



# Skills Development, Knowledge and Innovation at Suame Magazine, Kumasi

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## Abstract

The informal-sector industrial cluster of Suame Magazine in Kumasi constitutes a major avenue for training, innovation, and knowledge-sharing for artisans in Ghana. Activities of Suame Magazine enterprises include metal cutting, grinding, drilling, welding, fabrication, repair of machines, motor vehicles, and other products; and also electrical and electronic repairs—all of which involve significant innovation and collaboration among artisans. This research seeks to find out how artisans acquire skills and knowledge and share innovation in an informal cluster noted for providing avenues for training for young people through the apprenticeship system, and where a formerly significant level of innovation is stagnating due to inability of artisans to keep pace with recent technology-driven advances in their sector of work. The authors explore the linkage between Suame Magazine and the global maker movement and makerspaces, and offer recommendations for collaboration that will enhance acquisition of skills and knowledge and artisanal innovation.

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## Keywords

Suame Magazine, Kumasi, Ghana, artisans, skills development, innovation, informal sector, cluster, knowledge governance, Intermediate Technology Transfer Unit (ITTU), Kwame Nkrumah University of Science and Technology (KNUST), makerspaces, maker movement, digital economy

# I. Introduction

The research on which this Working Paper is based looked at skills development, knowledge, and innovation at the Suame Magazine, and the systems that govern the acquisition of skills, knowledge and sharing of innovation in the informal industrial cluster in Kumasi, Ghana. Further, the research explored linkages between Suame Magazine informal industrial cluster and the global maker movement, and the possibility of harnessing improved skills, technology and makerspace-type entrepreneurship to address innovation stagnation in informal-sector skills development, thereby providing a better understanding of how small businesses in the cluster can upscale.

Informal-sector skills acquisition and innovation-sharing as they exist today at Suame Magazine are facing difficulties. This is due to change in the technology landscape from mechanical and labour-intensive technologies to the fast-paced technologies, digitisation and entrepreneurship that are associated with the global maker movement.

Suame Magazine, located in Kumasi, is a cluster of artisans engaged mainly in vehicular repairs and metal work, with a working population of over 200,000, of which 12,000 are shop-owning proprietors. In the Ghanaian economy, Suame Magazine plays a crucial role in technical and vocational skills capacity-building for young school dropouts, and serves as the industrial attachment in practical training for trainees in technical and vocational schools and polytechnics (Azongo, 2007).

At present, little or no concrete research has been done in the area of linkages between informal innovation, the global maker movement, and the systems that govern knowledge acquisition, sharing and measurement of innovation. The study therefore sheds added light on the issues and perspectives to guide policymakers, development practitioners and the artisans and investors in the cluster.

## A. Purpose of the Study

This study seeks to highlight the processes and systems that contribute to knowledge-sharing, skills acquisition, and innovation. The study also considers whether there is a connection with global open innovation phenomena such as the maker movement. The study addresses the following research questions:

- what are the means of knowledge and skills acquisition in Suame Magazine?
- how are skills, knowledge and innovation shared within the cluster?

- what systems govern the process of knowledge and innovation sharing in the cluster?
- what is the connection between the informal-sector innovations at Suame Magazine and the global maker movement?

## **B. Objectives of the Study**

The main objectives of the research were to highlight skills development and innovation at Suame Magazine, the systems that govern knowledge acquisition there, and how (and with whom) businesses collaborate to innovate. The specific objectives of the study were:

- to identify the means of knowledge and skills acquisition;
- to examine how skills, knowledge and innovation are shared in the cluster;
- to ascertain the system that governs the process of knowledge and innovation sharing in the cluster; and
- to establish the potential connections between Suame Magazine innovations and the global maker movement.

Guided by these objectives, the study examined how Suame Magazine artisans can seize the new opportunities of the global knowledge economy and sought to identify the policies that will best ensure that the social and economic benefits of innovation are shared inclusively.

# **II. Suame Magazine: Background and Context**

Located in Kumasi, the second largest city in Ghana, Suame Magazine is home to a vibrant industrial cluster with thousands of artisans working in micro, small and medium-sized enterprises (MSMEs). The majority of the businesses are involved in the automotive industry and metalworking. Kumasi is strategically located along routes between major Ghanaian cities and is on the main route going north from the capital Accra. Products and services from Suame Magazine are patronised by customers from Ghana and surrounding West African countries such as Burkina Faso, Côte d'Ivoire, Mali, and Togo (Azongo, 2007).

