**Volume 1**

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| **PROFILING OF STI SERVICE PROVIDERS IN GHANA: Database for Technologies** |  |

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# INTRODUCTION

The Government of Ghana has secured financing from the World Bank for the implementation of a five-year Ghana Jobs and Skills Project to support skills development and job creation across the country through apprenticeship training, entrepreneurship and small enterprise support and operationalization of the Ghana Labour Market Information System.

The project has five (5) components: (1. Provision of Apprenticeship Training for at least 25,000 individuals; (2. Provision of Entrepreneurship and Micro and Small Enterprise Support for Jobs-support entrepreneurship training for at least 50,000 individuals including competitive business start-up grants for at least 5,000 individuals, provide at least 700 competitive grants to private enterprises; (3. Operationalization of the Ghana Labour Market Information System, Upgrading of District Public Employment Centres and Services, and Independent Performance Reviews of Government Youth employment and skills development programs; (4. Capacity development, technical assistance, and project management support to coordinating, implementing, and partnering agencies for enhanced skills and jobs impact; (5. Contingent emergency response to deal with emergence situations.

The project’s targeted beneficiaries include individuals seeking skills and jobs, Master craft persons and associations, Private enterprises and their workforces and Public and private training providers.

The implementing institutions for the project include the Commission for Technical and Vocational Education and Training (CTVET), Ministry of Employment and Labour Relations (MELR), Ministry of Environment, Science, Technology, and Innovation (MESTI) and Ghana Enterprises Agency (GEA). Under the project MESTI is expected to partner with GEA and CTVET under Component 2 to provide an advisory role on labour efficient technologies, green technologies, and innovative strategies for the main implementing bodies and project beneficiaries.

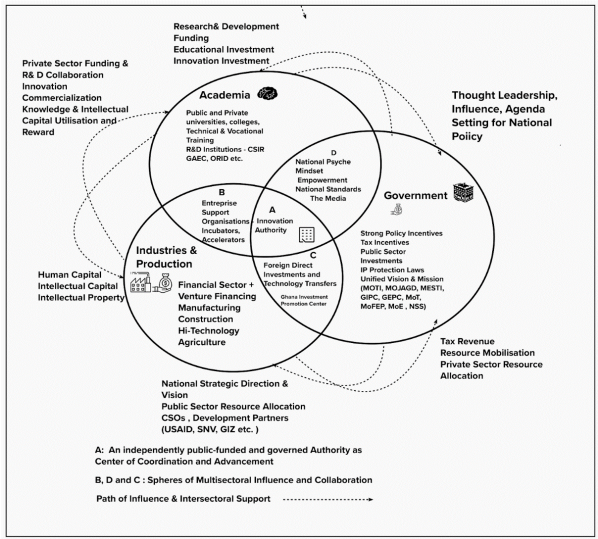
This report is a database of some relevant technologies that can be adopted by beneficiaries of component 2 to expand their businesses and create jobs. It is therefore focused on the actual technologies with just a few pages of text to provide a background of the profile of technologies in Ghana.

# 2.0 CONCEPTUAL FRAMEWORK FOR PROFILING THE STI SERVICE PROVIDERS

The Triple Helix Model has become a globally recognised model in analysing the National System of Innovation. Embedded in this National System of Innovation is technology development by Science and Technology (S&T) institutions which catalyses innovation by the industry.

The Ministry of Environment, Science, Technology and Innovation (MESTI) has also adopted the Triple Helix Model and contextualised it to the specific conditions in Ghana. This has been summarised in the diagram below:

*Figure 1: Ghana’s Triple Helix Model: Intersectoral Support Model*



With guidance from the Triple Helix Model, the various actors in the STI Ecosystem was analysed to reveal the critical roles of the various actors in providing the support systems for innovation.

