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School of Economics and Management

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Growing technology and innovation in Sub-Saharan Africa through Business Innovation Centres: Case study of Ghana.

Blaise B. Bayuo
bl0781ba-s@student.lu.se

Abstract
Bridging the technological innovation gap in Sub-Saharan Africa (SSA) is a concern to governments and development partners. Investments in programmes that will facilitate the diffusion of technology into the public and private sectors have been pursued over the past two decades. Yet, SSA still lags behind in reaping the digital dividend of technology. This study looks at the role of Business Innovation Centres, as innovation actors, in helping grow indigenous technology firms to solve local problems. Using Ghana as a case study, the study adopted the innovation system approach to assess how BICs are helping technology startups grow in SSA. Six (6) BICs and their startups were interviewed to understand the innovation actors and how they coordinate to facilitate knowledge transfer to startups. The study found that BICs play three core roles in the innovation system: knowledge transfer, innovation finance and building networks and partnerships to benefit startups. In spite of the efforts of BICs, poor coordination from other stakeholders such as government, TNCs and universities blunts the efforts of BICs in spearheading technological innovation and growth. BICs therefore, have stronger relationship with global innovation partners than they do locally. Thus, while BICs have the potential to spur technological innovation they are constrained by systemic innovation bottlenecks common to most developing countries.

Key words: Innovation, technology incubators, Sub-Saharan Africa, startups, innovation systems.

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Chapter 1: Introduction to Study

1.1 **Background**

Sub-Saharan African (SSA) countries lag behind in adopting digital technologies in fostering new growth paths. Even though digital technologies are widespread, deriving the economic dividends from them is low (Kelly & Firestone, 2016). This view is largely so because the ICT revolution in the 1980s have resulted in catch-up of Asian countries like Taiwan, Korea and India while leading to a divergence in SSA. These countries have experienced the emergence of new innovative technology firms that are competing globally. The connection between technological innovations and economic growth have been studied in economic history. Key technological revolutions like the Steam Engine, Electricity and ICT, referred to as general-purpose technologies (GPTs), have been linked to the growth of productivity in countries such as the USA (Bresnahan & Trajtenberg, 1995; Rhode & Toniolo, 2006). Bresnahan and Trajtenberg who first used the term GPTs describe them as pervasive, improves over time and are innovation-spawning. These innovative technologies make it easier for new inventions in products and services for the economy to grow. Due to their pervasive nature, GPTs have widespread economy effects for households and businesses.

Focusing on the ICT revolution of the 21st century, one area where it impacted growth the most is in the development of business software technologies and, the global effect of the internet. ICT diffusion made it possible for new technology firms located outside the USA to emerge and produce services for the global economy. This revolution ushered in different terms such as "new economy" (Rousseau, 2006), "death of distance" and "new economic geography" (Crafts, 2006) and the objective of these researchers is to demonstrate the impact ICT in spurring growth in different geographies and sectors other than where they started. This growth however, is primarily achieved through investment in new firms that invent or apply research to develop innovative technologies for governments and industries. In the USA, companies like Apple, Microsoft, IBM, Alphabet, Amazon and recently, Facebook are some of the new firms that emerged as a result of this new GPT. There has been a surge in the number of firms that listed on the New York Stock Exchange, the American Stock Exchange and the NASDAQ from 1990 (Rousseau, 2006) due to investments in ICT technology firms. The growth of economies around this GTP did not benefit SSA countries whose economies are largely agrarian. This called for a new approach to technology creation and diffusion in SSA. One

approach through which technology firms were built for growth in the USA and Europe was through business incubation.

Starting the 1990s, the ICT wave influenced a new trend which witnessed the establishment of Business Innovation Centres (BICs) focused on providing support for the growth of specialised IT startups (Mian, 2016). The BIC concept incubates companies in business incubators where they are nurtured and given the necessary support to innovate and grow. Notable among the early BICs was Idealab, set up in 1996 in the USA, and later several specialised BICs mushroomed to provide support for new innovations based on ICT. While some incubators were privately funded, others were state-run; together with the private sector.

The interest in business incubation became prominent because of their crucial role in nation economic development. Emphatically highlighting this point, Mian (2016) asserts that BICs have emerged as development tools to grow innovative enterprises in order to solve local problems. To remain competitive in this global economy, new technology-based firms have become important in driving innovation for export (Mian, 1996). Cognisant of this, governments in both developed and emerging economies such as China, Korea, France, Israel, Taiwan are developing business incubator programmes to link talented entrepreneurs to the development and commercialisation of innovation through technology startups (Mian, 2016, 1996). While ICT-based business incubators gained currency since 1990s, SSA adopted the concept in the late 2000s when incubators like iHub, MEST, 88MPH were established. These business incubators operated based on models of those in the developed countries; focusing on ICT. The example of India in producing IT firms that serve as outsourcing destination for software firms based in the USA served as a motivation.

SSA has a burgeoning youthful population and the mobile-telecommunication boom presented an opportunity to establish business incubators to churn out technology firms. The idea was to produce locally based technology startups that will produce jobs for the people, solve the continent's problems while taking advantage of the mobile phone and telecommunication boom. For example, US$250 million was invested in setting up the *Ethio ICT Village* and this resulted in the growth of the number of ICT firms in Ethiopia (Kelly & Firestone, 2016).

Despite the huge investments in business incubators and the modest achievements, the expected growth is not comparable to developed countries. Without presenting comparative studies, Kelly & Firestone observed that business incubators in SSA have not achieved the desired results as compared to those of developed countries. Rather, incubators are closing down and

the benefits of ICT revolution and the wave of growth continue to elude SSA (Kelly & Firestone, 2016). This phenomenon generates the question as to why the region did not have the absorptive capacity to grow around this innovation. There is the need to assess the innovation system and the relationships that make it difficult to achieve desired results from BICs. There are many actors in the innovation process that need to work together for a holistic result. How do TNCs, universities, startups and governments work to ensure the survival of technology startups? How does BICs support firms to do so? There are a complex set of factors within the socio-economic milieu that support or hamper the growth of technology firms and how BICs remain effective to solving these, needs attention in literature.

1.2 **Purpose of Study**

The aim of this study is do a nuanced analysis of BICs as innovation actors within the innovation system and how they work to nurture the growth of technology startups in Ghana. Since the ICT revolution, BICs have emerged with the aim of driving innovation through startups that disrupt traditional industries. In the developed world, mainly Western Europe and USA, BICs are attracting investments geared at firm level innovation and also, application of research and development (R&D) coming out of Universities. Silicon Valley is a proven model where BICs such as Y-combinator, 500 Startups, TechStars and DreamIt Investors have driven innovation and growth in the IT sector. In the last decade, governments, NGOs and the private sector have adopted BICs as model for growing new firms for technology growth in Ghana. However, the current literature is limited on how well BICs are playing their roles within the innovation system in SSA in terms of the Firm-BIC relationship and how BICs drive growth of innovative technology startups. This is particular crucial as the region is still lagging behind in reaping the benefits of technology growth according to a 2016 World Bank Development Report (World Bank, 2016). This study seeks to contribute to literature towards a framework to assess the role of BICs in driving innovation in Ghana and the challenges faced in this regard.

1.3 **Research Questions**

While the body of literature on BICs in developed countries is mature (Cohen, 2013; Kathleen, 2006; Mian, 1996; Monkman, 2010; Hackett & Dilts, 2004), the literature on BICs in SSA is scanty despite the widespread adoption of the concept as an avenue for innovation. Current body of literature on BICs in SSA focus on incubator development, their success and failures as contained in series of World Bank reports (Chakma, Masum & Singer, 2010; Kelly & Firestone, 2016). The research seeks to answer the following questions.

Research question #1: How do BICs operate within the innovation system to support startups to create and grow technology firms Ghana? This seeks to assess the role of BICs in the innovation system in developing countries. The current body of literature covers developed countries.

Research question #2: How do technology startup firms relate to BICs and what roles do firms expect from the latter with regards to their growth?

1.4 **Research Design– Summary**

The study adopted the qualitative research method using the case study approach. Selected BICs from Ghana were interviewed to provide their experience over the years in relation to the interactions they have with other innovation actors in Ghana. Startup technology firms from BICs were also interviewed. This study also uses information from websites of BICs to augment data obtained from interviews. Six (6) BICs were interviewed and at least a startup from each BICs surveyed. Data was analysed by coding results according to questions that fit into the research questions. Top-level managers were interviewed via Skype and follow-up responses collected via emails. Portfolio startups from BICs answered a survey to assess performance of BICs and how their startups have benefited or would like to have benefitted from BICs.

1.5 **Structure of Thesis**

Chapter 2 provides an overview and discussion of literature related to innovation systems approach and its applicability in developing countries. Further, literature on the emergence of BICs as actors in the innovation systems is reviewed. Chapter 3 provides detailed analysis of the research methodology and why it was employed. Chapter 4 presents the data results from study highlighting important observations. In chapter 5, the obtained results are discussed and various implications are highlighted. Finally, in chapter 6, conclusion is done aiming at a possible framework for BICs in the innovation system for firm growth and recommendations for future studies.

Chapter 2 - **Literature Review on Innovation System**

2.1 **Innovation Systems Framework: A brief analysis**

Innovation systems and development have been closely studied through the works of Freeman (1987), Lundvall (1992) and Nelson (1993) and further elaborated in the work of Edquist (Edquist, 2006). Freeman (1987) identified innovation systems as the organisation of R&D and production activities at the firm level, inter-firm relationships and the role of government in providing policy direction. Nelson (1993) on the other hand, identified with the public and private character of technology and the involvement of private firms, government and universities in the production of new technology. Innovation systems studies seek to explain how societies organise and produce knowledge that firms can use to improve their businesses. This knowledge can be new or an improvement of existing ways of doing businesses in the economy. R&D is a traditional approach by which universities and large firms produce science and technology inventions that are applied in different sectors of the economy. Invention and patents are filed when organisations produce knowledge for industries. The process of generating new knowledge by firms is complex. It depends on inter-firm relationships and the role of government in investing in higher education (Edquist, 2006; Freeman, 1987).

According to Lundvall (1992), while Nelson's work (Nelson,1993) narrowly looks at the production of knowledge and innovation system, Freeman broadly focuses on the interaction between the production system and the process by which innovation is driven. Institutional and organisational collaborations is key for the efficient production of knowledge. Firms, universities and government agencies do not work in vacuum but need to interact for knowledge sharing to create a vibrant innovation system. This form of collaboration is key to correcting the imbalances (Perez, 2009) arising out of different innovation activities by various actors. This organisational interactions can be vertical or horizontal and can also be broad or narrow. Vertical interactions occur when firms within the value chain collaborate for innovations. Organisations at the lower hierarchy learn from those at the top while building their capacity in the process. Horizontally, competitor firms interact to invest in research and learning which results in knowledge production.

Innovation systems involve a complex set of elements within both the private and public sectors that work to produce knowledge. Lundvall (1992) therefore, defines systems of innovation as

the elements and relationships which interact in the production, diffusion and use of new and economically useful knowledge within the nation, region or sector. His definition and approach is similar to Freeman's approach of how production and innovation activities are organised within the system. Lundvall (1992) however, lays emphasis on interactive learning anchored on the production structure and in the linkage pattern of the system of production.

The interactive learning and organisation of innovation is complex and takes into account the substance, form and process of innovation in any innovation system. Using empirical data from the 18th century, Freeman (2002) segmented the organisation, production and diffusion of innovation for the First, Second and Third Industrial Revolutions. Many different organisations and institutional actors and, their interactions emerge to drive each of these innovation epochs. From the data, the form of innovation evolves and responds to the economic needs of people at any point in time. The state, private firms and academia play crucial roles in shaping how knowledge is produced at any time.

The post-war (1945) US R&D system differed from previous ones in different ways. New firms were dominant in the commercialisation of new technologies while investment and demand came from the government for defense-related purposes. The actors or organisations and the interactive learning processes changed during the Third Industrial Revolution. First, the large basic research establishments in universities, government, and a number of private firms served as important "incubators" for the development of innovations (Bruland & Mowery, 2009, p.368). This opened the door for individuals to create new technology firms out of these "incubators" as they were equipped with knowledge and resources to produce for the market. In addition, weaker intellectual property rights regimes made it possible for newer firms to imitate or use knowledge from previous firms to innovate without facing fierce litigation from large and established firms (Bruland & Mowery, 2009).

2.2 **Institutions and Organisations in Innovations System**

The organisation of innovation explains how nations achieved national economic development by building the social conditions for firms and individuals to create innovative technologies for growth. The components of an innovation systems have been identified as the organisations and institutions that either determine or incentivize innovation systems (Edquist, 2006). Organisations are the structures that are formally and consciously created and, play a key role in innovation. Innovation systems organisations and actors include both private and public agencies such as: firms, city councils, universities and financial institutions and technology

transfer agencies (Chaminade & Vang, 2008). From Freeman (2002), some of these organisations include: research councils, government and university laboratories, firm in-house laboratories, and science and technology parks. These are the agents of the innovation process and a network of these actors lead to knowledge creation, adoption and diffusion in the economy.

Institutions on the other hand are norms, habits and accepted ways of engagement between the innovation actors identified above. Institutions are often referred to as organisations but within innovation literature, institutions are the "intangibles" that motivate organisations to pursue innovation activities. Edquist referred to institutions as rules of the game (Edquist, 2006) that determine how the different actors play. To Adelman, these are the socio-cultural milieu within which the economy operates (Adelman 1963 cited in Freeman 2002). Tax incentives, investment in education, protection of intellectual property rights are some institutions that have driven innovation in developed countries such as the USA. Countries with the right organisational and institutional absorptive capacity are able to either pioneer innovation or adopt technical change for growth and development.