## **A. Origins and Early History**

As early as 1935, enterprises began to cluster around former armouries in Kumasi (Dawson, 1988). In the 1950s and 1960s, the Kumasi City Council decided to move many of these enterprises out of the city centre to the area that is now called Suame Magazine. (Armouries were then known as “magazines”, and this name was passed on to the newly developing industrial cluster.) During the development of the cluster, blacksmiths, who had previously made cutlasses and other farming tools, became involved in the modern sector forging spare parts for vehicles (Johnson, 1979). Despite government’s initial involvement in establishing the cluster at its present site, the cluster’s subsequent growth, and its expansion beyond the original boundaries, have been almost entirely self-generated and unplanned.

During the same period as the development of Suame Magazine, domestic and multinational companies opened garages to provide vehicular repair and spare parts sales in Kumasi. These included F and A Swanzy, Cadbury and Fry, and A Shadid Company. The garages dominated the local market until the 1970s (McCormick, 1998). This situation changed when the Ghanaian government

began to put tight restrictions on imports in the 1970s (Dawson, 1988). Restrictions on vehicle importation limited the number of vehicles in Ghana and increased the importance of repairing the existing vehicles (McCormick, 1998). These policies had negative effects on the large enterprises that relied on imports, but at the same time innovation was stimulated in smaller enterprises such as those in Suame Magazine. MSMEs in Suame Magazine began to both illegally import spare parts and manufacture spare parts that could no longer be imported (Dawson, 1988). Suame Magazine eventually became virtually the only place in Kumasi where spare parts were available, and public and private organisations sent their vehicles there for repair (McCormick, 1998).

During this period, Suame Magazine businesses offered cheap prices—facilitated by evading minimum-wage laws and income tax—while at the same time providing high-quality work (since many of the artisans had previous experience working with large firms) (McCormick, 1998). Overall, the government’s efforts to encourage import substitution had a positive impact for small businesses in Suame Magazine. Artisans began to make not only vehicle spare parts but also food-processing and agricultural equipment, often copied from previously imported items (McCormick, 1998).

From its inception in 1972, the Technology Consultancy Centre (TCC) at Kumasi’s Kwame Nkrumah University of Science and Technology (KNUST) began to provide industrial-extension services to the public while making a concerted effort to support informal industries, including those in Suame Magazine (Powell, 1981). To increase the technical abilities of artisans, the TCC established the Intermediate Technology Transfer Unit (ITTU) in Suame Magazine in 1980. The ITTU established an iron foundry, a machine shop, and a welding and steel fabrication shop, to introduce and demonstrate more sophisticated engineering techniques to local MSMEs. Artisans in Suame Magazine were able to get free advice and practical training through the ITTU. Eventually, the ITTU sold some of its equipment to artisans who were seen as having the potential to use the equipment to run successful businesses. By the mid-1980s, the ITTU had transferred three major technologies to Suame Magazine: the capstan lathe, used to produce nuts and bolts; milling and gear hobbing machines, which produce gear wheels and chain sprocket wheels; and iron melting furnaces, which allowed artisans to recycle cast-iron scraps (Powell, 1990). These technology transfers led to the development of approximately 20 enterprises, which operated more than 100 major machine tools (Powell, 1990).

Following these demonstrations, artisans began to produce a variety of products including corn mills, cassava graters, palm kernel crackers, sugar cane mills, carpenters' saw benches, and wood-turning lathes. By inventing new equipment, and modifying and copying other equipment that could be used in local manufacturing and processing of raw materials, these enterprises helped to stimulate the wider Ghanaian economy (Powell, 1990).

While the aforementioned restrictions on imports in the 1970s encouraged innovation, they also increased pressure for Suame Magazine enterprises to use “black market” spare parts. Due to the informal nature of the cluster, work often involved practices that did not comply with government regulations and labour laws. In 1979, when the government promised to fight corruption and the black market, many Suame Magazine businesses began to turn down work from government ministries and state-owned enterprises (McCormick, 1998). It fair to assume that this response by the artisans was a way to avoid restrictions introduced by the government at the time.

