From lab to market: Strategies to nanotechnology commercialization in Africa

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Nanotechnology has the potential to affect many industrial sectors and every economic sector across the globe. It promises to offer new products with unique properties and advanced functionality using fewer raw materials and consuming less energy. Its worldwide market is expected to exceed USD$125 billion by 2024. Africa, Egypt, South Africa, Tunisia, Algeria, and Morocco, in particular, have already invested in nanotechnology R&D and human capacity building or have ongoing research in nanotechnology.[1] However, the majority of African countries are still in the early stages of R&D or have not prioritized nanotechnology, despite its potential.[2]

South Africa is the first African country to introduce a National Nanotechnology Strategy in 2005 through the Department of Science and Technology.[3] The main objectives of the strategy were to support long-term nanoscience research and exploration of applications in the areas where nanotechnology can generate the most benefits, such as health, energy, water, chemical and bioprocessing, mining and minerals, and advanced materials. Today, almost all public universities and science councils in South Africa are working on nanotechnology research or research that incorporates nanomaterials.

Through the National Nanotechnology Equipment Programme, the South African government has made a substantial investment toward creating a critical mass of infrastructure to enable first-class basic research, exploration of applications, and human capacity development in nanotechnology.[4] For infrastructure investment, the focus was on nanotechnology research equipment, clean rooms, and piloting facilities. Cutting-edge equipment for nanotechnology characterization available in some South African universities and science councils includes scanning electron microscopes, transmission electron microscopes, atomic force microscopes, focused ion beam scanning electron microscopes, and a nanoindenter. However, such equipment is expensive to maintain and quickly becomes outdated, making it difficult for scientists in South Africa to keep up with scientists from around the world.

Only a few African countries (e.g., South Africa, Egypt, and Morocco) are currently showing an interest in nanotechnology commercialization. Commercialization of nano-enabled technologies in Africa could help toward mitigation of the critical challenges that the continent is facing today, such as poverty, disease, lack of access to clean drinking water, electricity, basic sanitation, medical facilities, inadequate housing and food, and climate change.

The application of nanotechnology in medicine especially promises to offer unique potential for advances in the diagnosis, treatment, and prevention of diseases such as HIV/AIDS, tuberculosis, malaria, and ebola. In addition, inexpensive and simple handheld diagnostic devices that might not require expertise will be beneficial to those in rural areas where there is a lack of medical facilities. According to Dube and Ebrahim,[4] South Africa is one of the leading countries in nanomedicine (especially drug delivery and medical diagnostics) research and product development on the African continent. However, if African scientists need to capture the value of technology assets or to move their nanotechnology research from the laboratory to the marketplace, they will need to find a commercialization strategy that matches their potential and is sustainable.[5]

Four commercialization strategies seem suitable: licensing, equity investment, strategic alliances, and private consortium or cluster alliance.

Purification of nanoparticles by high-performance liquid chromatography for pharmaceutical application. Photo credit: Maluta Steven Mufamadi.

Licensing

A licensing-based commercialization strategy focuses on marketing intellectual property (IP) in exchange for compensation, whereby funds could be used toward long-term research, finance, and sustainability. In addition, it could help toward physical infrastructure, laboratory equipment maintenance, and human resource development. The university enterprise in most African universities could help toward technology transfer or market the IP on behalf of the university and public research institutions.

Equity investment

An equity investment-based commercialization strategy would involve transferring a patent into a spin-off company, with an equity investment from a parent company (e.g., university or research institution). In this case, the personnel, technology, and products and assets are taken from the parent company. In addition, the spin-off company also receives support from the parent company, such as incubation space, legal and technology assistance, or financial services. In the African context, this could contribute toward job creation in nanoscience, such as a technologist, technician, research assistant, researcher, technology transfer officer, safety and quality-assurance scientist, and compliance regulatory specialist.

Strategic alliances

A strategic alliance-based commercialization strategy is a joint venture approach with two or more partners (e.g., small and medium enterprises and a large company; government, university, and a private company; or Africa-to-Africa country partnerships). The partnership will be motivated by the nanotechnology application, marketing and manufacturing capabilities, resource capital, returns, and intra-African relations. Technology is mostly designed based on the requirements of customers or market need. Investors decide which technology should be developed and for what application. With nanotech startups and larger companies (e.g., pharmaceutical or medical device), the partnership sometimes goes beyond technology, and big pharma expertise can influence finances or resources in regulations, clinical trials, and marketing. In an Africa-to-Africa alliance, two or more African countries may enter into joint ventures toward nanotechnology commercialization to enhance one another and for economic benefits.

Private consortium or cluster alliance

A private consortium or cluster alliance could help with fostering a successful business partnership through the centralization of resources to finance a new business.[6] Such a platform may act as a bridge to fill in the gap between research activities and business creation, as an integration between public and private sectors, as a benchmark to the commercialization of research or for incubation, and for the establishment of an Africa Nanotechnology Business Initiative. In addition, it could be used as a platform to facilitate the establishment of an African nanotechnology roadmap that will outline the short- and long-term technology development processes and goals or to provide guidance toward the issues of ethics, public engagement, and/or social debate on issues associated with safety and quality control.

The Egypt Nanotechnology Center (EGNC) and IBM partnership is an example of a successful public and private partnership or strategic alliance in nanotechnology. EGNC published 897 nanotechnology articles in ISI-indexed journals and 23 patents on nano-articles.[7]

African inventors need to overcome barriers associated with technology commercialization before they can see their nano-enabled products in the marketplace, such as standards, regulatory approvals, IP and global competition, scale-up, and quality control. Africa cannot afford to play the "waiting game" with nanotechnology commercialization for its economic development; it needs to assemble functional regulatory systems now to ensure safe application of its nano-enabled technologies.

In the meantime, Africa needs to adopt available nanotechnology standards from the International Organization for Standardization (ISO) and a regulatory framework for the organization, such as the US Food and Drug Administration (FDA), to benefit African inventors who are already on the commercialization stage. Creation of a public certification authority (e.g., NanoVerify in Malaysia or Nano Mark in Taiwan) that will warrant the safety of nano-enabled products in the continent is needed for credibility.[6] Lack of safety of nano-enabled products could lead to negative publicity or a decrease in public acceptance.

For Africa to effectively advance nanotechnology commercialization, domestic and international investment is required, along with capacity strengthening of nano-scientists and inventors, safety regulations, and ethics. Collaboration is essential (e.g., African scientists, policymakers, entrepreneurs, and communities) to reduce the time needed to translate university research and patents into nano-enabled products. Full participation of organizations such as the African Union High Level Panel on Emerging Technologies, New Partnership for Africa's Development agency, African Science, Technology and Innovation Fund, and Africa Health Strategy and the Accelerated Industrial Development for Africa could provide an opportunity for Africa to harness nano-enabled technologies. In addition, cultivation of an entrepreneur mind-set in public research institutions, seed funding for innovation, and industry partnerships could assist in the establishment of new businesses, which is beneficial for economic growth and job creation in nanoscience. The success in nanotechnology commercialization will not be determined by nano-enabled product quality alone, but also by accessibility and affordability.

A technology developed within a country's unique culture could have qualities and applications not anticipated by others. The world could benefit from African-based nanotechnology from a technological and economic perspective.

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