These institutional and organisation components of innovation systems work together to foster learning and knowledge for societal development. This knowledge is created in different ways through R&D and, competency building (Edquist, 2005). R&D is a medium of creating new knowledge and learning in many OECD countries for industrial development. Governments and firms create funds or research labs for ground-breaking innovations to either solve economic problems or solve imbalances in current technological innovations. This form of learning and knowledge creation is based on Science and Technology and Jensen et al.. (2007), refer to it as science and technology innovation (STI). Another form of learning in innovation systems is through competency building (Edquist, 2006). This is based on education, training and learning by individuals and firms on new innovative production processes. Vocational and technical training organisations spearhead this form of learning in the economy. The goal is to facilitate knowledge sharing between firms through re-training, learning-by-doing and it is experienced-based (Jensen et al., 2007). Every form of innovation process demands different set of institutions and organisations networks to drive growth.

2.3 **Regional Innovation System (RIS) and the Network Interactions**

Globalisation of innovation and technology in the production value chain creates a greater need for localised knowledge. The different forms of innovation systems within the economy have

implications on the kind of knowledge produced and its availability for regional and national growth. Regions within countries develop their unique innovation systems that produce knowledge for the growth of firms within that geographical or administrative area. The definition of region can be based on several factors and often varies depending on the desired objective. Amin (2004), suggest how regions should be viewed. He suggests they be understood as open nodes in global value chains, which are constituted through dynamic relations and interactions with local and trans-local organizations. His definition points to two crucial innovation perspectives: local and trans-local organisations.

Trans-locality indicates firms in regions interacting with other firms beyond its boundaries within the global sphere. First, regions build trans-local relations with other firms to produce or receive global knowledge. R&D activities by firms and universities produce global knowledge which is codified. As the name implies, this form of knowledge is documented and any firm or organisation in any geographical location can take it and apply to their firm as well. Organisations do not need to be closer to the source of this new knowledge to be able to use. ICT is a typical example. Firms in different locations such as India, South Korea and Taiwan can produce world class software even though they are far away from hubs like the Silicon Valley where the knowledge originated. Codified knowledge from R&D therefore, becomes ubiquitous (Asheim & Gertler, 2006) and available to all regions and sectors for economic growth. Firms in regions cannot remain competitive in the global value chain by depending on codified knowledge.

What is however, non-tradable or not ubiquitous is tacit knowledge (Asheim & Gertler, 2006) which is unique to a particular region for local production purposes. That knowledge is produced through experience and learning in the regional innovation system. Regions build their institutions and organisations to support the production of this kind of knowledge. Tacit knowledge determines the innovativeness of a geographical region and it is important for securing competitiveness, dynamic growth and prosperity of firms within the global value chain (Asheim, Grillitsch & Trippl, 2015) . Regions develop this knowledge-base over a period of time and evolves to shape the role of a region in the national innovation system (NIS). Since tacit knowledge is not codified, it is sticky and not easily transferrable to other firms and industries in other regions.

Access to both codified and tacit knowledge are needed for firm production and growth. While firms within the region have access to tacit knowledge, they may not have the capacity to develop or adopt codified knowledge for complementary innovation.

Key to RIS and growth is the network relationships between actors within it and also, with external organisations. To develop tacit knowledge, RIS literature recognise geographic proximity as key for knowledge transfer and learning within the innovation system (Asheim, Grillitsch & Trippl, 2015; Asheim & Gertler, 2006; Chaminade & Vang, 2008). Regional closeness of firms and other actors makes it easier for interactive learning and support via social, cultural and institutional arrangements for firms to grow. Vertical and horizontal linkages within the RIS facilitate the generation of new knowledge and the application of innovations for production (Asheim, Grillitsch & Trippl, 2015). Over time, the region can build its capacity to incrementally innovate to prevent the regional tacit knowledge from going extinct. The cumulative effect is social assets that exist among firms that become path-dependent over time (Asheim & Gertler, 2006; Isaksen & Trippl, 2014) and can serve as avenue for regional renewal when there is national or global economic crisis.

Regional varieties in term of their capacity and diversity affect the innovation system. The presence of innovation institutions and organisations differ thereby determining how knowledge is produced in each region. Regions can have a high or thick concentration of innovation organisations that are diverse while some peripheral regions have a few or thin innovation organisations. In-between are regions that have thick concentration of resources but are specialised in the production of a particular knowledge activity. Organisationally thick regions are metropolitan in nature and benefit from agglomeration of innovation organisations that are also diverse and have the capacity for knowledge creation. The different regional varieties and characteristics are summarized in table 2.1 blow.

Table 2.1: Varieties of organisations in RIS

Organisationally thick and diversified	**Organisationally thick and specialised**	**Organisationally Thin**
- Strong clusters in several industries - Critical mass of knowledge and supporting organisations.	- Strong cluster in 1 or few industries - Highly specialized support infrastructure - Old industrial areas	- None or weakly developed clusters - Few or none knowledge providing organizations - DUI mode of learning

- Metropolitan areas - Related variety (Jacobsian externalities) - Diverse and Geographically-wide knowledge networks - Path creation and Branching	(e.g. Italian industrial districts) - Marshallian externalities - Regionally oriented, inward looking networks - Particularly vulnerable to industrial decline - Path extension	- Strong social capital - Path extension or exhaustion - Some firms might develop international networks as a compensatory mechanism

Source: Asheim, Grillitsch & Trippl (2015), Chaminade & Plechero (2015), Isaksen & Trippl, (2014).

These regional configurations can induce new paths of development and influence the direction of regional change (Asheim, Grillitsch & Trippl, 2015). Thick and diversified regions can support path renewal and path creation due to the presence of different knowledge bases. This suggests that such regions are able to overcome exogenous shocks by diversifying into related industries during crises. Organisationally-thick and specialised regions are also inwardly looking with specialised infrastructure to support a particular industrial knowledge base. They face the tendency of lock-down and extinction as they are easily exposed to vulnerabilities. Obviously, organisationally-thin regions lack the capacity to develop knowledge and will have to depend on external sources of knowledge for competitive production. Their limited capacity to promote path extension exposes them to the danger of path exhaustion (Asheim, Grillitsch & Trippl, 2015)

In an earlier work, Asheim and Gertler (2006) discussed regional varieties in terms of network of organisations and their embeddedness into the knowledge production through R&D and vocational training. Organisational networks in regions can also be integrated into the national and international innovation systems to avoid the danger of regional extinction as discussed above. It appears that access to extra-regional or exogenous resources for accessing non-tacit knowledge remains critical to regional resilience and growth. Arguing for a new foci on RIS and the capacity for extra-regional knowledge, Trippl, Grillitsch and Isaksen (2015) called for a stronger integration of the RIS approach with established conceptual frameworks such as global production and innovation network. This approach should not only focus on global innovation networks but a complete integration of RIS into the national innovation system as well.

RIS and global networks have gained currency and research is focused on how regions tap into global networks for additional knowledge. For this study, emphasis is put on techno-globalisation (Archibugi & Michie, 1995) and how regions import ICT by collaboration, exploitation and generation of technology. Global networks reduce the institutional and organisation distance required for firms in different regions to exchange knowledge. In a study of IT firms in Bangalore region and how they exploit global technology, outsourcing of technology jobs from US firms to their counterparts in Bangalore was key in helping firms in the region learn from top-class IT firms (Chaminade & Vang, 2008). Irrespective of the type or variety of regions firms, universities and other innovation actors develop global networks as a compensatory mechanism for what they are lacking (Chaminade & Plechero, 2015).

2.4 **Innovation System Framework in Developing Countries.**

The nexus between innovation systems and developing countries has been at the forefront of research by Lundvall et al.(2009) , Fressoli et al.(2014) and Arocena and Sutz (2000). There is the growing school of thought that has criticised mainstream innovation systems to be unfavourable to socio-economic development of developing countries. Arocena and Sutz (2002) have argued that there is no full-blown innovation system for developing countries while Viotti (2002) and Matthews (1999) advocate for the use of "learning systems" instead. Developing countries lack the resources for instance, to invest in sophisticated R&D activities. In addition to this, their economic structures are largely informal and cannot support innovation activities. There are others who disagree with this view. Cassiolato, Matos and Lastres (2014), for example, advanced that developing countries have productive activities, formal and informal knowledge structures for creation, adoption and diffusion of innovation which may not be high-tech or radical in nature. The kind of top-down innovation system approach will not benefit SMEs who engage in production activities in the lower strata of economy. The shortcomings of mainstream innovation systems for developing countries call for new research especially for the informal sector of the economy (Lundvall et al., 2009).

Lundvall et al. (2009) provide an insight into innovation systems in developing countries which sheds light on the functions of innovation system for developing countries. They identified three strata of innovation systems for developing countries as: Emerging/Nascent, Fragmented/Dual and Mature. Each of these systems have their characteristics and the nature of innovation system to be adopted. Table 2.2 gives a full overview of each.

Table 2.2: Functions and nature of innovation systems for developing countries

	Emerging/Nascent	**Fragmented/Dual**	**Mature**
Main Objective/function	Technology adoption Capability building	Technology adaptation and technology creation	Technology creation
Common Characteristics	- Large informal sector. Majority of small firms with low or no technological capabilities. - Poor business and governance environment - Limited access to basic infrastructure like electricity, internet, and finance Lack of skilled workers.	- Pockets of dynamism with large proportion of the population in poverty and other forms of exclusion. - Critical mass of qualified engineers and technical staff. Inter-organizational links are weak. -Born-globals are fairly common as a compensation mechanism.	- Critical mass of S&T and managerial capabilities. - Good business climate.

Source: Chaminade et al (2009).

The function of an innovation system determines the kind of innovation activities in each category. While emerging systems focus on competency building and learning-by-doing, mature systems begin to create knowledge through R&D to add to global knowledge. In terms of the organisations and actors of innovation in developing countries, Chaminade et al (2009) identified the following as critical to the process: indigenous firms, universities, technological centres, government and transnational corporations (TNC). The network relationship among these actors is somewhat weak in nascent system but stronger in mature innovation systems. This list however, fall short of the important actors involved in organising innovation in developing countries. Fressoli et al. (2014) particularly emphasised the role played by grassroots innovation movements (GIMs) and development partners such as the World Bank and UNDP. GIMs include civil society groups, NGOs, trade associations and corporative unions. George, Mcgahan and Prabhu (2012) present an interesting dimension where they advocated adoption of public-private partnerships as a way of organising innovation sytems in developing countries.

The innovation process in developing countries tend to be based on learning and competency building. On the job training and apprenticeship is common where firms take in individuals and train them over a period of time. Training modules can take place both in formal and informal technology organisations (Chaminade et al., 2009). The importance of networks, peer-to-pear learning, trial and error and re-engineering of existing tools form part of the process of innovation in developing countries. Innovation networks in developing countries must be inclusive and provide firms and entrepreneurs with access to actors who can provide capital, advice and other valuable resources (George, Mcgahan & Prabhu, 2012). The inclusive innovation literature identify the resources needed by firms in the bottom of the pyramid as physical capital and knowledge, organizational capabilities, partnerships, and property rights which are unorganised in the informal sectors (see Fressoli et al., 2014; George, Mcgahan & Prabhu, 2012).

2.5 **Business Innovation Centres: Concepts and History**

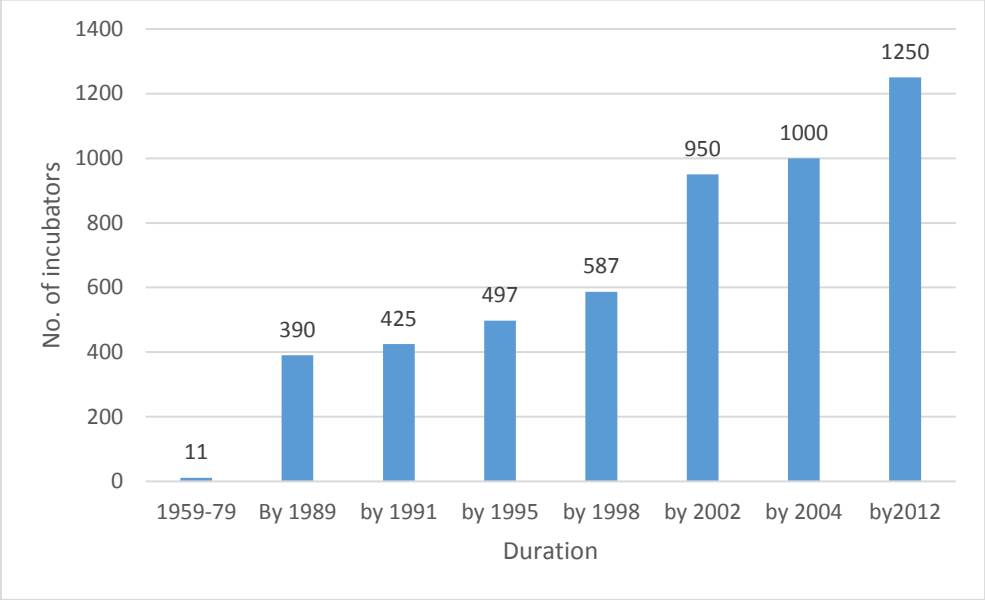
Different innovation systems have been adopted globally to create new technology firms that produce knowledge in the innovation system. BICs are emerging as pivotal in knowledge creation and technology transfer to firms to complement the efforts of universities and multinational firms. BICs remain one of the key actors in digital technology innovation and transfer through business incubation. Business incubation is a process that accelerates the successful development of innovative startups by providing entrepreneurs with targeted business services and technology support (Kathleen, 2006). Despite the emergence of BICs as conduits of innovation and growth, research literature is still developing. Temali and Campbell began this when they published a report on the results *of Business Incubator Profiles: A National Survey* in 1984 (Hackett & Dilts, 2004). Since then, Campbell and Allen (1987) and Kuratko and LaFollette (1987) have done literature reviews on the subject of business incubation. Apart from research literature, the National Business Incubator Association (NBIA) of the USA has been at the forefront in publishing annual reports and assisting BICs to operate. The first business incubator was first established as the Batavia Industrial Centre in 1959 at Batavia, New York (Mian, 2016; Hackett & Dilts, 2004), after a real estate developer rented parts of his facility to startups. The firms later asked for business support services from the real estate company and the concept was born.

