complex international relationships demands a fresh look at policies that integrate science, technology, and innovation into economic strategies. Thus, policy-makers need to develop, apply and emphasise the important role of engineering, technology and SME development in human welfare improvement and sustainable development (Juma, 2007) as technology-based growth is key to the creation of wealth and career oriented jobs (IC2 Institute, 2007). Singh (2007) technological progress itself stems from the build-up of innovative activities, innovation itself being the product of a complex set of interactions conditioned by institutional, organizational and cultural systems. Undoubtedly too, the capability to innovate and to bring innovation successfully to market will be a crucial determinant of the global competitiveness of nations over the coming decade and there is growing awareness among policymakers that innovative activity is the main driver of economic progress and well-being as well as a potential factor in meeting global challenges in domains such as the environment and health (OECD, 2007).

The pace of technological change has been steadily increasing over the last 100 to 200 years, if not longer (Carnegie Mellon University, 2010). The ability of nations to grow and prosper economically is dependent on their ability to harness the forces of technological change which pervades our lives, entering nearly every decision we make. Therefore, the rapidly changing national and global realities require change in regional economic strategies and policies (IC2 Institute, 2007) for it is been slowly realised that our conventional models are neither realistic nor sustainable in the long run (Mukherjee, 2003) as empirical evidence from the experiences of many developing countries tend to say that conventional approaches have consistently failed to answer the phenomena of poverty, unemployment, inequality and ecological degradation. In these circumstances the role of entrepreneurs (especially the S&T entrepreneur) seems rather obvious, not only because both the creation and the use of knowledge, as is the case with any other resources, is subject to entrepreneurial activities but also because 'ideas' and 'knowledge' together with risk taking are the classical attributes of entrepreneurship (Aligica and Florian, 2008).

African countries are equally characterised by weak institutional and policy frameworks. In such countries it may take decades of sustained changes in many national, cultural, political and economic institutions if they are to join the "elite" of entrepreneurial economies (Reynolds, 1999) because strong and effective institutional frameworks encourage productive entrepreneurship (Baumol, 1990) as government policies that encourage entrepreneurship are most likely to result in increased innovation and resultant economic growth (Ernst and Young, 2009).

It then implies that the SEED initiative may offer Africa an opportunity to redirect her efforts to jumpstart her technologi-

cal growth as according to Jordan et al (2006) the SEED model can be expanded and adapted to different regions of the globe as well as support for international research and education across science and engineering. Similarly, government programmes in other countries can learn from the experience of similar entrepreneurship development programmes (Kropp and Zollin, 2005).

Conversely, state support is not just implementing a set of policies that succeed elsewhere; it is the ability of the state to set up institutions that reflect a harmony between knowledge and physical infrastructure and the formal and informal institutional compensations that are important to them, and structure the idiosyncratic exchange processes of developing economies (Oyelaran-Oyeyinka and Sampath, 2009) as a success model cannot be copied too mechanically (De Beule and Van Beveren, 2008). Therefore, it requires further studies to ascertain the peculiarities of Africa so as to ensure a perfect match between the philosophy behind the SEEDA initiative and the realities on ground.

3.1 Why the proposed SEEDA initiative?

Notwithstanding the work of economic and business historians and others, mainstream economic theory has not properly recognised the role of entrepreneurship, institutions, management and organisation in economic development and growth (Teece, 2007). Also, the idea that education about entrepreneurship may be an effective way to ensure that the entrepreneurial resource will be used in a productive way does not seem to have gained significant ground (Aligica and Florian, 2008) in most African countries. The creation of an “entrepreneurial economy” – one whose political, social and economic responses are dictated by the dominance of entrepreneurship capital, and the capacity to engage in or generate entrepreneurial activity (Audretsch and Thurik, 2004) must be the responsibility of all African governments, if we must eradicate poverty in Africa.

The SEEDA initiative advocated in this paper among other things is aimed at galvanising African governments, the organised private sector and the intelligentsia into a platform that will foster the creation of science and technology entrepreneurs for the technological and socioeconomic development of the continent. In such a platform so advocated, South Africa is suggested to be the node or gateway as the country is Africa’s biggest economy with capabilities in world class technologies, a vibrant manufacturing sector, has Africa’s leading universities and been fairly consistent in producing some of the world’s first 500 universities over the years and her University of Pretoria reputed to be having top project management expertise with the first Graduate School of Technology Management in the continent.