Along the lines of the Triple Helix Model, the STI Service Providers were identified and analysed. To simplify the model and to place it in a pure production value chain, the innovation value chain has been categorised into the Upstream, Midstream and Downstream as elaborated below:

**Upstream**

The Upstream involves the actors who generate new ideas, inventions, and Intellectual Property. Ideas are generated by humans, so though the labour power of researchers and existing level of technology, new ideas and inventions are generated which leads to technological progress and innovation. The actors in the upstream include:

1. Higher Learning Institutions
2. Technical and Vocational Training Institutions
3. Research and Development Institutions
4. Innovation Hubs
5. Informal Sector
6. Individuals

**Midstream**

The midstream is usually associated with the storage and transport of the output from the upstream to feed the downstream. In the context of the Innovation value chain. The inventions in the form of technologies or better still Intellectual Property are usually documented and protected to form a portfolio of assets for the actors of the upstream. It is at this stage that arrangements are made for the transfer of technologies, inventions or IPs through various technology transfer arrangements. It is also at this stage that some investments are made by financial sector to further develop and commercialiase IPs. The main actors in the segment of the value chain include:

1. Technology Transfer Offices
2. Commercialisation Centres
3. Agents
4. Investors (Venture Capital and Angel Investors)

**Downstream**

Associated with the downstream are the actors that create value from the outputs of the upstream by developing products and services from the IPs generated. At this level, the focus is on how to address societal problems with the knowledge created and to the satisfaction of consumers. The main actors in this section include:

1. Manufacturing companies
2. Business enterprises
3. Entrepreneurs

Even though the above seeks to elaborate how the innovation value chain works, it is worth noting that, the value chain is not a linear model but intersectoral and interdisciplinary and requires a very good level of coordination and harmonisation to realise the expected level of innovation. The analysis presented in this report is therefore limited to the direct activities in the innovation technological development value chain.

# 3.0 Implications for Skills and Jobs in Ghana

Ghana is a small open economy and therefore is subject to the disruptions of global technological progress. The direction of technology shows what kind of skills that will be required soon. The Ghanaian youth and work force will be required to prioritise their skills in these sectors to stay relevant in the job market. Isl either that happens, or they lose their jobs because of the application of technologies. With the emergence of AI and ChatGPT for instance, secretaries might be losing their jobs in a few years to come if their jobs are just to draft letters for review by their bosses.

From the patent information provided above, it is obvious that, the focus of technology is now on the computer technology, electricals and Digital Technology reflecting the obvious fourth industrial revolution. What this means is that, future jobs are going to be in the field of digitalisation and electricals. It also means that the most qualitative and high paying jobs will come from these areas. But even with the old and low technologies, the fact that new patents are granted in those fields means there are technological progress in those fields and they may have the potential of disrupting jobs in existing fields. Technologies are required to solve technical problems, but the application of those technologies requires skills and when the skills are acquired they form the basis for employment and thus job creations. The jobs in urban transport in Ghana now does not just depend on the ability to drive but the skills in the application of navigation applications and the use of digital platforms. So are the job requirements for mechanics who must use diagnostic machines to diagnose a vehicles fault before fixing it.

As technology comes to developing countries as manna from heaven, it is the interest of government to keep track of the direction of technology and the threats and opportunities that comes with it.

It is therefore becoming a matter of policy concern if the universities and research institutions in Ghana are still researching and attempting to develop technologies that are predominantly related to the first and second industrial revolutions. Nonetheless, it is still very important to build capacity and master the old and existing technologies whilst the country strives to leapfrog into the new and modern technologies.

# 4.0 TECHNOLOGY PROFILE OF GHANA

Given an overview of the technology landscape of the world and the fact that Ghana is an open economy and mostly dependent on the importation of most products and services, it is very crucial that, in profiling the Ghanaian Technologies and STI service providers government should look out for the outputs from the ecosystem in connection with the substitutes or competitions from other countries like China.