Gradually, the concept grew in the 1960s and 1970s with the establishment of the University City Science Centre (UCSC) in Philadelphia with the aim of commercialising basic research outputs (Hackett & Dilts, 2004). Mian (1996) has done extensive work on the role of

University-based incubators in drawing the attention of governments and investors to how R&D could be commercialised. It was not only universities that saw the potential of BICs in driving innovation and growth but the government did as well. The National Science Foundation's Innovation Centres Programme in the USA was aimed at creating the institutional set up for commercialising certain inventions (Hackett & Dilts, 2004). Business Incubators started as publicly funded organisations by universities and governments. Later, privately funded incubators emerged. The 1980s to 1990s significantly saw a greater interests in business incubators as many public and private incubators were set up in the US and Europe. The diffusion of the ICT wave heightened the interest in BICs as launch pad to creating technology-based startups. As reviewed earlier, the ICT revolution ushered in software, internet and computers which made it possible for new startups to be built in different regions. The success of companies such as Microsoft, Apple and Google who later ran incubator programmes encouraged the adoption of the concept worldwide.

Therefore, the 1990s-2000s witnessed the emergence of BICs focused on ICT or its offshoots. Software and biotech were key areas where BICs were focused on. Over the past two (2) decades, emerging economies such as Taiwan, Israel, Korea, India, China, Brazil have launched different versions of BICs with the aim to building new technology firms for national economic development (Mian, 2016). In an address to the Small Business Committee of U.S. House of Representatives in 2010, David Monkman (President of NBSA) observed that for about 50 years, BICs have been helping entrepreneurs turn their ideas into viable businesses, promoting innovation and creating jobs (Monkman, 2010). He reported that there are over 1,100 incubation programs in the United States alone and more than 7,000 worldwide. Figure 2.1 shows the growth of BICs in the USA since 1959.

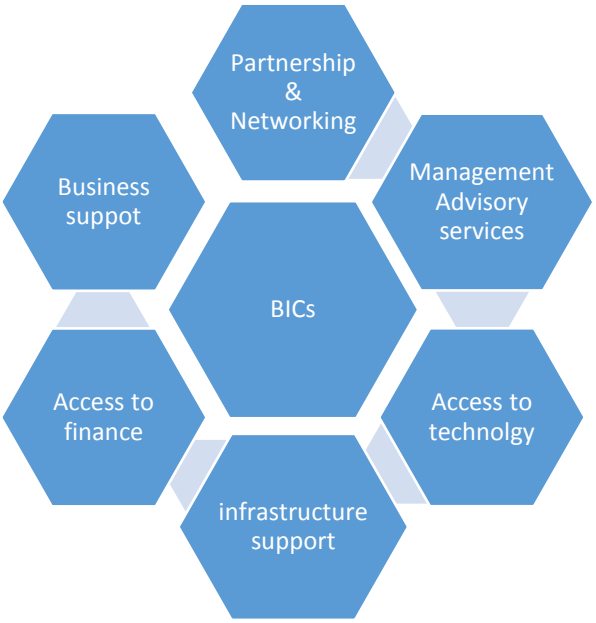
Figure 2.1: Growth of Incubators since 1959 in the USA



Source: Mian (2016)

BICs have controlled physical or virtual space that supports businesses until they become self-dependent (Yee, 2009). Business Incubators focus on business support services, funding and mentorship for firms to innovate and grow. Apart from resources and services, BICs work actively with startups to become operationally and financially sustainable to compete with mature firms. By doing this, BICs reduce the chances of new innovative startups collapsing while shortening the time-to-market required to deploy a product. The nature and composition of innovation centres have evolved over time. BIC have different structures with different operational goals and objectives. Based on existing literature, the most important incubator services are presented in figure 2.2 below.

Figure 2.2: Key support services provided by BICs



Source: Cohen (2013), Kathleen (2006), Mian (2016), Monkman (2010), Yee (2009)

These services are provided at different phases of the incubation process. At the early stage, new firms need different set of services as compared to matured companies. Innovation support needs of portfolio startups at different stages have been categorised by Mian as shown in table 2.3 below.

Table 2.3: BIC services provides at different stages.

Phase	**Services**
Phase 1: Idea development	This earlier stage of intervention is designed to help entrepreneurs design a prototype or minimum viable product. Ideal for S&T based startups and run by universities or innovation centres. Companies are at still at the development or laboratory stage aiming to commercialise the technology.
Phase 2: Incubation and Acceleration	At this stage, a team is formed with a business plan to operate the company. Incubators provide resources, funding and partners for scaling. Companies are not profitable but may be cash flow positive.

Phase 3: Post-incubation consolidation and growth	Here, BICs provide portfolio graduates with contacts to TNCs and venture firms. Growth and scaling of the technology due to their interaction with mature firms. Knowledge exchange is key here and companies may also relay on key R&D activities to remain competitive.

Source: Mian (2016)

Globally, BICs have gained currency and developing countries are investing in such programmes. Governments, development partners and the private sector have recognised their capacity to create jobs at the regional and national levels. The World Bank has invested in incubator programmes in Ukraine, Morocco and South Africa. In Brazil, growth rates for incubators was 30% as at 2002 with an average of 8 portfolio companies per BIC. I terms of impact, portfolio companies of BICs in Brazil directly created over 5,000 jobs while half recorded revenues exceeding R$ 500,000 (Scaramuzzi, 2002). In SSA, there are about 60 BICs (Kelly & Firestone, 2016) that aim to grow digital technology startups that will solve local economic problems in the region. The role and impact of BICs in driving innovative technology firms in countries and regions such as United States, Europe, Asia, the Middle East, and Australia have been studied extensively (Khorsheed, Al-Fawzan & Al-Hargan, 2014; Monkman, 2010; Hackett & Dilts, 2004; Soetanto, 2006; Yee, 2009). For instance, impact studies of BICs for Europe in 2014 revealed that BICs number around 900 and make a significant contribution to job and wealth creation. About 40,000 new (net) jobs are generated each year by incubators (European Union, 2002). However, the literature on how the concept can be adapted to the unique development challenges of SSA countries remains underdeveloped. According to Kelly and Firestone (2016), BICs are fast folding up in SSA despite the investments and interests in them. The cause of the failure of BIC to drive innovation startups for growth is multi-faceted and a framework for understanding the interactions of the various actors within the system is needed. Literature on this will help model frameworks that will shape the implementation of BICs in SSA in order to achieve benchmarks like their EU and USA counterparts.

2.6 Typology of Business Innovation Centres

There are varied approaches and mechanisms for modelling a typology of BICs. Developing a standardised typology of BICs is somewhat difficult since different names are adopted

dependent on the objectives of the managers. This is also problematic due to the operationalisation of models to fit into the unique needs of different countries and regions. The literature is therefore varied and divergent in categorizing BICs. Most of the classifications overlap and in some cases, it is a matter of nomenclature. This notwithstanding, there are key themes that remain prominent in an attempt to build a taxonomy of incubators. They are modelled based on: nature of their primary financial sponsor (Hackett & Dilts, 2004; Yee, 2009), the business focus of the incubatees (Mian, 2016; Scaramuzzi, 2002; Hackett & Dilts, 2004) and the *use* to which BIC is put to (Khorsheed, Al-Fawzan & Al-Hargan, 2014; Mian, 2016). Table 2.4 presents the different typologies of incubators and their descriptions.

Table 2.4: Typology of BICs

Typology	**Description**
Development Incubators	These are aimed at solving specific economic or social and development challenges such as economic restructuring, job creations. These are funded or subsidized by local authorities.
Mixed-Use	These include knowledge-intensive and low technology firms in service and manufacturing. The main focus is access to local/regional sources of technical, managerial, marking and financial resources.
Specialised Technology	The goal is help develop technology-based firms. They are located close to universities, large industrial laboratories, and innovation and science parks with formal links. They are also specialised in specific technologies such as: biotechnology, agriculture and ICT.
University Incubators	University incubators are established in or by university campuses. There are different models, sizes and nuances regarding these kinds of initiatives. The common factor is that these incubators generally promote the development of new research/technology-based firms inside their own facilities.

Virtual Incubators	These have no walls and are internet based. This is associated with internet based startups but provides normal incubator support services.
International Enterprise Centres	These incubators provide a full range of support services for the development of knowledge-based businesses. Most of them are export-oriented and show impressive growth rates and sales records. They link universities, research institutes, venture capital and international joint ventures.
Science/Research parks	A complex set of activities within a limited area around a university where research, industry and capital combined entrepreneurs and researchers.

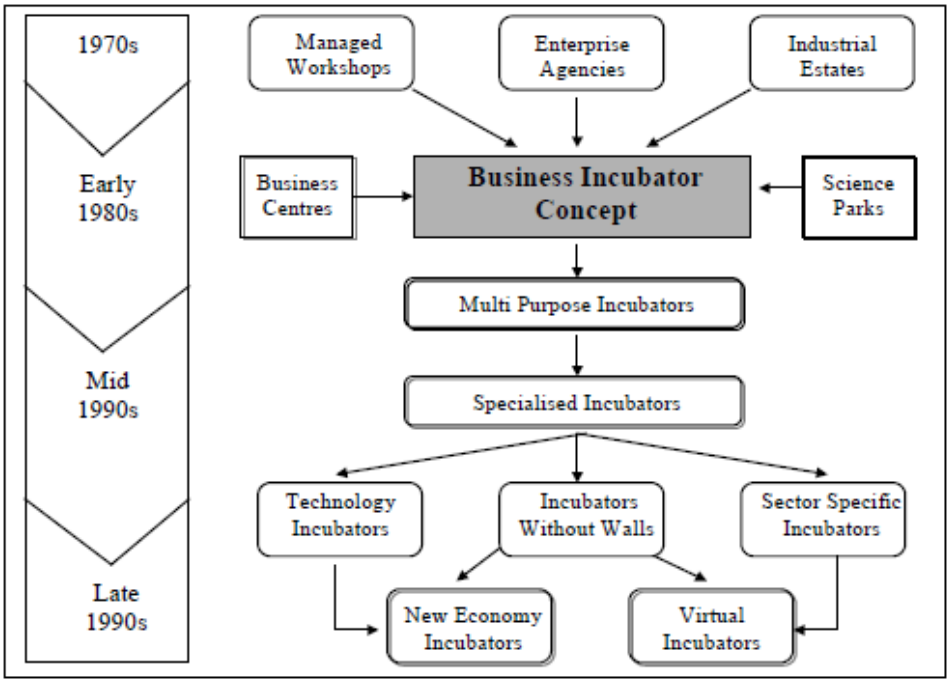
Source: Kathleen (2006), Khorsheed, Al-Fawzan & Al-Hargan (2014), Mian (2016), Scaramuzzi (2002).

The above taxonomies focus on the purpose of the BIC and their priority areas. In terms of funding, BICs are operated on any of these models: public, private and public-private funded. Publicly funded BICs are financed by government agencies or NGOs which provide resources to help startups. Government funded BICs also provide financial assistance to help firms build technologies to address market failures such as access to finance and information (European Union, 2002). Privately funded BICs are set up by Venture Capital firms and TNCs who see BICs as a strategy to attract teams with innovative business ideas. For a detailed review of both public/private funding of BICs, see two World Bank reports on incubators in developing countries written by Kelly & Firestone (2016) and Scaramuzzi (2002). One area that is not given attention in the typology analysis of BICs is the motive of the founders of BICs. This is important because it influences how actively they help firms churn out innovation within the innovation system. The motive for setting up BICs can either be "for-profit" or "non-profit" purposes and each has implications for the nature of firms they produce.

For-profit BICs have the sole aim of making money either from equity stake in the companies or from rents and service charges to firms. Non-profit BICs either have external funding that are tied to a particular goal such as poverty reduction or minority empowerment. Resources and funding are provided free of charge to selected firms through a criteria (see Yee, 2009). Yet, a third form which is in-between these two is BICs ran as social enterprises. These are aimed at making revenues to cover basic operational costs but not to make profit from startups. It is interesting to see how these arrangements affect innovation processes of BICs and their

portfolio companies. Further research is needed to ascertain how these different typologies impact innovation and growth of portfolio startups. The evolution of BICs and how these typologies have changed is well captured by the EU report as illustrated below in Figure 2.3.

Figure 2.3: BICs concepts and models since 1970s



Source: EU Report (2002)

Specialised BICs have become dominant since 1990s and have a focus on a particular sector or technology. Furthermore, S&T incubators have become prominent since the ICT revolution with more technology firms admitted to BICs. There could be a mix of technology and non-technology startups working together in BICs.