Like the SEED initiative, the broader objective of the SEEDA initiative among others may include: development of research programmes in technology forecasting and assessment processes across international markets; identification and examination of research in science and technology entrepreneurship issues in Africa; Supporting technological entrepreneurs in Africa; Supporting the establishment of endowed chairs in Knowledge Management and Technology and Innovation Management (TIM) to organise programmes in TIM,

for knowledge management plays an important role in the development of innovations and technology based entrepreneurial firms (Brännback et al., 2007); the identification and examination of intellectual property issues in African countries as fostering strong intellectual property rights regimes across the continent; and creation of stronger collaborative ties among African universities and others to make them more effective in the industry-university-government linkages in the national systems of innovation. For instance, Elfing et al (2006) stated that the Finnish reality indicates the correlation between innovativeness and entrepreneurial activity and to give a very simplified picture of the reality, the innovation system is supposed to turn innovations into commercialized products and hence new entrepreneurs emerge as a part of the process (Elfing et al., 2006)

Venkataraman (2004) opined that a well-functioning innovation system requires both a tangible and an intangible infrastructure - the tangible infrastructure consists of things like legal systems, capital markets, logistics, buildings and other structural features; - the intangible infrastructure refers to things like human talent, novel ideas, visions, commitment to work, positive attitude towards entrepreneurship, trust, reciprocity, dynamic capabilities. Intangible infrastructure was referred to as the sum of the social and the human capital embedded in the innovation system. In order for the system to spur economical growth, both the tangible and the intangible infrastructure are needed, and to a large extent the intangible infrastructure must arise spontaneously as a result of iterated cooperation and collaboration with government providing the right context for that to happen in most cases (Venkataraman, 2004). Also, if the quality of the intangible infrastructure is to improve, it presupposes initiatives and participations from all the parties involved as a weak intangible infrastructure can estrange the entrepreneurs and the potential entrepreneurs from the innovation system, despite the best intentions (Elfing et al., 2006).

To achieve its aims, SEEDA can leverage on the opportunities provided by development partners, the JAES Action Plan 2011-2013, the New Partnership for Africa’s Development (NEPAD), the Association of African Universities (AAU). The Higher Education Research and Policy Network (HERPNET), an initiative of AAU that was founded following a research meeting at Human Science Research Council (HSRC), Pretoria in 2000 may be the vital link between African universities. This is so because HERPNET is dedicated to creation, preservation, propagation, and promotion of scientific knowledge that would help in transforming institutions of higher education to internationally recognized ones in a knowledge society and equally shares the vision of AAU that universities should generate and disseminate knowledge and understanding, foster the values of openness and respect for merit, and enrich the general quality of the social life of their communities through the promotion of research, that universities must give priority to effective and positive participation in the global creation, exchange and application of knowledge through a maximum exploitation of the potential of the information and communication revolution (HERPNET, 2010).

The ultimate end should lead to the organisation of international SEEDA conference annually. Such a conference can be

supported by NEPAD through the African Union and the African Development Bank by sponsoring technological entrepreneurship business proposal competition as it is done elsewhere.

However, Sirolli (2008) observed that the wealth of a country depends more on the intelligence of its people than the abundance of its natural resources, more on its civic structure than the fertility of its soil, more on its freedom to invent and create than on the beauty of its landscape". On the other hand, Dietz (2000) maintains that social capital (human capital) appears to have grown in concert with, if not preceding, the formation of strong economic and scientific assets, and all three developed synergistically while regional actors kept very clear and mutually beneficial roles and goals in mind. Dietz added that programs are geared towards improving the R&D competitiveness of whole regions should focus on the growth of social capital and the capacity that it generates for still more social capital development. In trying to achieve the above objectives, Friedman (2008) maintains that premium should be placed on the development of human capital; as a country (or region) cannot develop politically, socially, and economically if they don't have to utilise the resources of their citizens to help in the process.

3.2 Why a regional (continental) groupings?

Globalization of the economies goes hand in hand with the increasing significance of regional and local activities as regions are key players in the global economy (Bezirtzoglou and Bezirtzoglou, 2006). Dividing the world into continental groupings such as Europe, Asia, America, Africa and Oceania often appears in international business research (Vaaler et al., 2007).

There has been considerable interest in regional development as that strategic to the achievement of global developmental goals. Countries are expected to group on regional basis to tackle common problems. It is easier to solve common problems when resources are shared to tackle the problems. Moreover, the spatial proximity has economic importance as it reduces the distance among learning actors, enhances communication with reduced cost on transportation and communication (Nozawa, 2011).