The relationship between the MSMEs and government improved in the early 1980s when the Ghanaian government began an initiative to have all state-owned vehicles repaired using old vehicles for replacement parts. This led to increased levels of growth in Suame Magazine (Adeya, 2008).

Another shift in government policy in 1983 was the introduction of the Economic Recovery Programme (ERP), which removed many trade barriers. The changes under the ERP encouraged the importation of spare parts, vehicle components, and even entire vehicles. With this change, large commercial and corporate garages were able to access imported materials. This was good for business, but the garages mainly served corporate clientele and their growth did not seem to affect Suame Magazine MSMEs, which remained the core of the local industry (Adeya, 2008; McCormick, 1998). But the 1980s market liberalisation did hurt certain local trade groups. Blacksmiths and middle-level producers with low technical skills found it hard to compete with the flood of imports. Meanwhile, engineering firms using higher-level technology benefited, and were able to compete with both large domestic industry and imports (McCormick, 1998).

## **B. Business and Social Associations in Suame Magazine**

As in other parts of Ghana, businesses in Suame Magazine are often affiliated with associations that seek to represent members' business interests and provide social support. Historically, the major association in Suame Magazine was the Magazine Mechanical Association, which was founded in 1957 and by the 1970s had achieved 98% membership in Suame Magazine (DHPR, 1971). As new trades evolved, new associations began to form, starting in the late 1970s.

In 1983, as part of a state initiative, the Ghana National Association of Garages (GNAG) was founded by the national government as an umbrella association with its headquarters in Suame Magazine. This association was intended to act as a bridge between government and artisans, but faced challenges from the outset, which may have stemmed from: trying to work with groups that were too diverse (McCormick, 1998); lack of perceived legitimacy among members in view of the government involvement (Dawson, 1988, as cited in McCormick, 1998); or challenges of globalisation and local economic hardship (Adeya, 2008).

In 1985, government, in collaboration with the Social Security Bank, founded the Suame Foundry Company Limited, to be managed by the GNAG. This business was intended to facilitate the manufacture of simple implements—such as cutlasses for agriculture, and tools for the mechanics of the Suame Magazine—as well as enabling the local manufacture of motor vehicles (Freiku, 2009). After more than 20 years, the Suame Foundry eventually collapsed in 2009 amid allegations of corruption.

Despite the existence of these two umbrella associations—the Magazine Mechanical Association and the GNAG—the number of trade-specific associations has continued to grow. Because the Mechanical Association and the GNAG both focus on vehicle repairers, they have tended to neglect the needs of manufacturing enterprises. To address this problem, clients of the ITTU came together in the late 1990s to create the Association of Micro and Small Metal Industries (Adeya, 2008).

Later, the creation of the Suame Magazine Industrial Development Organization (SMIDO) in 2006 was an initiative that originated from local associations seeking to present a unified force to advocate for the needs of Suame Magazine. Since its inception, SMIDO's role has shifted and the organisation now also acts directly to address challenges faced by artisans in Suame Magazine. In its original setup, SMIDO focused on two main areas: increasing MSMEs' market access through its Engineering Contracts Programme, and capacity development for local artisans through technical capacity building.

SMIDO's Engineering Contracts Programme connected MSMEs to large formal-sector companies, by securing contracts for engineering fabrication and other work that would not otherwise be available to businesses in Suame Magazine. At its peak, SMIDO acted as managing contractor for this work—establishing specifications; preparing designs and work schedules; procuring the various elements of the job from artisans within the Magazine; coordinating activities; and ensuring the quality of the work. Not only did this bring work to Suame Magazine artisans, but it also introduced them to the requirements and expectations of clients from the formal sector, thus addressing standardisation and quality challenges.

Meanwhile, through the technical capacity-building programme, SMIDO sought to address the growing technology gap between Suame Magazine and outside industry. For Suame Magazine MSMEs to continue to compete in global markets, artisans need to learn to work with modern equipment, which increasingly involves computerised components. It was in response to this need that SMIDO entered into a landmark partnership in 2008 with the Ghana-India Kofi Annan Centre for Excellence in ICT. The research therefore highlights how skills development, collaborations and open sharing such as pursued by SMIDO can help businesses scale up and seize the opportunities of a global knowledge economy made possible by technology advances.