2.7 **Business Innovation Centres within the Innovation System**

BICs cannot operate in isolation to drive innovation and a network of relationships with other innovation actors is needed to achieve their gaols. Within the innovation system, BICs are actors who actively or passively help new firms to generate or apply existing knowledge in solving societal problems. The history of BICs points to the strong relationship that existed between BICs and universities (see Mian, 1996) and the objective was to use BICs are agents for the transfer or application of R&D coming out of universities. Graduates who wanted to implement research ideas had the opportunity to do that in the BICs where resources were provided for that purpose. Subsequently, large enterprises such as Alphabet (Google) set up

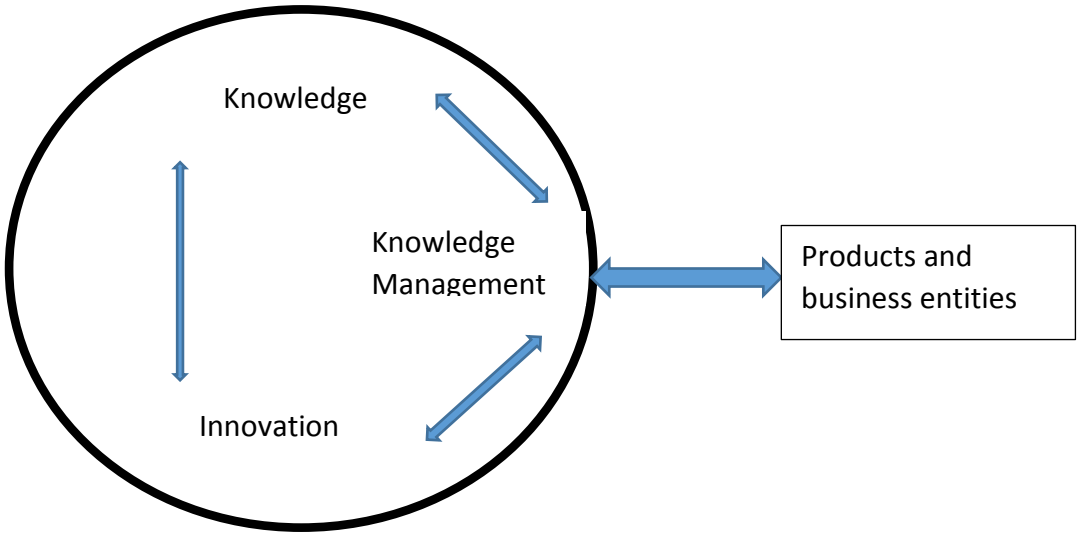
BICs to nurture spin-off ideas out of research by employees. It can be argued that BICs stimulate research internally among its portfolio companies. This is achieved by investing in resources to help mature portfolio companies undertake ground-breaking researches that will make them competitive. Portfolio firms can collaborate with each other or with external actors for radical or incremental innovation research. BICs therefore, need to build networks with industry for tacit knowledge, partner with universities for new and codified knowledge and, lobby governments for policy support. Equally important is innovation finance as this is key to the development and commercialisation of new knowledge. BICs are handicapped in their abilities to assist startups innovate where financial resources are lacking. Market failures make it relatively costly and risky to provide services to startups as compared to larger firms. BICs need adequate financing to provide resources and services that are subsidized and affordable to new firms. Governments and donor partners such as the World Bank have remained key source of funding for innovation activities in developing countries (Kelly & Firestone, 2016; Scaramuzzi, 2002) while venture capital firms pioneer BICS in developed countries. Therefore, within the innovation system, BICs serve as laboratories to hatch and commercialise new ideas based on research and technology.

BICs themselves are able to foster knowledge sharing within their own setup. According to Hackett and Dilts:

"*the incubator is also a network of individuals and organizations including the incubator manager and staff, incubator advisory board, incubatee companies and employees, local universities and university community members, industry contacts, and professional services providers such as lawyers, accountants, consultants, marketing specialists, venture capitalists, angel investors, and volunteers*" (Hackett & Dilts, 2004, p.57).

Hacket and Dilts's description of the incubator captures both the internal and external mechanisms that make BICs capable of churning out innovative firms. Internally, BICs themselves are able to foster a positive synergy among their startups who can collaborate on various fronts. Arguably, BICs can themselves develop tacit knowledge which is unique to that BIC and only available to their portfolio firms for competitiveness in the broader marketspace. Yee (2009) presents a model in figure 2.4 below which illustrates how BICs can facilitate knowledge and innovation for the growth of its firms internally.

Figure 2.4: Knowledge and innovation mechanisms in BICs.



Source: Yee (2009).

Yee's framework illustrates how knowledge and innovation is managed to produce innovation outputs in the form of startups. The ability of a BIC to manage this process effectively will likely result in success of its portfolio firms.

Chapter 3 – Research Methodology

3.1 **Research Design**

The study required gathering qualitative data from BICs, their startup firms and how they collaborate to drive innovation in Ghana. The qualitative research approach was adopted because it affords the study the opportunity to do an in-depth and open discussion with BICs and startups about their innovation activities. Experience of the subjects in this study is important in understanding the dynamics of technology innovation and how the different actors work to drive it. Interviewing both BICs and startups through this qualitative study in an open discussion exposes the researcher to other factors that the study could not anticipate in a quantitative or mixed-methods study. Also, BICs in Ghana are still young and quantitative data is inadequate or unavailable for detailed studies. To avoid one-sided responses, the study covered both BICs and startups and also gathered secondary data relating to BICs and their operations. The number of BICs interviewed represent the main actors in Ghana, and SSA in general over the past 10 years. Their views can therefore, be taken to be representative of BICs and technology startup innovations in Ghana.

3.2 **Research Data**

Data for the study was gathered from two main participants: managers of BICs and startup co-founders. For each of these participants, different set of data was collected and the subsections below discusses the research data gathered from the different groups of participants.

3.2.1 Managers of BICs

Data for the study was mainly qualitative and based on the responses from managers of BICs during the first phase of the study. Apart from primary data from managers of BICS, supplementary secondary data gathered from websites and other press release articles. Interviews were conducted with each manager and captured their views on various subject areas ranging from the motivation for running BICs to how they collaborate with other organisations to help startup firms. Table 3.1 below highlights the broad themes based on which data was gathered.

Table 3.1: Key research interview topics with BICs

History of BIC and why it was started
Goals and objectives of BIC and if they have changed
The services and resources provided for firms and if they are free or paid
In what way have they support new firms to innovate and grow
BICs interests in startups both during and post-BIC
BIC relationship with other innovation actors such as Universities, TNCs, Governments, financial institutions and other BICs
External network relationships were captured
Number of portfolio startups and the impact on society
Challenges BIC and startups face and how they address them
Classification of BICs and how it impacts on startups

The most relevant interview responses are cited in text although the information may have been confirmed in a number of other interviews. Direct quotes are taken from select interviews to illustrate key points of the model. However, majority of the responses used for the analyses are paraphrased to reflect the central theme of all respondents.

3.2.2 Co-founders of Startups

After data was collected from the Managers, follow-up interviews were done with selected startups from each BIC for data regarding their participation in the incubation programme. Data on the kind of support received from BICs and the level of satisfaction with services provided was gathered. Co-founders of at least each BIC were also interviewed for data on which innovation networks they have access to for innovation activities. BICs face challenges and the study also gathered information on how these challenges affect innovation and growth While most of the data was mostly qualitative, quantitative data was collected on the number of employees and how long the company has been operating.

3.3 **Sampling**

The thesis was focused on how BICs promote the development of innovative technology firms in SSA using Ghana as a case study. To get potential sample, an internet search of all BICs operating in Ghana for not less than three (3) years was conducted. I found about eight (8) BICs actively operating in Ghana in terms of startup incubation. Out of this, six (6) BICs were

selected for the survey. These are BICs that operated for more than 3 years and also had significant exposure with positive startup growth in Ghana. Selected companies also had experience with startups who have graduated or still incubating with the BIC. This was to make the study in-depth in terms information and its quality. There is only one government BIC known as the Ghana Multimedia Incubation Centre (GMIC) and was studied extensively using reports and information on its website. GIMC was started with funding from the Government of Ghana and the UNDP. A telephone interview could not be organised with the manager of GMIC and a questionnaire was sent for him to fill. Also, the selected BICs are all based in Accra and those outside Accra were not interviewed. The Accra region is the capital with the developer and receiver competencies to support innovation and growth of new firms. The goal was to identify BICs in Accra which have the infrastructure and resources to support innovations by startups. BICs that had no websites were not considered because part of research data was collected from the websites of BICs to augment primary data collected. The selected BICs are presented in table 3.2 below:

Table 3.2: List of selected BICs

BIC	**Portfolio companies**	**Website**
ISpace	76	http://ispacegh.com/
Impact Hub	4	http://accra.impacthub.net/
MobileWeb Ghana	10	http://mobilewebghana.org/
Meltwater Entrepreneurial School of Technology	33	http://meltwater.org/incubator/about-the-incubator/
Servled	13	http://servled.com
GMIC	Not available	http://gmic.gov.gh/en/

Source: Author's research, 2017.

Once the BICs were selected, at least one portfolio company from each incubator was also interviewed. After the interview with each BIC, they were asked to recommend some of their portfolio startups for interviews and I surveyed any startup that was recommended. In total, seven (7) startups were recommended and a question guide was prepared for them to fill. Since the surveyed startups were based on recommendations from BICs, there could be an element of bias in the responses. It is possible BICs recommended portfolio startups who will give desired responses to boost the image of the BIC. To minimise the bias, the study relied on review articles and reports by Vc4africa to augment responses. This notwithstanding, the study

believes in the independence of startup co-founders. The companies are small-to-medium size of about 1-6 employees and about 1-3 years old. All startups are building technology solutions for the Ghanaian economy except one which is focused on the global ecommerce space. The study was anonymous and responses cannot be associated with any particular startup.

3.4 **Research Methodology**

Once the BICs and portfolio startups were identified, the study was conducted using the qualitative research design. The research instruments were mainly open ended questions administered by the interviewer. See Appendix 1 for the questionnaire that was used. The questions only served as a guide and were framed to fit into the conversation. Managers of BICs were emailed with a brief description of study with a request for an interview in the same email. Once interview dates were agreed, interviews were conducted based on qualitative research methodologies as outlined by Creswell (2013). The interview guide was improved and restructured after each interview for oral administration. However, there were follow-up emails to clarify or ask new questions that were missed. After interviewing each manager, I requested for introduction to their portfolio startups whom I contacted for the second phase of research. Startup co-cofounders answered a survey form and results collated using Google survey forms.

Each interview was conducted over the internet using Skype and were recorded without any hitches. While interviews were ongoing, I took notes for future references. Each interview lasted about 30-45 minutes. A coding table for each question and response was developed. After each interview, responses were entered into the coding table to fit each question. To complement interviews, it was common practice to visit websites of each BIC to verify some response and data provided as well. No formal quantitative analyses are presented in this study due to time constraints. Direct quotes from the interviews appear in italics. Interviewees had no problem with being quoted as part of the study.

Coding of the results was done using an Excel sheet and the responses recorded against each BIC. See appendix 2 for all coded results. In terms of analysis, Nvivo was used for detecting key responses that appeared in multiple interviews.

Chapter 4 – Results of Study

4.1 **Introduction**

Using the research methodology, the data was analysed and the results of the study are presented in this chapter. It presents the BICs in Ghana and the services and support networks provided to technology firms and how this affects innovation.

4.2 **The Ghana BIC Background**

BICs in Ghana are still young and evolving. The first technology business innovation centre was set up in 2005 known as the GMIC. It was set up jointly by the Government of Ghana and the UNDP with the main focus of ICT Entrepreneurship through ICT startups. Five years later, the first privately funded technology BIC was established in 2010 known as Meltwater Entrepreneurial School of Technology (MEST). The MEST incubator programme is focused on ICT-based startups just like the GMIC. Following MEST, other privately funded BICs were founded to provide resources and support to students and graduates who wanted to build technology startups. For instance, MobileWeb which was also founded 2010 focuses on incubating startups to take advantage of mobile phone boom in the country (Business Monitor International, 2010).

ISpace and Impact Hub started as co-working spaces but gradually incorporated incubation into their goals. Providing working space alone was not enough to drive innovation and they quickly realised the need to provide resources and actively guide startups. About 90% of incubators are located in Accra, the national capital. Kumasi, which is the second largest city, hosts two business hubs which are just co-working spaces for rent to entrepreneurs. Regional distribution is skewed towards Accra. In terms of focus, earlier incubators focused mainly on ICT or sectorial (specialised incubators) but there is an emerging trend where BICs are becoming mixed-purpose and accepting non-technology-based entrepreneurs into their programmes. Servled and ISpace have portfolio startups that span across both the technology and non-technology spectrum. One thing is common: all BICs have their core goal as providing the resources, working space and guidance to entrepreneurs who have the desire to build successful technology startups.

4.3 **Goals and Objectives of BICs**

While each BIC has its goals, there are commonalities underpinning how each one aims at nurturing technology startups. The common themes that run through BICs and their goals in Ghana are presented table 4.1 below.

Table 4.1: Goals and objectives of BICs to help firms innovate.

Theme	**Motivation**
Dynamic social innovation system	The network of interactions and support for entrepreneurs to interact is missing and filling this void is key. For ISpace, they hope to foster this by providing: working space, internet, mentorship and business support for young entrepreneurs. Similarly, Impact Hub seeks to develop training programs, providing workspace, access to capital and connecting entrepreneurs with each other to help create a synergy for innovation.
Access to seed capital and mentorship	All BICs recognise this as key to success of technology startups. The MEST incubator has provided seed funding and hands-on mentorship to over 33 startups since 2010. Servled also provides seed capital aimed at commercialising innovation. This they believe is key to addressing challenges of entrepreneurs.
Addressing market failures	High cost of doing business, infrastructural challenges and access to both human and financial capital are factors that make it difficult for startups to innovate.

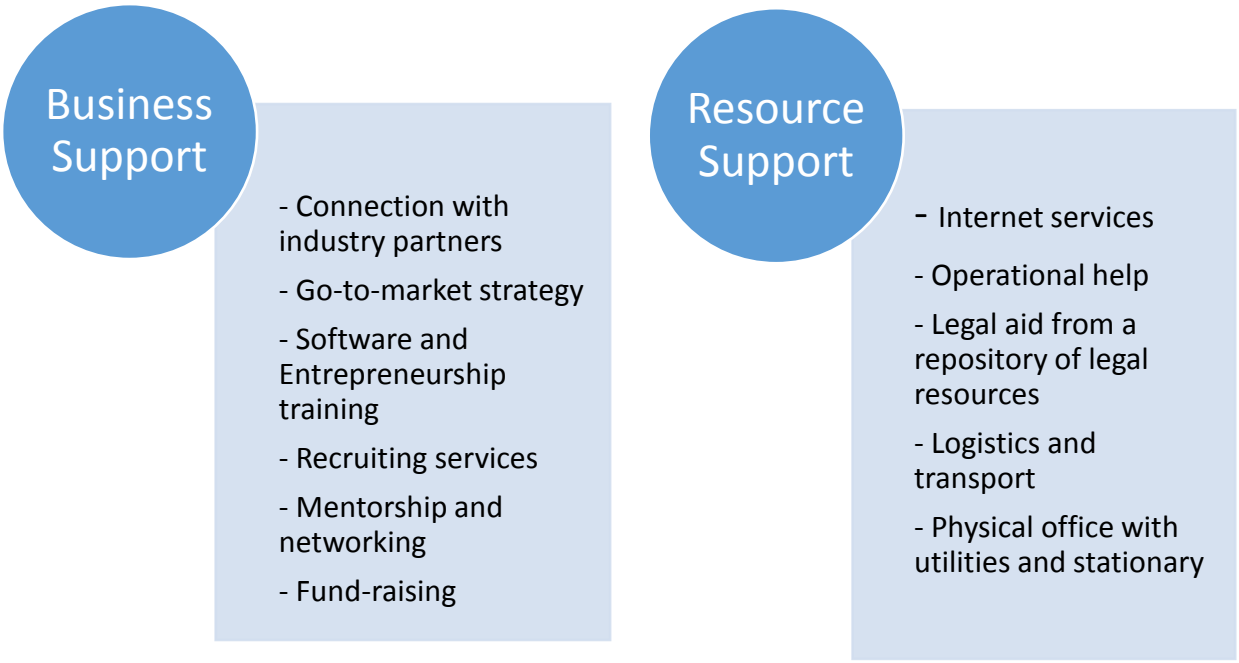
Source: Author's field survey, 2017.