To profile the technologies in Ghana, a profile of the various STI institutions was conducted with guidance of MESTI’s adopted Triple Helix Model. The STI Service providers have been analysed along the value chain presented above:

**6.1 UPSTREAM**

This section provides some general findings on the actors expected to generate the knowledge and technologies to support entrepreneurship and innovation.

***6.1.1Research and Development and Higher Learning Institutions:*** these involves all universities in Ghana who are potential inventors of technologies and engines of growth for businesses. Even though all universities have their areas of specialisations according to the instruments establishing them, all university lecturers receive book and research allowance and are expected to conduct research which either leads to publications or patents.

There are over 16 universities and 1 major Research Institution in Ghana, but the generating of patents has been very low for obvious reasons. Annex 1 provides the list of universities and the specialities. Research institutions are also captured in annex 1.

Ghana has not been able to put a fund in place for Research and Development reflecting a very low investment in R&D. The National Research Fund Act promulgated in the year 2020 is yet to be operationalised by government. Public universities currently depend on Book and Research allowance which is inadequate to undertake Applied Research. The focus has therefore been on conducting basic research and publications because the main promotion requirement is publications. Even though patents are also acceptable for promotion, there are no compelling provisions to generate patents hence, universities have conveniently focused on publications. There were however significant capacities especially at the technical universities for training in some technical and vocational skills like fabrication, food processing, agriculture, mining etc. most the technologies that were developed and made available to the public were technologies for mechanisation mostly associated with the 1st and 2nd industrial revolution.

**6.1.2 Innovation Hubs and Strategic Technology Centres:** innovation and incubation hubs were analysed including the Strategic Technology Centres in Ghana. The Ghana Hubs Network was identified as an umbrella organisation coordinating the activities of innovation hubs in Ghana. The membership is voluntary, but it was interesting to note that, almost all the properly established hubs had registered as members. The Ghana Hubs Network coordinates and advocate for better policies to improve hub developments in Ghana.

The key revelation from the Ghana Hub Network was that their members only provide the space and platform for developers and startups and does not necessarily generate technologies or inventions by themselves. For that matter, it might be difficult to have a catalogue of their technology solutions unless they are dealt at individual levels whilst the GHN serves as an intermediary to safeguard the interest of the solution provider and the client. The GHN has over 36 hubs across the country in the position to render services to startups and entrepreneurs.

The Ghana Digital Centres Limited was also incorporated in 2017 to lead the development of technology parks and digital centres across Ghana by providing the required infrastructure, facilities, environment, services and programs that foster the growth of ICT and IT-enabled Business Process Outsourcing industry. So far the Ghana Digital Centre doubles as the Accra Digital Centre with the Ghana Innovation Hub located within the premises.

The Ghana Innovation Hub also provides space for Ideation, Incubation and acceleration to start ups and innovators.

The general findings from the Innovation and incubations hubs was the fact that, there was some critical amount of skills that provides potential for ICT related products in terms of softwares, programmes and applications that can be absorbed by entrepreneurs. The major challenge however, is the low corresponding investments into the innovation hubs to move their ideas from prototypes to commercial products.

The other service providers in this category include the Strategic technology centres set up by government under the 1 District 1 Factory initiative and the existing set ups like the GRATIS. It is interesting to note that, the strategic centres have also focused on developing mechanisation technologies predominantly for agriculture and food processing.

**6.1.3 The Informal Sector:** The informal sector also constitutes a critical source of technologies for application by entrepreneurs. The activities of artisans have generated some form of technologies. Under the assignment, the Suame Magazine Industrial Development Organization (SMIDO) was identified.