### **C. Physical Characteristics**

Suame Magazine lies on the side and foot of a hill to the east of the main road from Kumasi to the northern regions of Ghana, and to the west of a cove. The trapezoidal-shaped area is nearly 1.80 kilometres long with an average width of 320 metres. Over the last 20 years or so the area has seen steady development and expansion, with springing up of concrete structures for workshops, stores, petrol stations, financial institutions, and residential buildings, all lining the 1.8-kilometre stretch of road in the main Magazine area. Currently, the perimeter of the nucleus of the cluster covers a distance of 7 km. There are two main roads running through the area parallel to its length and several main roads running across its width.

The facade of permanent concrete structures in the Suame industrial slum stretches for half a kilometre along the perimeter known as Akwasi Oppong Road, formerly "new road", where vehicle spare parts, building and construction are sold. According to Obeng (2001), in the core area of Suame Magazine, six out of every 10 buildings are constructed of temporary materials such as wooden boards and iron sheets. Although the land is zoned for administrative purposes, plots within the zones are not well demarcated. This is mainly due to the haphazard location of temporary workshops by squatter artisans. Abandoned vehicles (often referred to in the Magazine as "condemned"), smeared engine oil floors, metal scraps and metal chips are typical features of Suame Magazine. On the other side of the main Magazine, extending into the residential area of Suame, there are businesses selling

items for vehicle upholstery and decoration, selling second-hand vehicles, and manufacturing donkey carts, push trolleys, etc. In addition to the noticeable presence of several engineering workshops in the Suame Magazine area, there are numerous spare parts dealers, traders in engineering materials and accessories, and scrap-metal dealers, some of whom belong to various trade associations. Distinctive scenery when entering the Suame Magazine by the main road from the Kumasi city centre is the sloping landscape of the Suame roundabout, the biggest in Kumasi.

For the purpose of spatial planning and administration of land, the various vehicle repair, fabrication and engineering clusters in Kumasi (e.g., Asafo, Ahinsan, Sofoline, Krofrom) have been categorised into 21 zones, of which the Suame Magazine covers areas of zones 1-7, 11, 12, 13, 18 and 19. The inconsistency in the numbering of the zones has come about as a result of the rapid emergence of other informal industrial clusters in the City of Kumasi (Obeng, 2001).

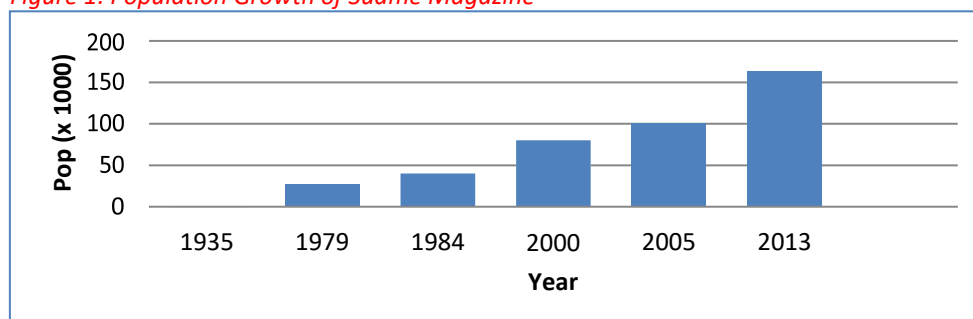
#### D. Cluster Population

The population of Suame Magazine grew rapidly from an original 50 artisans to over 27,000 artisan entrepreneurs in 1979. By 1984, the population was more than 40,000 (Powell, 1981). Currently, there are over 80,000 people working in Suame Magazine. In a 1990s projection, it was estimated that by 2005, around 100,000 people would be employed, engaged in a wide range of indigenous techniques and technologies, in the Suame MSMEs (Obeng, 2001).

In the 1990s, the Technology Consultancy Centre at KNUST estimated an average rate of growth of 8% per annum in the Suame Magazine labour force, far exceeding the national average of 4.5% urban drift by youth into the cities. This means that many of the youth who migrate to Kumasi with the intention of learning a trade are being absorbed into the MSMEs. Figure 1 below shows the population growth of Suame Magazine.