Broadly, the innovation system is fragmented and unfavourable to startups thereby exhibiting similar characteristics to nascent IS as observed by Lundvall et al. (2009). Part of creating a dynamic IS is to organise training programmes and entrepreneurship events that seek to stimulate interest among graduates who are like-minded to team up and implement their ideas. All BICs have training modules which precede their incubation programs. The training programmes are focused on software development and entrepreneurship. ISpace believes that, graduates lack the requisite skills or, are unwilling to share their innovative ideas with their peers. As part of the training, entrepreneurs get the opportunity to develop their creative and business acumens needed for developing their ideas. The MEST incubation programme has a full one-year training program as a prerequisite before teams are admitted into the incubation programme

4.4 **Services and Support Modules**

Services provided by BICs Ghana are similar to those provided by BICs in developed countries (see Mian, 2016). While the services and support offered remain similar, the approach to doing so differs. Broadly, support services to firms are categorised into two main areas*: resource and business support.*

Figure 4.1: Business and resource support service provides by BICs in Ghana



Source: Author's field survey, 2017

The key support services provided to firms also vary depending on the stage of the company. Early stage companies that are still developing ideas have been provided with training and legal aid resources that aim to protect intellectual property rights of companies. All the incubators in Ghana have physical space where companies work from and therefore, working space remains the number one value added services provided for startups. It came out that infrastructural challenges such as unstable electricity supply and internet make BICs key to success of startups who cannot afford these services on their own. BICs incubate technology startups which require constant power supply, a fast and reliable internet connectivity to help them successfully deploy their innovations on the cloud. With regard to business support, BICs organise training and events where participants have the opportunity to gain knowledge and exposure regarding possible technologies they could use to build their companies. Training is crucial at the pre-incubation stage. BICs undertake pre-incubation training and guidance

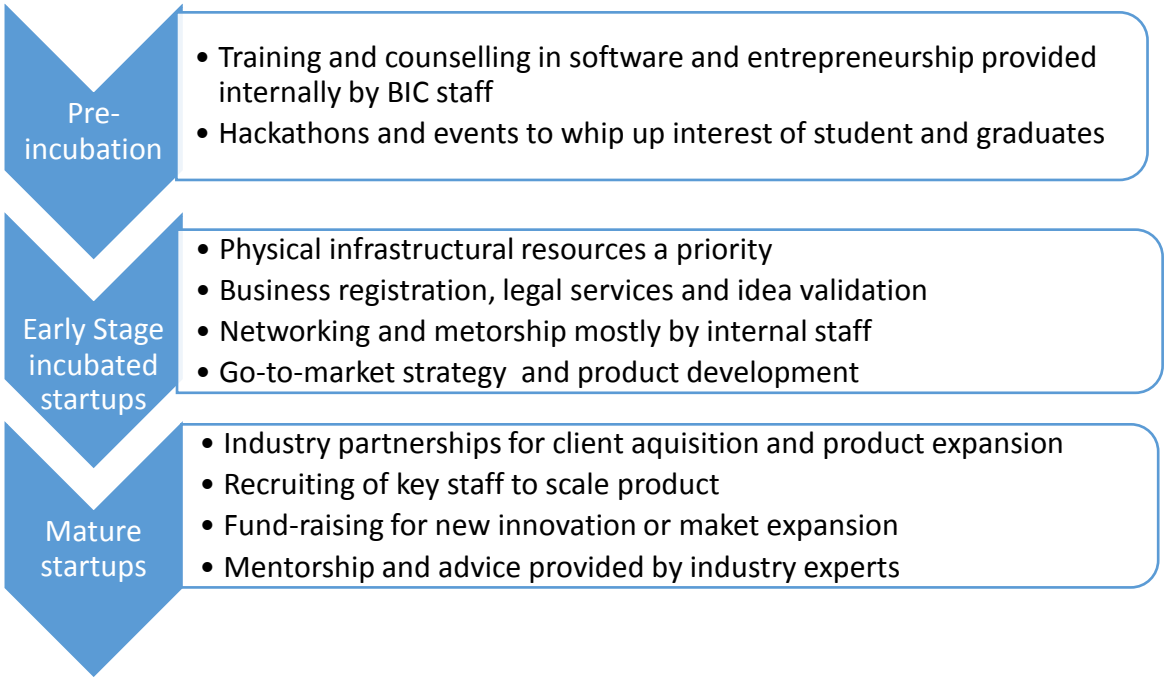
because students out of universities do not have the capability to start companies. Bridging the skill-gap before startups are formed is viewed as a vital step to reducing startup failure. Teams that have innovative ideas have failed to execute them because they lack the skills and guidance to get them off the ground.

Not all services provided by BICs are free. ISpace and MobileWeb Ghana offer highly subsidized services for portfolio companies with 70% and 80% of their service offered for free respectively. The remaining BICs charge startups for the resources provided. However, these service-charges are levied when the companies move in to incubate at the BICs.

Business support services are offered mostly to portfolio companies. Go-to-market strategy and product distribution are vital when companies have developed an early version of their technologies. During the early phase of the technology firms, mentorship and networking opportunities are rigorously pursued to help companies get their innovations to fit into the market. Also, connecting companies with the required partners is deemed important by BICs and startups. The strategy to achieving this is by organising events which bring together industry players to interact with portfolio startups.

Lastly, fund-raising and recruiting support is provided for technology startups that are mature and ready to scale up their operations. BICs either provide them with direct funding or introduce portfolio firms to potential investors. In the developed countries, BICs organise demo-days where startups pitch their businesses to potential investors. In Ghana, BICs either run their own investment funds which is accessible to only portfolio companies or partner with venture capital investors. Both Servled and MEST provide direct funding to their startups. The remaining BICs only incubate technology startups up to the time they graduate and have to raise funding on their own or through networks of the BICs. Figure 4.2 below gives a chronology of services provided to technology firms at different stages.

Figure 4.2: BIC support at different stage of incubation process.



Source: Author's field research, 2017

While some of the support services are provided at every stage, Figure 4.2 above highlights the most important needs of portfolio firms critical for survival. Physical infrastructure is still needed by mature startups but it is not the most critical need at that stage. The BICs system runs two (2) parallels: those that incubate but provide no funding for growth (ISpace, MobileWeb, Impact Hub and GMIC) and those that provide funding for portfolio startups (MEST and Servled).

4.5 **Typologies of BICs in Ghana**

BICs in Ghana bear similar characteristics to the 1990s-and-beyond BIC models for innovation in the USA and Europe (Mian, 2016, 1996; Hackett & Dilts, 2004). The earlier BICs set up were technology-based that sought to take advantage of the ICT boom for growth. The centres were set up to train Ghanaian youth to build innovative solutions leveraging the internet and mobile phones. GMIC focused on training entrepreneurs to build business processing centres that would make Ghana an outsourcing destination. Specialised BICs focusing on ICT-related innovations informed the earlier rational for setting up BICs. This was a way of providing jobs for the unemployed youth as intimated by Management of GMIC. Similar reasons were given for running BICs such as ISpace, MEST and Impact Hub. However, newer incubators that are being set up are mixing technology startups with non-technology startups. Servled and ISpace

remain as mixed BICs with portfolio companies targeting different verticals other than technology. Table 4.2 below shows BIC classification and the areas of their focus.

Table 4.2: BIC typology and focus areas in Ghana

Typology	**BICs**	**Focus**	**Market focus**
Specialised BICs	MEST	Software technology startups	- Ecommerce - Mobile games - ERPs
	MobileWeb	Mobile phone technology startups	- SMS startups - Techaid - Education mobile apps
	Impact Hub	Health technology startups	- Applications to fight cancer - Hospital automation
	GIMC	ICT-based business processing startups	- Business outsourcing startups
Mix-Purpose BICs	Servled	Any startup with an innovation solving any market need is accepted	- Agribusiness startups - Fintech to get unbanked population banked - Clothing and Apparel
	ISpace		- Fintech for financial inclusion - Farmcrowd – crowdfund for farmers to get investors - Creative arts startups - Recycling startups: money used to fund children in poor communities. They also do monthly beach waste pickups

Source: Author's field survey, 2017.

Mix-purpose BICs have portfolio companies that are non-technology related. Servled and ISpace have portfolio startups that focus on fashion and apparel, creative arts and waste

recycling. The emerging interest in mix-purpose BICs stems from what some managers believe is the over concentration of resources on technology to the detriment of other sectors in Ghana.

According to Manager of Servled:

> *"It is not technology that will take Africa out of poverty and Africa should not try to build another Silicon Valley. Technology should be* ***an enhancer****. Innovation should be locally based and the example of biotech in Cuba show IT may not be the way out for all countries. Innovation should be put to use in solving our own problems using our own approach*".

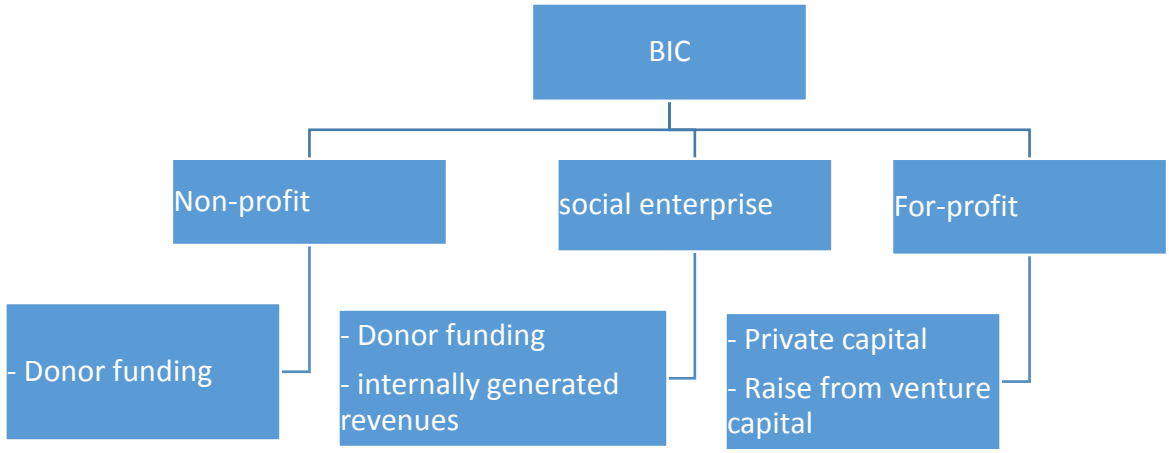
This view resonates with the manager of ISpace who believes there are many opportunities besides technology that need investment. Apart from the philosophical beliefs of these BICs, there are benefits from running mix-purpose BICs. The team at ISpace sees mixed-purpose BICs as a way of building synergy and connection between technology and non-technology portfolio companies. Technology startups, especially those in IT, sell their products to other non-technology startups. They are able to beta-test and get early customers from within the BICs. Similarly, mixed-purpose BICs offer the opportunity for knowledge sharing among tech and non-tech startups. Talent migration is possible where BICs move skilled employees from one portfolio startup to help other teams that may need their services; this is a core part of Servled's strategy.

4.6 **Financing innovation at BICs**

Development partners play a key role in the establishment of BICs. Apart from MEST and Servled, the remaining incubation centres have received funding from government or external donors to start their operations. The donor funding is tied to set goals and objectives to be achieved within a time frame. As a result, they (donor-funded BICs) operate as NGOs using two main models: either as a non-profit or social enterprises. The nature of funding requires that services are provided free and teams are selected based on available resources. It emerged that, BICs who classify themselves as social enterprises first started as NGOs with donor funding but converted to social enterprises after funding was exhausted or the donor pulled out. Once BICs begin to operate as social enterprises, they have to generate revenues internally. BICs that are unable to generate revenues to sustain operations either fold up or begin to shift focus to bidding for consultancy projects that are outsourced to incubated startups. It is however, different with privately funded innovation centres. These are for-profit and raise money to invest in startups. For-profit BICs take equity stake in their portfolio companies while

non-profits BICs do not. Figure 4.3 illustrates the typologies of BICs and how they finance innovation activities.

Figure 4.3: Funding structure of BICs in Ghana



Source: Author's field survey, 2017

It emerged that when donor funding ends, BICs start bidding for consulting projects which is outsourced to portfolio startups. These joint projects serve as a revenue stream for the BIC while building the capacity of their startups. Apart from rents for work space, ISpace also hosts technology and entrepreneurship events where corporate entities pay to exhibit their products and services. At this stage, non-profit and social enterprise BICs are constrained by how much they can assist startups innovate due to lack of funding. Apart from the for-profit BICs, the remaining BICs have little engagement with portfolio startups especially, after they have graduated. This is explained by the fact that, non-profit BICs do not take equity share in their portfolio startups. Only for-profit BICs take equity shares in portfolio startups and are therefore actively engaged with companies to succeed. Servled and MEST (for-profit BICs) have close working relationship with their portfolio startups during and after incubation.