Local knowledge developed within regions can be shared and innovated for competitive advantage of the regions. Technological learning is easily facilitated on regional basis. Accordingly, it has been globally observed that, more and more, countries are organising themselves into their continental groupings to tackle their common development needs. For instance, there is far more cooperation and cohesion in the European Union (EU) today than ever. The EU promotes regional innovation programmes simply because in the increasingly knowledge-based economy, innovation holds the key to regional competitiveness (Bezirtzoglou and Bezirtzoglou, 2006). The Asia-Pacific region and Latin America are not left out. Interestingly too, the Africa Union has continually renewed its call for greater integration and cooperation amongst African countries in so many spheres. Similarly, the Joint Africa European Union Strategic (JAES) Action Plan 2011-2013 - 'Partnership on Regional Economic Integration, Trade and Infrastructure' supports African economic integration and

development agenda in line with the Abuja Treaty. This means that Africa's quest towards meeting the continents development aspiration can leverage on the SEEDA Initiative.

3.2 Why South Africa?

Most of the framework conditions needed for the development of S&T entrepreneurship in Africa is already prevalent in South Africa as the opportunities for economic cooperation are great, and South Africa could play a pivotal role in helping regional economies advance technologically.

South Africa is no doubt the continents acclaimed biggest economy. The country is one of the most stable economies in Africa, a middle-income country, with fully developed basic infrastructure. The country exhibits several indicators of a developed economy, such as well grown primary, secondary and tertiary sectors and non-dependency on agriculture with manufacturing, mining and service sectors being the largest contributors to the country's GDP (Economy Watch, 2010). In an emerging economy like South Africa, there are several hi-tech sectors that develops products and services that are cutting-edge and globally competitive (Cunningham, 2010). By 2009 estimates, South Africa was said to have had an annual GDP purchasing power parity of US\$488.6 billion and was ranked 26th in the World in GDP terms with per capita GDP of US\$10,000 (Economy Watch, 2010). The World Bank (2012) countries rankings placed South Africa as the world's 28th biggest economy with GDP of US\$384, 313 billion (World Bank, 2013).

The World Economic Forum's (WEF) 'Global Competitiveness Report 2013-2014' ranked South Africa as the world's 53rd most competitive economy, making her Africa's second to Mauritius. However, going by the WEF's Global Competitiveness Reports (GCR) for the past five years (2009-2014), South has been more consistent than any other Africa country. See Table 1 for a comparison of the top ten most competitive countries for the past five years. WEC (2013) highlighted the framework conditions that set South Africa ahead of other African countries as the nodal country for the proposed SEEDA initiative include: institutionalised property rights systems (world number 20), with high intellectual property protection regime (world number 18), sophisticated financial markets (world number 3), venture capital availability (world number 28), quality management schools (world number 23), local availability of research and training services (world number 54). Others are; availability of latest technologies (world number 40), firm-level technology absorption (world number 35), and yet others are: highly developed business clusters with sophisticated production processes. The reports claims that South Africa has a high capacity for innovation, quality scientific and research institutions, high company R&D spending with an effective university-industry collaboration in R&D (world number 29) as well as utility patents (WEF, 2013).

**There other African countries that came ahead of ones listed above

South Africa equally boasts of world class technologies in area such as military, energy and power, petrochemical, nuclear technology, mining, information technology, as well as a vi-

brant manufacturing sector. Another major advantage South Africa has is the presence of highly rated higher institutions of learning. South African Universities have been the top 10 uni-

TABLE 1
TOP TEN MOST COMPETITIVE AFRICA COUNTRIES FOR THE PAST FIVE YEARS

S/N	Country	2013-2014	2012-2013	2011-2012	2010-2011	2009-2010
1	Mauritius	45	54	54	55	57
2	South Africa	53	52	50	54	45
3	Rwanda	66	63	70	80	
4	Botswana	74	79	80	76	66
5	Morocco	77	70	73	75	73**
6	Seychelles	80	76	-	-	-
7	Tunisia	83	-	40	32	40
8	Namibia	90	92	83	74	74
9	Zambia	93	102**	113	115	112
10	Kenya	96	106	102	106	98**

versities in Africa for over a decade, and few have equally featured consistently in the First 500 universities of the world. Amongst those elite universities in South Africa is the University of Pretoria known for its world class programmes in project and technology management. As the UNM serves as gateway for the Ibero-American region, the University of Pretoria can serve as the gateway for the African region.

4 CONCLUSION

The idea that education about entrepreneurship (particularly technological entrepreneurship) may be an effective way to ensure that the entrepreneurial resource will be used in a productive way does not seem to have gained significant ground (Aligica and Florian, 2008) especially in Africa. Africa is characterised by weak institutions. More so in such areas of research strength, institutional missions, sectors of the economy, and levels of the education system - that are the basis for the development and exploitation of social capital and its attendant effects on human capital (Dietz, 2008). The SEEDA initiative modelled after the SEED initiative of the Ibero-America region must strive to equip Africans to understand the forces underlying and unleashed by technological change in order to become better decision makers, managers, policy analysts, and researchers. And perhaps, this is one route through which Africa can jumpstart her journey to technological advancement and development socio-economically.

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