As seen in Figure 1 below, the population of Suame Magazine was projected by Obeng (2001) to reach 164,000 artisans by the end of 2013, based on the yearly growth rate of 8%. Based on this percentage growth rate, we estimate that the population of Suame industrial cluster today has now surpassed 210,000 people (living and working in and around the cluster).

Figure 1: Population Growth of Suame Magazine



Source: Derived from Obeng (2001): 2005 and 2013 figures projected based on 8% yearly growth.

Figure 2 below (from Azongo, 2007) is a map of the greater Kumasi Metropolitan area including Suame, Kwadaso and Tafo Municipal areas. The area in grey is Suame Magazine industrial cluster, which forms part of both the Suame and Tafo Municipal areas.

Figure 2: Metropolitan Map of Kumasi



Source: Azongo (2007, p. 4).

As in other parts of Ghana, businesses in Suame Magazine are often affiliated to associations intended to represent members' interests and provide social support. Historically, the major association in Suame Magazine was the Magazine Mechanical Association, which was founded in 1957 and by the 1970s had 98% of Suame Magazine artisans in its membership (DHPR, 1971). As we found in our research, several other associations have since been established to represent members' business interests, facilitate training, and provide social support. A list of such associations is given in Table 1.

Table 1: Suame Magazine Sub-Cluster Associations

Association name	Mandate	Core business
<b>Mechanical Association</b>	Overseeing the activities of the various mechanical workshops operating within the Suame Magazine area	<ul style="list-style-type: none"> <li>• Routine maintenance</li> <li>• Repair of all brands of cars and machinery</li> <li>• Physical alterations</li> </ul>
<b>Fuel Injection Pump Mechanics Association (FIPMA)</b>	Overseeing the activities of the various fuel injection pump mechanics operating within the Suame Magazine area	<ul style="list-style-type: none"> <li>• Routine maintenance, servicing, calibration and re-calibration of mechanical and electronic systems</li> <li>• Undertaking various installations to enhance operating conditions and fuel consumption</li> </ul>
<b>Foundry Men Association</b>	Overseeing the activities of over 150 foundrymen operating within the Suame Magazine area	<ul style="list-style-type: none"> <li>• Smelting of medium- to high-carbon steel (cast)</li> <li>• Simple casting operations (milling plates for food and mining industries)</li> </ul>
<b>Scraps Dealers Association</b>	Overseeing the activities of over 200 freelance and small- to medium-scale scrap dealers operating at Suame Magazine	<ul style="list-style-type: none"> <li>• Mobilisation and processing of metal scraps from the domestic and industrial markets of Ghana</li> </ul>

<b>Lathe Turners Association</b>	Overseeing the activities of lathe turners operating about 40 machine shops within the Suame Magazine area	<ul style="list-style-type: none"> <li>• Undertaking fabrication jobs with lathe machines</li> </ul>
<b>Dynamic Spare Parts Dealers Association (DSPDA)</b>	Governing the activities of over 100 spare parts dealers operating around the Suame Magazine area	<ul style="list-style-type: none"> <li>• Retail of light- to heavy-duty vehicle parts</li> </ul>
<b>Garages Association</b>	Overseeing the activities of over 500 vehicle repair shops operating in Suame Magazine	<ul style="list-style-type: none"> <li>• Maintenance and repair of all varieties of vehicles and heavy equipment</li> <li>• Structural modifications</li> </ul>
<b>Condemned Vehicles Association</b>	Overseeing the activities of vehicle mechanics who are engaged in dismantling vehicles and heavy-duty equipment to recover re-usable spare parts	<ul style="list-style-type: none"> <li>• Dismantling cars for spare parts</li> </ul>
<b>Caterpillar Dealers Association</b>	Overseeing the activities of mechanics that deal exclusively in heavy-duty equipment servicing and repair	<ul style="list-style-type: none"> <li>• On-site and field maintenance and repair of heavy-duty equipment</li> <li>• Supply of refurbished parts and spares</li> </ul>
<b>Liners Association</b>	Overseeing the activities of over 30 artisans engaged in vehicle lining and upholstery maintenance at Suame Magazine. This association is currently being formed to formalise its operations so that it is recognised in the formal sector.	<ul style="list-style-type: none"> <li>• Lining</li> <li>• Upholstery</li> </ul>
<b>Electrical Welders and Fabricators Association</b>	Overseeing the activities of over 100 artisans engaged in electrical welding and fabrication in Suame Magazine	<ul style="list-style-type: none"> <li>• Welding and fabrication of various forms</li> </ul>

Source: Derived from Azongo (2007).