The funding structure of BICs affects how startups are funded to engage in innovation. It is only the privately funded BICs that are able to provide direct funding to their portfolio startups as seed capital. For instance, MEST provides funding of about $50K to $200K for a minority equity interest in the startup. Even though the figures are not available for Servled BIC, they provide seed funding for minority equity interest as well. In contrast, non-profit BICs provide

not more than $1000 in resource and support services to startups. They however, actively introduce and connect portfolio startups to potential investors within their network.

4.7 **Network relationship with other actors**

Within the innovation system in Ghana, network relationships are crucial in driving innovation. Relationships can be both local or external and formal or informal. These levels of relationships have implications for driving innovation by BICs. Building these networks which portfolio startups can tap into is discussed in this section. Table 4.3 below shows the number of formal and informal network partners that are either local or foreign in each BIC.

Table 4.3: Formal and informal networks that are either foreign or local

	External		**Local**		**Description**
	Formal	informal	Formal	Informal	
MEST	11	26	2	2	More focused on foreign partners for resources and funding.
Servled	-	-	-	2	
Impact Hub	6	-	0	1	Working more with external BICs and firms.
MobileWeb	1	-	1	2	Works with Microsoft and the W3 foundation. Local industry innovation actors are not willing to corporate.
ISpace	1	-		2	Has one foreign innovation partner. Partnerships are in areas of mentorship, funding of startups and co-hosting of events.

Source: Author's field survey, 2017.

BICs in Ghana have stronger formal relationships with external organisations who are mostly engaged in technology and entrepreneurship. Local and formal partnerships are however limited and weak. Network relationship with external innovation organisations was stronger because external partners understand ICT technology confirming earlier studies by Archibugi and Michie (1995), Chaminade and Plechero (2015) and Chaminade and Vang (2008). Taping into these global innovation networks was also easier because ICT served as the common

knowledge-base that is available through global network but lacking within the region of Accra. In the case of ISpace, it indicated that foreign organisations understand technology and the need to look outward for collaboration while local companies are focused on running businesses as silos. Local organisations do not understand the need to develop startups especially in the field of technology. In the case of MobileWeb where they have a partnership with Microsoft Ghana, this was made possible after they contacted Microsoft Global who directed them to sign an agreement with the local branch.

Local networks are mostly informal and are based on collaborative efforts to organise innovation events. Interestingly, formal networks among BICs in Ghana was weak as well. BICs only collaborate to organise events but have no official engagement terms. MEST has two official partnerships with Kosmos Energy and Vodofone Ghana to help their portfolio startups build on the infrastructure of these firms. All BICs indicated they are members of Afrilabs, an association of African BICs, where they interact and share ideas. Helping portfolio firms of different BICs to officially collaborate on projects was non-existent. Each incubator operates as a silo with inactive inter-BIC collaboration for knowledge sharing; apart from networking events that are seldom organised. Collaboration with external partners is done with the objective of receiving funding, mentorship, resources in terms of product development and taping into global knowledge from hubs such as Silicon Valley.

Locally, TNCs and large firms have less involvement with BICs and their portfolio startups apart from serving as customers. Universities have remained key in collaborating with BICs to drive innovation in the developed countries (Mian, 1996; Hackett & Dilts, 2004). However, no BIC in Ghana has a formal network relationship with any higher education institute and where any relationship existed, it was to help BICs recruit graduate into their programmes. Manager of ISpace foresees BICs as complementing the efforts of universities and TNCs because they have the resources to guide entrepreneurs bring their ideas to fruition. The for-profit BICs, due to their vested interest in companies, have worked with some TNCs such Beige Capital and Vodafone to help their firms build technologies for these TNCs.

4.8 **Challenges to nurturing technology firms**

The study revealed budding challenges faced by both BICs and firms in the innovation system. Even though some of the challenges overlap, each actor within the innovation system faced different set of challenges. While some challenges are exogenous to BICs and firms, others are

within their control. The subsections below presents innovation challenges from the BIC and technology firm perspectives.

4.8.1 The BIC perspective

The challenges faced in nurturing innovative technology startups were mainly inadequate skillsets and access to capital to finance innovation. BICs identify the low technical and business skillsets of graduates as challenges to the innovation system. This explains why BICs have pre-incubation programmes to upgrade the business and technical know-how of students before they start to execute their ideas. Students or applicants to BICs are deficient in terms the skills needed for building cutting edge technologies. This reveals a lack of coordination between universities and BICs to develop a curriculum that adequately equips students. Entrepreneurship is still unattractive to the many talented graduates. Apart from the skills levels of applicants, there is a short supply of talents in the economy. As such, TNCs attract co-founders of startups with better remunerations after they have undergone training at BICs. It is not uncommon for co-founders to abandon their companies to take up employment with TNCs leading to startups folding up at a faster rate. In a World Bank Report, Kelly and Firestone (2014) bemoaned the high failure rate of BICs in SSA but failed to broaden their scope to consider the role of other innovation actors. Startups fail due to a multiplicity of problems such as infrastructure challenges within the economy, TNCs attracting co-founders with better remunerations and inadequate institutions to motivate innovations. BICs exist because of their startups and if the startups are folding up, BICs will also collapse in the long-run because they do not have infinite resources.

Access to capital for investing in technology startups remains a challenge. Donor funding has been key but that is insufficient to help startups scale their innovations. BICs have to compete with large firms for capital from financial institutions. Local financing is lacking leading BICs to focus on external organisations for funding. Government has not also provided the funding to assist BICs drive innovation. Rather, the Government is duplicating the efforts of BICs by setting up their venture capital funds and parallel innovation centres thereby further constraining the financial capacity of BICs.

Market failures such as unreliable power supply, high cost of doing business and the unpredictability of the market make it difficult for startups to execute innovative ideas. BICs drive innovation by guiding, financing and training entrepreneurs to overcome market failures. In the case of Servled BIC, credibility is also a problem for business operating out of Africa.

Servled gives legitimacy and trust to portfolio startups when dealing with clients and partners; both local and abroad.

4.8.2 The startup perspective

The obstacles to innovation from the firm perspective further highlights the system-wide problems that hinder growth in developing countries.

Firstly, access to talented graduates for hire remains a challenge to startups. In order to scale-up, technology firms need to hire the right people albeit at an expensive rate to expand both the product technology and markets. However, as explained earlier, there is a short supply of skillsets and technology startups face similar problems. This is more exasperating as startups do not have enough financial resource to compete with large firms for talented graduates. Startups contend that inadequate investments cripple their ability to build the right team for growth. Product failure is therefore common in the system. Having access to the right mentors could help firms take strategic decision that will minimize product and market failures. Startups delay to get products to market or have to release imperfect innovations which costs them time and resource to fix.

User adoption of technology innovations in the market is a bane to innovation. Getting clients to change business process to the cloud for instance is one of the reasons innovative solutions have failed in the country. The informal nature of markets in developing countries limits the penetration of technology innovations and is worsened by the lack of resources by startups to push and effect behavioural changes in the market. Acquiring the skillsets to overcome these market imperfections will be a valuable service provided by BICs. Cultural differences regarding technology and entrepreneurship hampers growth according to co-founders. Attitude of government, firms and graduates towards technology development is weak as compared to those in developed countries. The innovation system does not encourage early stage startups to innovate since the system does not reward excellence. Most graduates prefer therefore, to get a job with well-established firms to starting or working for a startup.

Chapter 5 – Discussion of Findings and Implications

The research question of how do BICs operate within the innovation system in Ghana to support startups create and grow technology firms will be discussed.

5.1 **BICs and Technology Innovation in Ghana**

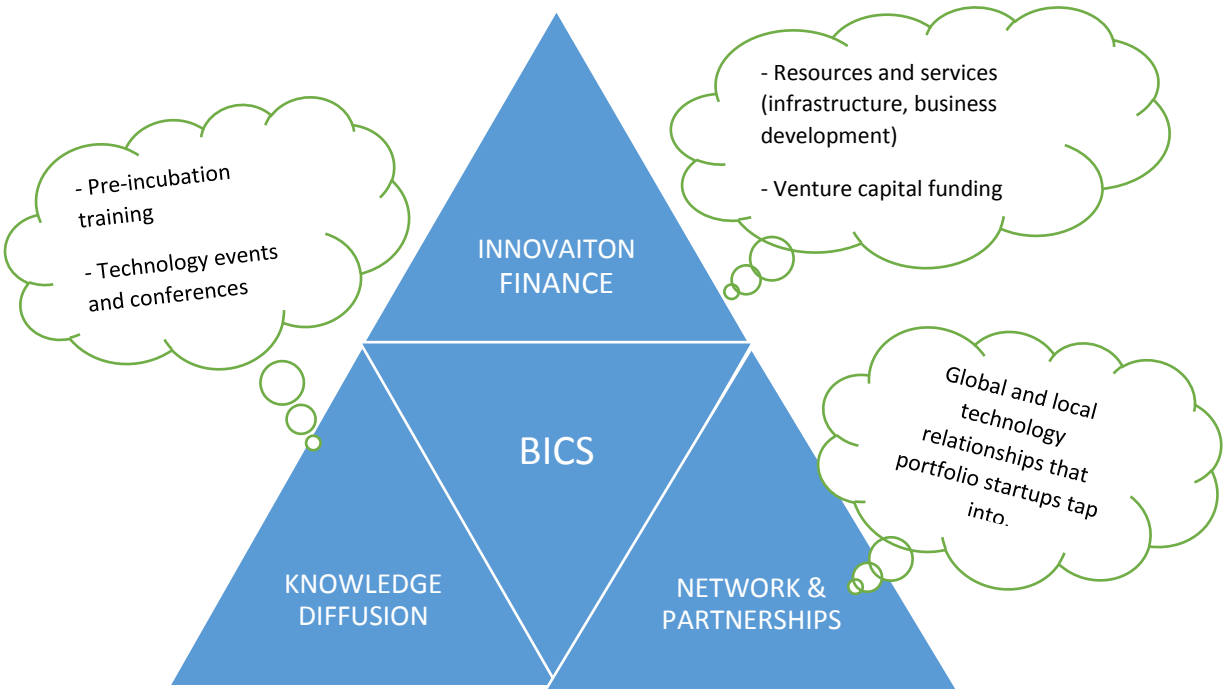
The results in this study situate BICs in Ghana as *enhancers of knowledge creation and application* for the benefit of startup firms and society. They provide the opportunity for startups to apply existing technologies without being exposed to the vagaries of nascent innovation systems in SSA. BICs complement the efforts of universities which engage in R&D and also, transferring new knowledge to students. In Ghana however, they are assuming the role of transferring new knowledge to startups prior to starting their companies. Even though graduates have innovative ideas, there is the deficiency of skillsets to execute in terms of technology and business development. This explains why all BICs have pre-training programmes for potential co-founders of technology startups to acquire skillsets. The results show a lack of adequate knowledge and innovation produced by the Universities. BICs are taking the extra burden of filling this gap as a knowledge transfer organisation in order to build sustainable technology startups. As a nascent innovation system, which is characteristic of most developing countries (Heeks, Foster & Nugroho, 2014; Lundvall et al., 2009), Ghana's innovation actors operate as silos with little inter-organisation coordination. These organisational and institutional coordination failures make it difficult for BICs to actively partner with universities and government to design and update curricula of universities.

BICs invest resources in skillset training thereby limiting the resources to be invested in financing and importing innovations. The training programmes last about three months to one year. The dichotomy between profit and non-profit BICs is worthy of note. How they contribute to innovation and growth can inform two possible roles played by these two modules. Non-profit BICs who get donor funding do not have profit-seeking motive and as such, could focus on skillset training of graduates to build their capacity with the right technologies and business potentials. With these skills, graduates with innovative ideas will build prototypes and apply to incubate at profit-seeking BICs who will focus on investment and growth of the technology firms. Private BICs are able to build the required networks with TNCs, venture firms and other BICs for the success of their portfolio companies. Profit-seeking BICs take equity shares in portfolio companies and are therefore, actively engaged in growing technology firms. Splitting the responsibilities of knowledge transfer and funding innovation between the non-profit and

for-profit BICs respectively will help in better resource allocation for driving innovation. A strong relationship with higher education institutions for knowledge transfers will build a synergy for creating tacit knowledge that is geared towards the local innovation system.

The services and resources provided by BICs to enhance innovation by its portfolio startups are similar to those provided worldwide (Kathleen, 2006) and there was nothing unique about BICs in Ghana. Providing these services and resources for innovation is a way of financing innovation in the system. In Ghana, BICs play three key roles in in their efforts to enhance the creation of technology startups and are represented in Figure 5.1 below.

Figure 5.1: Key roles of BICs in Ghana's innovation system



Source: Author's fields survey, 2017.

BICs have a stronger and formalised relationships with external innovation networks than they do locally. This results are not surprising and supports previous research (see Asheim, Grillitsch & Trippl, 2015; Chaminade & Plechero, 2015; Isaksen & Trippl, 2014) where regions or innovation organisations that depend on coded knowledge are able to tap global networks than they do locally. ICT remains the core areas where portfolio companies of BICs base their innovations on which is a codified knowledge and well developed in developed countries. BICs build these networks and partnerships to facilitate application of this knowledge within the economy. This knowledge is not available locally and seeking external help is key to remaining competitive. It is not just knowledge but finance also. BICs depend

on external sources of funding for financing innovations in Ghana since donor agencies and global venture capital firms are providing funding for BICs to invest and drive innovation in Ghana.

To build the IS locally, BICs need to engage in policy advocacy to get the Government enact the right institutions that will motivate large firms to collaborate with BICs and their portfolio startups. For instance, a tax relief for TNCs that allow startups to build innovations based on their architecture will encourage stronger collaboration. Financial institutions and Telecom companies have remained closed to external companies that seek to leverage their platforms to build innovative firms. Creating the need for enterprise firms and TNCs to open up their networks to startups, who have little resources, will further spur knowledge sharing and innovation. With this arrangement, startups get to understand problems faced by customers of enterprise firms and TNCs. Together, all actors can resolve these problems for wider economic benefit.