The Suame Magazine Industrial Development Organization (SMIDO) is a non-governmental organization created by the various trade associations operating within the Magazine. It was established in 2006 with the support of the ‘Business Sector Advocacy Challenge (BUSAC) Fund 2’ and the Dynamic Spare Parts Dealers Association3 to foster local development. SMIDO has over 1600 individual registered members and is affiliated with 12 associations within Suame Magazine. The mission of SMIDO is “to ensure effective and efficient management of the Suame Magazine industrial estate with respect to appropriate technological innovations, partnership, marketing, employment creation and enhanced investment opportunities to establish the estate as the main industrial propelling sector of Ghana and the technological hub of the African continent”. To pursue this mission, SMIDO collaborates with industrial and institutional partners and investors to secure technology, expertise and financial resources that will contribute to the Magazine’s development. Through the establishment of the Suame Magazine Automatics Technical Institute (SMATI) in 2009, SMIDO runs programmes to build artisans capacity to run successful businesses. SMIDO also seeks to improve market access for businesses in the Magazine through its engineering programme, which creates links with large formal sector companies and introduces artisans to these companies’ standards and expectations.

The general observations from the profiling of Ghana’s STI Service providers are that, the general level of technology and innovation are relatively weak compared with other peers in sub-saharan Africa.

**6.2 MIDSTREAM**

If the Midstream is supposed to build a stock of technologies for commercialisation and transfererd to industry, then, the findings from the study revealed a very weak functioning at this level. There were generally low IP portfolio for Universities and Research Institutions and the investment culture in technology development and innovation was also generally low. This has been reflected in patent filings and VC financing.

**6.2.1 Intellectual Property Rights Managers**:. The managers of IPs play very significant roles in the innovation ecosystem. The innovation and technology development space are governed by IPs because it forms the main bases for economic returns from the hard work and investments of inventors.

Ghana has nearly all the Intellectual Property Laws with some institutional arrangements for its management. However, there remain concerns that IP enforcement activity remains weak, and unreasonable delays in infringement proceedings discourage right holders from filing new claims in local courts. The existing laws on intellectual property rights in Ghana that apply to STI include the Protection against Unfair Competition Act, 2000 (Act 589); the Copyright Act, 2005 (Act 690); Intellectual Property Act, 2003; the Patents Act, 2003 (Act 657); the Trademarks Act, 2004 (Act 664); the Geographical Indications Act, 2003 (Act 659); and the Layout Designs of Integrated Circuits Act, 2004 (Act 667) and the Industrial Designs Act, 2003 (Act 660); and the Protection against Unfair Competition Act, 2000 (Act 589). Additionally, in 2020 the parliament of Ghana passed the Plant Variety Protection (PVP) Bill, into law in accordance with Article 106 of the 1992 Constitution. The Plant Variety Protection Act, 2020 (Act 1050) seeks to establish a legal framework to protect the rights of breeders of new varieties of plants or plant groupings and to promote the breeding of new varieties of plants in Ghana.

Out of the total number of local patent applications filed within the period 2015-2020 in Ghana only 22 were granted and about 50% of ARIPO patent applications designating Ghana filed was granted within the same period. The low number of local application granted is a disincentive for the development of new technologies by researchers. Globally, IPRs are taken as an indicator of innovation outputs, and recent rankings for innovation outputs indicate that Ghana ranked between 97 in 2019 to 103 in 2021 out of the 132 economies featured in the annual Global Innovation Index (GII) reports. This shows a decline in performance of Ghana’s innovation outputs and calls for an improvement of mechanisms for the protection and promotion of the nation’s knowledge and technology outputs (e.g., patents, etc.) and creative outputs (e.g., trademarks, industrial designs, etc.).

Table Ghana Patent Filings, 2015-2020

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Year** | **Local Applications Filed** | | **ARIPO Applications** | | **Total** | |
| **Filed** | **Granted** | **Filed** | **Granted** | **Filed** | **Granted** |
| 2015 | 16 | 4 | 573 | 313 | 589 | 317 |
| 2016 | 30 | 7 | 488 | 324 | 518 | 331 |
| 2017 | 26 | 5 | 561 | 335 | 587 | 340 |
| 2018 | 26 | 6 | 584 | 187 | 610 | 193 |
| 2019 | 21 | 0 | 612 | 172 | 633 | 172 |
| 2020 | 20 | 0 | 535 | 324 | 555 | 324 |
| **TOTAL** | **139** | **22** | **3353** | **1655** | **3492** | **1677** |

*Source: Ghana Industrial Property Office, 2021*

**6.2.2 Venture Capital Finance**

The Venture Capital Financing and Angel Investment has by far remained the most critical funding arrangements aimed at supporting innovation and startups. The role of VC and Angel Investors provides some motivation for inventors and innovators. The case of Ghana however, does not reflect the traditional roles of VC financing in the most competitive economies.