### III. Study Methodology

Suame Magazine has been the subject of several academic and policy-related research initiatives. Hence, artisans tend to be research-fatigued, leading to sometimes uncooperative attitudes. The main reason for choosing Suame Magazine as the study area was the comparative ease of access to data. (The lead researcher (Adu-Gyamfi, the lead author of this article) has worked in the industrial cluster for roughly a decade, and was for a period the manager of the Suame Magazine Industrial Development Organization (SMIDO), the cluster's umbrella development organisation. He has undertaken research and advocacy related to the cluster for audiences in Ghana and internationally.)

Our study used exploratory research methods to solicit the views and inputs of Suame cluster actors and other stakeholders who either work directly within the research area of Suame Magazine or develop and implement policies and programmes that affect the way innovation- and knowledge-sharing operate within the industrial cluster. Through the research, we sought to highlight the modes of skills and knowledge acquisition in Suame Magazine; the ways in which knowledge appropriation measures contribute to innovation in the cluster; and the means through which artisans can potentially scale up their innovations through open collaboration and enhanced innovation.

## **A. Target Population**

The target population for data collection was divided into three groups: (1) artisans in the Suame Magazine cluster; (2) government officials linked to the cluster; and (3) training institutions linked to the cluster. The artisans from whom data were collected comprised: workers in the Suame cluster, and heads of Suame artisans' trade associations. The second group, government officials, was represented by the head of the Suame Sub-Metro office and by the Suame Member in the Kumasi Metropolitan Assembly. The third group, training institutions, included the National Vocational Training Institute (NVTI), the KNUST Technology Consultancy Centre (TCC) (which manages Suame Magazine's Intermediate Technology Transfer Unit (ITTU)), and non-governmental organisations (NGOs) offering training programmes for artisans.

## **B. Data Collection**

Data were sourced from both secondary and primary sources.

### **i. Secondary Data**

Secondary data sources for this study comprised reports, articles, papers written by researchers, and proceedings of workshops by the Ministry of Trade and Industry, the Metropolitan Assembly, and NGOs. Related works of scholars also served as sources of secondary data—in particular, publications by Dr. John W. Powell, who, in his work at the Ghana Regional Appropriate Technology Industrial Service and at the TCC at KNUST, pioneered the evolution of artisan engineering (see Powell, 1981; 1990; 1995). Another key source was the SMIDO industrial profile of Suame Magazine (SMIDO, 2012).

### **ii. Primary Data**

Primary data for this study were collected from three target groups listed above—(1) artisans, (2) government officials, and (3) training institutions—via two methods: administration of a semi-structured questionnaire, and semi-structured interviews. (See Appendix for the questionnaire administered to Suame artisans and heads of Suame trade associations.) Identification of individuals to complete the questionnaire and be interviewed was done primarily via purposive sampling.

The interviews with the government officials covered their influences—through policy implementation and management of Suame Magazine—on knowledge acquisition and innovation at the cluster. The interviews with training institution heads covered means of skills acquisition for artisans, and how knowledge and innovations are governed within the cluster.

Preliminary visits were made to the study area, visiting various trade associations to assess the feasibility of the study and to establish rapport with respondents before the actual study. The information obtained from artisans was useful in the actual study and assisted in the interviews with leaders.

Thirteen enumerators were recruited in Kumasi. They received two days of training on how to effectively administer questionnaires and guide the process of data-gathering. Enumerators also assisted in the administering of a pre-test questionnaire for 10 respondents comprising eight artisans and two representatives of training institutions.

## IV. Literature Review Findings

This section reviews the key literature on skills development, technical and vocational education and training (TVET), informal-sector enterprises, clustering and knowledge flows within clusters, technological capability and innovation, innovation in the informal sector, evolution of technology and innovation in Suame Magazine, and the maker movement internationally and in Ghana.

The literature, which begins in the 1980s, is mostly by scholars, supplemented by reports by SMIDO and ITTU on their work in the cluster.