Internally, BICs drive knowledge circulation among its startups which startups find valuable. Companies are able to partner or seek help from other portfolio companies easily. BICs such as MEST and Servled employ teaching fellows and mentors who work directly with startups to overcome innovation bottlenecks with their technologies. However, BICs need to engage with other actors locally to build a form of tacit knowledge that will make Ghanaian startups competitive. Alternatively, refocusing to operate as a mixed-purpose BICs will play a key role in getting local actors open up to startups. A cultural change towards startups will be achieved in the long run if non-technology startups are accepted into incubators. Servled, a mix-purpose BIC had a stronger working relationship with local financial institutions and the creative arts industry. ICT-based technologies are still not integrated into the economy of most SSA countries as Kelly and Firestone (2016) observed. This could explain the low interest by the other innovation actors in the activities of BICs and their portfolio startups.

Integrating non-technology startups will make it possible for other innovation actors to contribute and collaborate effectively with BICs and their startups. Ghana, like many developing countries, still have budding development challenges that can be solved with non-technology innovations. The literature on developing countries (George, Mcgahan & Prabhu, 2012; Heeks, Foster & Nugroho, 2014; Lundvall et al., 2009) argue that, low-tech or non-tech innovations which are non-radical in nature are common. The economy of Ghana may not be ready for high-tech innovations yet. BICs may be addressing problems which are not

painkillers in the economy. Infrastructural challenges such as electricity and low-speed internet make it challenging for the economy to support innovations that depend on them.

5.2 **Firms and BICs: interactions and challenges**

The level of satisfaction expressed by technology startups in the role BICs play in their growth is high. The high rating is largely in the areas of the resources and service provided. Connections to partners and networks that firms can tap into remains an area where startups indicate a stronger relationship with BICs. Critical however, is the issue of capital investment for growth which is limited. BICs have not been able to help startups with capital finance to enable them scale-up their technologies. Non-profit BICs maintain unofficial relationship with ex-portfolio companies and have little impact in their post-BIC growth. In a budding innovation system, startups out of BICs still need guidance to grow as they operate on their own. Post-BIC engagement with startup firms will further help spur innovation. For-profit BICs which have equity stake in technology startups, hold monthly and bi-annual meetings with each portfolio company. Besides that, they also provide growth-stage funding for companies that need to scale.

Both firms and BICs have identified skill gap and cultural behaviours as challenges which continue to hamper their work. As discussed above, collaborating with large firms and TNCs can lead to talent-sharing where talented employees of TNCs can spend part of their time helping startups develop their products and business strategies. This way, startups spend less in terms of wages but still benefit from the talent. TNCs bear large portion of the wages of their staff who volunteer to work with startups. This will also lead to knowledge sharing between startups and large firms. While startup firms are satisfied with services provided by BICs, they still demanded for more assistance in the areas of product and market fit. Addressing market imbalances in developing countries remains key to attaining an innovation system for growth. Admittedly, correcting some of the imbalances is beyond the capacity of BICs but policy advocacy will be key to overcoming this. Advocating for institutional changes to incentivise entrepreneurship will go a long way to driving growth.

Cultural and attitudinal challenges result in high staff turnover especially with startups. BICs have to contend with co-founders who abandon their startups due to loss of interest in entrepreneurship. Committing to building scalable technologies take time and BICs revealed co-founders lack the drive and attitude for entrepreneurship. TNCs and large firms still remain the attractive option after school. Getting a job instead of starting technology startups is

engrained in the culture. BICs should aim to create role model startups that will inspire the youth and encourage them to pursue similar innovations. The lack of stellar technology startups such as Google, Apple and Microsoft in the case of the USA make it difficult for industry players to appreciate startups as an avenue to innovation and growth. This remains a challenge. Refocusing on mixed-purpose BICs can also motivate people who are not technologically savvy to aspire to start new firms. Showcasing success stories will gradually change the perspective of young graduate towards entrepreneurship. When technology adoption and application becomes widespread, technology startups will thrive and contribute to economic growth in the economy. Table 5.1 is a proposed framework within which BICs can operate in Ghana to drive the growth of technology startups.

5.1 Towards a framework for understanding role of BICs

	Local	**Global**
Typology	- Gravitate towards mixed-purpose portfolio startups - Encourage non-tech startups to apply	
Network relationship	- Stronger relationship with universities since the source of their startup founders are young graduates. Curricula development and guest lectures key here. - Work locally with TNCs, large firms and informal association to allow startups leverage their resources.	- Global networks are great but local innovation system is not mature to apply knowledge. - Build exchange programme where workers of companies in developed countries intern with startups for a period of time. This could virtual or in-person.
Startup-BIC relationship	- Minority equity stake encourages both parties to invest in the startup - BICs should employ mentors and experts who will sit within BICs to directly work with startups. - Organise events to help startups and industry share ideas.	

Financing innovation	- BICs can form a consortium to raise funding locally. - Bid for project of financial value that portfolio companies can execute and share revenue. - Co-working space charges is insignificant as a source of revenue.	- Donor funding should be a short-term measure. - Continue to engage with international investors on potential for investing in startups in Ghana - Encourage diaspora to return and start companies or invest in companies with potential for growth.
Policy advocacy	- Work with government for institutional changes to encourage local actors to support innovation - Work on behavioural changes towards entrepreneurship by highlighting the few success stories.	- Encourage development agencies to invest donor funding directly to solving development challenges such as internet, power supply and a good addressing system.

Source: Author's construction, 2017.

Different approaches are needed to stimulate local and global knowledge for the benefit of technology growth in SSA. Running BICs purely as technology startups will yield limited results while a combination of technology and non-tech will stimulate innovations that solve basic economic needs. Financing innovation with donor funding should be temporary but seeking the trust of venture capital firms to invest in African startups will provide a strong leverage for startups. Leveraging local networks and partnerships is key in stimulating local knowledge sharing. Local innovation networks can be stimulated through policy advocacy for economic institutions that will encourage TNCs and a large firms to engage startups for a holistic innovation system.

Chapter 6 – Conclusions and Limitations of Study

6.1 **Conclusion**

The ICT revolution in its wake brought many opportunities for technology growth and the developed countries have built innovations that have impacted on various sectors of their economies. Since the past decade, governments in developing countries have invested in programmes that will hasten the adoption of ICT in business delivery. The Government of Ghana implemented the ICT4 Accelerated Development programme aimed at integrating ICT technologies in both the private and public sectors of the economy. This did not achieve the desired results as most of the IT innovations were imported and set up by TNCs hindering knowledge transfer locally. Realising the success of Silicon Valley and lately Bangalore in India, SSA have witnessed the proliferation of BICs in their quest to nurture indigenous technology firms. Kenya, South Africa, Nigeria and Ghana have led this process with donor support from development partners and foreign investors. Despite these efforts, TNCs and large firms still remain dominant in driving innovations. Across SSA, mobile money innovation for financial inclusion is driven by giant telecommunications companies such as MTN, Orange, Tigo and Vodafone.

The results of this study confirm previous research (Kelly & Firestone, 2016; World Bank, 2016) about the low pace at which SSA is deriving the dividends of technology. BICs currently are weak as innovation actors and do not have the capacity to overhaul this. Resource constraints and lack of coordination from other innovation actors leave BICs struggling to influence radical technological innovations. BICs as actors serve as centres of knowledge transfer to firms but at a small scale. The lack of formal collaboration makes it difficult for BICs to act as centres for commercialisation of innovation coming out of universities as it is the practice in developed countries. Rather, BICs have to re-train graduates to come up with innovative ideas and, also provide the resources for the commercialisation of these innovations as well. This places a heavy burden on BICs in view of the resource constraints they face in incubating technology startups.

Even though startups were satisfied with the help received from BICs, they believed more could be done in the areas of funding, skilled human resource and network support. BICs are unable to organise these locally and have to depend on global networks for knowledge transfer to portfolio startups. Even though this is effective, distance and lack of knowledge about local innovation requirements limit the knowledge transfer process. Local networks remain key to

achieving the desired impacts. From the study, non-profit and social enterprise BICs run the risk of remaining unsustainable and collapsing. Donor funding is not permanent hence the need to design long-term sustainability plans. Revenues from co-working spaces remain a long shot at financing innovation by BICs. As a lower middle income country, young graduates do not have the resources to pay for these services albeit heavily subsidised. It does appear BICs must be motivated by the potential profit gains from startup companies. BICs should work towards attracting venture capitals that will co-invest in startups for an equity stake. Profit-seeking BICs have a closer engagement with portfolio startups and the reason is because they have invested in these startups. The success of a company is a win for the BIC and, a source of revenue for investing in future startups. The concept of BICs remain key to driving growth in SSA but their current focus on technology may limit their potential. This study contends that, nascent innovation system do not favour technology startups but a re-focus on low-tech or traditional sectors such as food processing, agribusiness, creative and fashion industries will be a step towards economic growth. When these sectors are driven by low-tech innovations, it will gradually affect behavioural changes towards high-tech innovation and its adoption.

6.2 **Limitations of Study**

A key limitation of the study was the inability to talk to other innovation actors such as Universities, TNCs, large firms to understand their perspectives of how they can work with BICs and startups for innovation and growth. In terms of the startups, the study could not survey failed portfolio startups of BICs. Current portfolio startups may have given good ratings of BICs which may not represent what failed startup would have to say. Also, the views of other technology startups that have not been into incubation programs were not collected. This could serve as a control case to understand how they innovate without assistance from BICs. Future research should aim to expand this by engaging in wider research of the innovation actors.

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Appendices

Appendix 1: Open ended questionnaire guide for interviews with BIC managers.

Interview Guide

This survey is conducted to assess the role of Business Innovation Centres in driving innovation in developing countries. How BICs support and grow startups to solve both local and global problems is key to this study.

The research is purely academic and part of studies towards a Master's thesis at Lund University. Information provided will not be revealed to third-parties and will be used solely for this purpose.

Q1. Tell me more about your incubator: when it started and why it was started

Q2. What are your goals and objectives? Have they changed since you started?

Q3. What services do you provide? Is it free or paid?

Q4. How do you support firms? Technology? Finance? Legal services?

Q5. How has your organisation helped startups grow? In what way?

Q6. Do you take equity in companies? Post-incubator relationship

Q7. How do you see your role in relation to Universities, TNC, government, NGOs and Established firms? Are you competitors or partners?

Any working relationship with other incubators?

Q8. Do you have formal or informal partnerships with organisations in Ghana or abroad? Which are they? What kind of relationship?

Q9. How many companies have you produced so far? What kind of impact are they making?

Q10. What challenges do you face in helping technology firms grow in Ghana? How do you help address that?

Q.11. Do your startups apply existing technologies or they create new knowledge for society?

Request for access to some portfolio companies

Q12. How will you classify your BIC

	For-profit	Non-profit	Academic	
Mixed-use incubators				
economic development incubator				
Technology incubators				

Mixed-use: promote continuous regional industrial and economic growth through general business development

Economic development: these incubators narrow down the regional development gaps by creating jobs and industrial restructuring (Aernoudt, 2004)

Technology incubators: they help transform research and technology-based ideas into commercial products and services by fostering the creation and growth of startup companies

Appendix 2: Raw interview notes taken during interviews

Tell me more about your incubator: when it started and why it was started		
BIC	Memo	Remarks
iSpace	There was no IS to connect developers with entrepreneurs. Developers and entrepreneurs did not have the environment synch and start companies. iSpace started to provide resources :working space, internet, mentorship and officially opened in 2012.	Graduates and students didn't have right guidance regarding startups in Ghana
MobileWeb	MobileWeb started to promote the content for the booming mobile phone era in Ghana. Locally generated content to power mobile devices were missing and BIC was started to train graduates to fill this void. It was started in 2010	
Servled	Servled was inspired by the founder's experience with a startup in Ghana. The market in Africa was unpredictable. What works in matured markets don't necessarily work in developing markets. So the unpredictability of the market for startups spurred him to start an incubation programme to prepare future entrepreneurs to overcome challenges and grow. I was stared in 2013	Servled set out to dispel the stigma that to run a business in Africa you needed to be corrupt. Our portfolio companies run businesses with reproach and using best practices. Africans could build their own successful startups and create role models for upcoming entrepreneurs. He got venture funding to do this
Impact Hub	To support inclusive growth in Ghana through the creation of a resilient and dynamic social innovation system by developing programs, providing workspace, access to capital and connecting entrepreneurs focused on creating sustainable solutions to regional challenges in employment, financial inclusion, agriculture, health, and education.	
MEST	The MEST Incubator program was founded in 2010 to support the overall mission of MEST, by providing seed funding, office space and hands-on support for graduates of our training program who have ambitions of founding their own technology companies in Ghana. Its inception was driven in part by the limited access to seed stage capital and access to seasoned entrepreneurs to provide mentorship for software startups	
GMIC		

What are your goals and objectives? Have they changed since you started?		
BIC	Memo	Remarks
iSpace	1. Ispace started as a co-working space for networking pivoted immensely 2. Training and accelerator programmes to train and retrain developers and entrepreneurs to have the right mind for startups. 3. The goal is to train and support aspiring entrepreneurs as well as existing startups with resources to grow. The BIC runs the following programmes: a. Code school for students and graduates on how to write software b. Code to startup where software developers network with business people to build synergies for starting companies c. Unlocking women technology target at women. Goad is to offer 12-weeks 4. Final goal is the incubation programme with supports startups with resources with up to $1000 worth.	1. Pivoted due to lack of money from co-working space 2. Training is done because startup founders initially had mistrust among themselves and companies failed. 3. Others thought if they discussed ideas, they colleagues would steal them. 4. Software developers were also expensive business entrepreneurs couldn't compete with TNCs to attract talents for startups formation 5. Incubation is 70% women and 30% men 6. Incubation lasts about 6 months
MobileWeb	1. To train gradates with mobile/web development skills to build local content for lower-end phones. 2. Goals changed with the advent of social media and smart phones. 3. The BIC also re-focused on working on projects with industry such as media houses in the code4ghana project	Entrepreneurs were using skills to find jobs and not start companies.
Servled	1. Build world class businesses and stamp authority of trust for firms from Ghana 2.	
Impact Hub	INNOVATE To exemplify business as a force for systemic change and cultivate a culture of high-impact entrepreneurship focused on intractable regional challenges in agriculture, health, energy and education. CURATE Hold inclusive events that educate, inspire and cross-pollinate the dynamic skill sets of our members whilst shifting paradigms and building a new collective of change makers.	