The VCTF of invests in fund managers in the business of supporting Small and Medium Enterprises in priority sectors of the economy, specified from time to time. Fund Managers invests in SMEs through Equity, Debt or a combination of the equity and debt instruments with additional working capital support for the smooth running of business operations. Obviously, the VCF focused on SMEs and not necessarily technology start ups and thus does not have any obligation to support technology development.

**6.3 DOWNSTRREAM**

The downstream represents the actual start ups and enterprises that adopt technologies or exploit IPs to grow and make their businesses competitive. The Ghana Enterprises Agency (GEA) has the mandate to promote and develop micro, small and medium enterprises in Ghana. As part of its objects, the GEA seeks to encourage the participation of micro, small and medium enterprises in industrial transformation through innovation and technology transfer. It is therefore crucial that at every point in time, the GEA has an idea of the technologies available for transfer.

The profiling exercise reveals that, the GEA currently has some programmes and projects to support the development of SMEs. As an implementer of the Ghana Jobs and Skills project, GEA conducts entrepreneurship trainings at basic, intermediate and advanced levels. Even though the training modules underscores the importance of the application of technologies, the critical understanding of technology transfer and innovation has received low attention but an interaction with MESTI revealed that, the output of the profiling of technologies will be presented to the trainees through GEA to enable them to identify the technologies they wish to adopt and apply in their businesses. This will trigger a technology transfer between the entrepreneurs and technology developers.

There entrepreneurship landscape in Ghana is characterised by commerce with a relatively lower levels of production that will usually require the adoption and application of technologies or technical and vocational skills. The open nature of ghana’s economy allows the importation of general goods with competitive prices into the country and thus becomes a disincentive to produce due to higher cost of production.

The governments 1District 1 Factory and industrialisation drive ushered in some new manufacturing companies and factories that are producing various goods for the local market but these factories are not completely protected from competition as the economy is still opened to the importation of very essential goods.

# 5.0 TECHNOLOGIES PROFILED

In meeting the objectives of this task of collating comprehensive information on STI Service Providers and developing a comprehensive database of STI service providers for the GJSP beneficiaries, both primary and secondary data was used. The primary data was collected through consultations and surveys, and the secondary data was gathered through a desk review of relevant documentation, review of existing relevant databases (local and International) and web search.

With the general overview of the STI institutional profile of Ghana, technologies were put into two categories. The technologies developed locally and available at the universities and research institutions and the market ready technologies. The former involves technologies in their prototype forms or documented processes that could be transferred to entrepreneurs for mass production or application for production whilst the latter are technologies that have been developed and certified for market use. The latter were mostly imported technologies. Annex 2 provides a catalogue of the profiled technologies from various technology and innovation service providers.

The technologies are supposed to help entrepreneurs and private enterprises under component 2 to identify existing technologies and their applications to enhance their businesses. The technology database can be used with assistance from technology and innovation officers at MESTI. But some quick training on the use of the database for training firms and partner entities would eventually minimise the burden on MESTI.

**Technologies developed locally**

These technologies are in agriculture, services, industry, and manufacturing sectors. The table below shows the number of technologies profiled. Volume 2 of this report presents the comprehensive details of the technologies profiled.

**Market ready technologies**

These technologies are most foreign based but available in Ghana. The table below show the number of technologies profiled. Volume 3 of this report present the detail profile of market ready technologies profiled.