### A. Brief History of Skills Development

During the 1960s and early 1970s, TVET was a high priority for many bilateral and multilateral agencies (King et al., 2001). From the very first World Bank education loan in 1963 up until the mid-1980s, funding of diversified secondary education with prevocational streams became a high priority for the Bank—in line with its views on the need to promote TVET in order to train people for jobs. Indeed, during this period it “became the norm of education operations” (Psacharopoulos, 2006, p. 330).

Skills learned through TVET are often linked with positive developmental outcomes, including the allegedly positive impact that skills have on employment outcomes in an economy (Palmer, 2007). In enterprise clusters, skills transmuted into knowledge add value to products and services and improve the environment within which firms operate.

Skills training is often said to be beneficial to informal-sector enterprises in a number of ways (as cited in Palmer, 2007):

First, it is widely assumed that skills training increases productivity, quality, diversity and occupational safety and improves health, thereby increasing incomes and hence leading to reductions in poverty levels for these workers and their families [...]

Second, it has been argued that on-the-job skill training helps to develop social capital and enterprise networks [...]

Third, skills training can help develop business skills and experience, crucial to apprentices' future survival as independent entrepreneurs [...]

Fourth, given that increasing numbers of people in Sub-Saharan Africa are engaging in occupational pluralism, any increase in productivity resulting from nonfarm skills training has positive knock-on effects to agricultural enterprises, principally through cross-financing [...]

Fifth, traditional apprenticeship training represents the most accessible source of training for the poor and an important source of technical skills for those who cannot access formal training. (Palmer, 2007, p. 72)

Apart from the Suame ITTU and the National Vocational and Technical Institute (NVTI) that provide institutional training, formal training is rare within the cluster. Many of the enterprise owners,

especially those in vehicle servicing and trading, are trained through apprenticeship and on-the-job training. Sometimes trainees are family members (Adeya, 2008).

## **B. Technical and Vocational Education and Training**

As noted above, in the 1960s and early 1970s TVET was a high priority for many bilateral and multilateral agencies, including the World Bank (King et al., 2001; Jones, 1992). Conversely, the mid-1980s, at the height of structural adjustment programmes, marked a turning point in Bank policy regarding the usefulness of diversified education.

Since the beginning of the 1990s, however, the attention of international development agencies has been focused on primary education—an emphasis subsequently entrenched in the post-2015 time-bound targets of the Millennium Development Goals and in the Sustainable Development Goals now being implemented. Fluitman and Haan (2002) note that the focus on basic, and especially primary, education has contributed to neglect of post-basic education and training and reduced interest in skills development. Indeed, what has contributed greatly to the international neglect of skills development in developing countries is the absence of skills development in the Millennium Development Goals and the fact that they are not clearly outlined in the Sustainable Development Goals. Likewise, other researchers, including Bennell (1999), have noted the neglect of skills development evident in many poverty reduction strategy papers, where, in reference to education and training, universal primary education is prioritised. There was initial turnaround when the World Bank produced an influential policy paper on TVET (Velenchik, 1994) and a related book in 1993 (Middleton et al., 1993). But after that policy paper and book, no significant research was forthcoming.

In recent years, there has been a growing concern among development partners that the Millennium Development Goals were interpreted more restrictively than had been agreed at Jomtien (UNESCO, 1990) and Dakar (UNESCO, 2000). The 1990 Jomtien Declaration and 2000 Dakar Framework made skills development a much more explicit priority. The six Dakar goals included the goal of ensuring that the learning needs of all young people and adults are met through equitable access to appropriate learning and life skills programmes. The Jomtien Declaration included “skills training, apprenticeships, and formal and non-formal education programmes” (UNESCO, 1990).

Adoption of these goals and creation of policy frameworks by government in Ghana culminated in the establishment of the Council for Technical Vocational Education and Training (COTVET). This organisation implements policy on TVET and skills development in the country, offering opportunity for technically inclined students and entrepreneurs as well as artisans to progress in their chosen fields of endeavour.

A national TVET qualifications framework enables a country to integrate all of its TVET qualifications in terms of content and complexity, so as to establish equivalencies. It also confers national recognition on all qualifications that are registered in the framework, as these qualifications are subject to a process of quality assurance before they are registered. Ghana’s framework has an orientation towards technical and vocational education and training, in which Suame Magazine is the largest informal-sector industrial cluster for skills acquisition.