	CONNECT To curate programs and build connections that empower the most visionary members of our community working on alleviating high youth-unemployment through the creation of sustainable and socially responsible enterprises IMPACT To be the epicenter of the West African startup system, as well as a soft landing pad for impactful businesses from throughout the IH Network with models that are relevant to the region.	
MEST		
GMIC		

What services do you provide? Are they free or paid?		
BIC	Memo	Remarks
iSpace	iSpace operate 24hours and is open to startups to take advantage of the following resources and services 1. Resourced office space equipped internet, utilities and conducive environment 2. Business support services such as company incorporation, partnerships with industry players and funding-raising 3. Events and sponsorship where companies participate to exhibit their companies to general public. 4. They have the *unlocked series* where industry practitioners come and speak to startups on business basics and serve as mentors.	The BIC makes money from the events they organise. Brands are asked to sponsor each of the events 70% of services are free for startups
MobileWeb	1. Incubation service but with no capital 2. Training services for corporate IT staff 3. Commercial app development for industry in partnership with incubated startups BIC supports firms in the following ways: • Connection with industry partners • Go to market strategy • Subsidised office space	Commercial app development: BIC sources for a contracts and uses startsups within incubator to implement. This helps to build capacity of firms while providing revenues for operations 80% of services are free because they get grants from donors

Servled	1. Resources a. Internet services b. Tax and accounting c. Operational help d. Legal aid from a repository of legal resources 2. Training a. General training for all kinds of companies who pay for general business courses b. Masterclasses where the general public can participate and they are sponsored. It is also a time for Servled to interact with potential companies for funding. Covers general business training guides selected companies c. Hands-on business training for their portfolio companies. 3. Distribution and growth: this is to help portfolio companies scale business 4. Recruiting: Hiring talent for teams is an area the incubator is actively involved. Human resource management is support service offered to portfolio companies.	
Impact Hub	**Health Innovation Program** The Health Innovation program at Impact Hub Accra is focused on creating a vibrant, pan-African health innovation system through a diverse offering of health-related programming, including hackathons, pitch competitions, and social enterprise acceleration. Led by director Emily Sheldon, the Health Innovation program partners with the government, industry, academia, and health sectors to improve health outcomes in West Africa through the lens of entrepreneurship **The Makerspace** "Unlocking the Potential of Maker Culture in Ghana" A makerspace is a 21st-century digitally-connected community workshop and lab open to entrepreneurs and anyone interested in learning, designing and making together in a collaborative environment. They complement Science, Technology, Engineering, Art and Math (STEAM) fields to drive innovation and support entrepreneurship through new product development.	
MEST	• Seed Financing Typically $50K to $200K for a minority equity interest in the business. • Physical Infrastructure Public and Private office space, conference rooms and high-speed internet connectivity in a 5,000 sq ft.	

	building in East Legon, adjacent to MEST's main campus. • Dedicated Advisors Full-time, on-site staff of business advisors and cross-functional experts who work day-to-day with our portfolio companies to support application development, marketing, sales and distribution. • Value-Added Services Centralized suite of resources and shared databases to assist companies in accelerating sales, marketing, finance, and legal. • Events & Education Access to local networking events, global startup competitions, and technical skills development workshops. • Global Presence Leverage satellite offices in San Francisco and London, which enables easier access to these key markets and facilitate global sales, business development and fundraising activities and connections.	
GMIC		

How do you see your role in relation to Universities, TNC, government, NGOs and Established firms? Are you competitors or partners?		
BIC	Memo	Remarks
iSpace	1. We see our role as providing skillsets that are not thought in schools and *could* complement efforts of universities, TNCs, NGOs and Established firms. 2. BICs know how to maximize resources for the benefit of startups 3. They now the current technologies and needs of industry which universities don't teach, TNCs don't have the time to experiment with ideas 4. TNCs have different terms for engaging startups which is to get innovative ideas and integrate them into their existing businesses. Interest is to trap entrepreneurs to generate innovative ideas through competitions after which the TNCs own the ideas	Gov'ts, TNCs are duplicating work of BICs but could channel resources through BICs to promote growth of startups. The key concern here is focus. BICs are focused on nurturing innovative startups but governments and TNCs have several focus areas and so most of their efforts are failing. Universities are focused on churning out graduates but we have to retrain most graduate to fit into the needs of industry or start their own companies

	5. All the actors are working in *Silos*. Hubs are providing infrastructure	
MobileWeb	MoibleWeb is complementing the efforts of TNCs like Microsoft to bridge the skills gap after school. BIC only works with universities to recruit graduates for training but collaborative efforts in any way.	
Servled	1. Servled engages with banks, British Council and working to engage with Telcos. They are support Beige Capital to roll out innovative ideas for customers.	They build partnership to help startups build innovative services on top of their platforms.
Impact Hub	They complement Science, Technology, Engineering, Art and Math (STEAM) fields to drive innovation and support entrepreneurship through new product development.	
MEST		
GMIC		

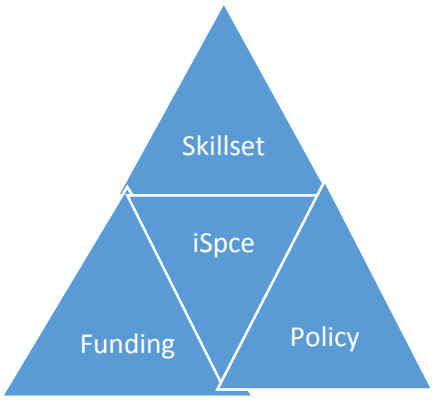
BIC involvement in companies both during and after incubation		
BIC	Memo	Remarks
iSpace	1. No equity in companies	
MobileWeb	1 Product development and paid for travel expenses of companies within BIC 2 Monthly post training follow-up calls	It is largely the responsibility of startups to ask for help from BIC if needed. We are not actively involved because we have not stake in companies
Servled	Servled takes equity in companies and that explains their involvement and the impact they have on companies. Hold weekly and monthly updates and also have Mid-year and End-of-year retreats with portfolio companies.	
Impact Hub	No Equity taken in firms	

MEST	MEST takes an equity in portfolio companies and are actively involved in their operations.	
GMIC		

Do you have formal or informal partnerships with organisations in Ghana or abroad? Which are they? What kind of relationship?		
BIC	Memo	Remarks
iSpace	1. Sporadic that happen when needed. Mostly informal 2. Have partnerships with 1776 in Washington due to start in 2017. 3. They have foreign networks than local 4. Developed countries have matured networks and are looking outward for BICs to partner 5. Local companies and BICs have local focus and operate as businesses who are focused on running businesses and not building networks with others 6.	Focus is to make local partnerships that are formal. Partnerships are in areas of mentorship, funding of startups and co-hosting of events.
MobileWeb	1 Most partners are abroad because they understand the need for startup development 2 Companies abroad with whom they have partnerships direct them partner with local branches as well. 3 Relationships are informal 4 They collaborate with other tech hubs like iSpace	Local industry innovation actors are not willing to corporate unless it's at the request of the parent company. They partnership with Microsoft is such example
Servled	1. Servled has a non-for-profit arm which works with universities to educate students about entrepreneurship. 2. Active member of the Social Enterprise Ghana which seeks to advance innovation in Ghana. 3. They collaborate with Innohub and Impact Hub	

Impact Hub	Key partners for the Health Innovation program include Merck, Hack for Big Choices, the Yale School of Management, the Turner Family Center for Social Ventures at Vanderbilt University, Facebook	
MEST	MEST is privileged to work with the following fantastic corporate partners, who support our mission in various ways. 1. Microsoft Bizpark - MEST companies enjoy three years of free software, invitations to local Microsoft-sponsored events, professional technical support from Microsoft engineers, access to Microsoft's Early Adopter Program 2. Rackspace Hosting - MEST companies get $2,000/month for 12 months in Rackspace hosting credits, as well as fanatical support and mentorship. 3. Afrilabs - MEST is a member of the AfriLabs network, which exists to support the growth of communities around African technology hubs, and to encourage expansion of the network by providing tools and resources for new and emerging labs. 4. Kosmos Energy - In line with the MEST vision of providing training, investment and mentorship for African technology entrepreneurs, Kosmos Energy in partnership with MEST, launched a new flagship corporate social investment programme, the Kosmos Innovation Center (KIC), in Accra to focus on supporting and inspiring entrepreneurs and innovators in the agritech sector 5. Vodafone - MEST works with Vodafone's Innovation Team, providing early access to innovation, and in turn MEST companies have the opportunity to build on top of existing Vodafone platforms, with entry routes to markets around the world 6. Samsung - Samsung provides technical support, sales, distribution and marketing muscle for MEST-incubated startups as well as potential investment dollars and partnership opportunities with various departments at Samsung as well as within their enterprise partner network	Most partnerships and relationships are abroad than local
GMIC		

How many companies have you produced so far? What kind of impact are they making		
BIC	Memo	Remarks
iSpace	76 startups nurtured and the most impactful are 1. Farmerline- agriculture information through mobile apps 2. Fintech 3. Medical – mobile and web apps to engage rural areas via SMS for feature and digital phones 4. Farmcrowd – crowdfund for farmers to get investors 5. Creative arts startups 6. Recycling startups: money used to fund children in poor communities. They also do monthly beach waste pickups Why startups fail? The co-founders wanted an opportunity to get a better job and after obtaining skills from iSpace, they left their companies. The failure was due to the attitude of the startup co-founders	Students and graduates are the target of the programme iSpace helped Farmerline get funding Enterpreneurs were not interested in starting companies but lack of jobs and opportunities made them avail themselves at iSpace. When they get better opportunities in the course of their incubation or after, most leave for better paying jobs at TNCs, and established firms.
MobileWeb	10 successful companies in sectors such as techaid, education and agriculture	Notable company is Farmerline which also incubated with iSpace
Servled	13 portfolio companies and impact is created in areas of tax revenues for government. Average of 8 employees per company targeting to reach 15. Half a million in tax revenues since starting. • Agribusiness startups • Fintech to get unbanked population banked	
Impact Hub	Four companies in the health innovation program	
MEST	MEST Incubator has invested in over 30 companies and backed more than 55 co-founders. Our focus is on companies in the following areas: SaaS, Consumer Internet, eCommerce, Digital Media, and Healthcare IT	
GMIC		

What challenges do you face in helping technology firms grow in Ghana? How do you help address that		
BIC	Memo	Remarks
iSpace	• Skillset – Graduates lack the required skills to ideate and execute startups. *iSpace provides training and mentorship* • Funding – Startups lack the required funding to innovate and build ideas. *iSpace provide funding during incubation and after. We help them raise funding* • Policy – there is lack of policy direction for helping BICs and entrepreneurs grow. *We are engaging government and NGOs for a policy direction that will encourage investment*	
MobileWeb	1. Capital 2. Poor working attitude from entrepreneurs and lack resilience to persist 3. Industry players and TNCs not willing to help startups. MobileWeb helps by: • Building capacity of startups to scale and grow. T • hey introduce startups to investors • Free office space	Bureaucracy is too much
Servled	1. Lack deficient skills in running successful to scale. So many start businesses but they collapse. 2. Engagement with external agencies like suppliers, tax	

	authorities and partners is a problem. 3. Access to market for most is a problem	
Impact Hub		
MEST		
GMIC		

Do your startups apply existing technologies or they create new knowledge for society?		
BIC	Memo	Remarks
iSpace	Startups apply existing innovations in building technologies.	
MobileWeb	Startups are mainly apply existing technologies in building mobile technologies for mobile phones and other smart devices	
Servled	They apply existing technologies to solve local problems	
Impact Hub	Companies build technologies and companies that solve current health challenges of Ghana	
MEST	They apply existing technologies to build software solution solutions the solve both local and global problems.	
GMIC		

BIC Classification		
BIC	Memo	Remarks
iSpace	Mixed-use incubator and a social enterprise. They don't seek to be profitable but makes money from events, space and external funding to operate.	Mix uses brings synergy and connection between IT starts and non-IT startups. IT startups sell digital technologies to non-IT startups.
MobileWeb	Technology incubator and a social enterprise	Focused mainly in IT startups
Servled	Servled is Mix-use and a for-profit. They are mixed because it offers the opportunity for knowledge sharing among tech and non-tech startups. Talent migration is possible where they move skilled employees from on portfolio startup to help other teams that may need that service.	Servled believes it's not technology that will take Africa out of poverty and Africa shouldn't try to build another Silicon Valley. *Tech should be an enhancer* Innovation should be locally based and the example of biotech in Cuba show IT may not be the way out for all countries Innovation should be put to use in solving our own problems using our own approach.
Impact Hub		
MEST	It's a Technology incubator focused on only IT enabled innovations.	
GMIC		

Appendix 3: National Systems: "narrow" and "broad" innovation system by Freeman (2002)

	Narrow	Broad (18^{th} – 19^{th} century)
18^{th} Century	"Industrial revolution" (factories), Technical Education, Nationalism of Technology, Consulting Engineers	Strong links between scientists and entrepreneurs. Science has become a national institution, encouraged by the state and popularised by local clubs Strong local investment by landlords in transport infrastructure (canals and roads, later railways). Partnership form of organisation enables inventors to raise capital and collaborate with entrepreneurs.
19^{th} Century	Growth of Universities, Ph.D. and Science Faculties, Technische Hochschulen, Institutes of Technology, Government Laboratories, Industrial R&D in-house, Standards Institutes	
20^{th} Century	Industrial in-house R&D in all industries, "Big Science and Technology", Research Councils, NSF, etc., Ministries of Science and Technology, Service Industries R&D, Networks.	Small, new firms were important entities in the commercialization of new technologies. Defense-related R&D funding and procurement exercised a pervasive influence in the high-technology sectors of the US economy. US antitrust policy during the post-war period was unusually stringent.