COTVET is a national institution set up by an Act of Parliament of the Republic of Ghana to coordinate and oversee all aspects of technical and vocational education and training in the country. The major objective is to formulate policies for skills development across the broad spectrum of pre-tertiary and tertiary education, and formal, informal and non-formal sectors. Ghana's TVET system as it is being established by COTVET is intended to improve the productivity and competitiveness of the skilled workforce and raise income-generating capacities, especially of women and low-income groups, through provision of quality-oriented, industry-focused and competency-based training programs and complementary services.

Among the provisions relating to skills enhancement for master craftsmen and skills training delivered through apprenticeship placements was the provision that master craftsmen should undergo brief training in pedagogical skills enhancement with the Ghana Regional Appropriate Technology Industrial Service (GRATIS) to make them more effective trainers. Skills training was then to be delivered by attaching up to 10 trainees to a master craftsman to undergo a workshop-based apprenticeship for up to 12 months. Apprenticeship training organised by GRATIS either took place in their own facilities where adequate equipment and machinery existed for the training or in informal enterprises with master craftsmen identified by GRATIS.

However, COTVET reports that the policy goals fell short for the following reasons:

- Many of the MCs [master craftsmen] given apprentices to train by GRATIS could not provide a decent training environment and were ill-resourced in tools and equipment
- Training duration was not considered long enough, especially in trades like welding and carpentry, leading to the creation of half-baked apprentices. Moreover, most of apprentices being trained had no prior knowledge of the trades
- Inadequate post-training support and huge delays in STEP graduates accessing micro-finance. By October 2006, only 10% had received loans. (COTVET, n.d.)

### **C. Clusters, and Knowledge Flows in Clusters**

Clusters can be a large conglomeration of firms in *related industries*, located in a *specific region*. According to Zeng (2008), Africa has pockets of vital economic activity—many in the form of enterprise clusters scattered across the continent's countries and industries. By clustering, enterprises are able to overcome constraints in capital, skills, technology, and markets. Enterprise clusters help their constituents grow and compete by encouraging more effective knowledge and technology diffusion and product specialisation, leveraging local comparative advantage, fostering production value chains, and achieving collective efficiency.

Industrial clusters are said to provide jobs for the continent's growing population. But in today's increasingly knowledge-intensive and globalised economy, these clusters also face serious challenges in the areas of technology, natural resources, infrastructure, skill acquisition, quality control and the quest for sustainability

Suame Magazine is primarily a cluster of auto mechanics, with some fabrication and manufacturing. Basant (2002) argues that the nature and characteristics of knowledge flows within a given industrial cluster depend upon the following dimensions, which are all inter-related:

- internal characteristics of the cluster (e.g., capabilities, internal structure, linkages, etc.);
- types of external linkages of the cluster; and
- external policy and economic environment faced by the cluster.

For innovation to occur in such a cluster, any knowledge that is introduced must be tailored to local needs; artisans must understand new concepts and machinery well enough to fully appropriate these and develop their own technologies. Studies by Schmitz and Morrison, as quoted in Basant (2002), imply that a cluster such as Suame Magazine can greatly benefit from external initiatives designed to upgrade local production capabilities.

#### **D. Technological Capability and Innovation**

We adopted Bell's (2009) definition of technological capability for our research:

- production capability: the capability to carry on producing goods and services with given product technology, and to use and operate given forms of process technology in existing organisational configurations; and
- innovation capability: the capability to create new configurations of product and process technology and to implement changes and improvements to technologies already in use.

A common failure of external initiatives intended to upgrade technical capability in the developing world is the conflation of tangible (physical) and intangible (knowledge- and skills-based) assets; in particular, programmes related to the ICT4D movement (Information and Communication Technology for Development) inadvertently assume that the mere existence of new technology is sufficient to instigate development. Yet for any physical technology to be properly utilised, it must be adaptable to local needs. The target community must possess sufficient understanding to be able to fully appropriate the technology. Technology is a tool rather than an end in and of itself, and thus must be considered in relation to the human capabilities that it amplifies.

Much of the literature emphasises the importance of deconstructing the multiple components of technology and technical innovation (Basant, 2002). Further, Basant (2002) lays out a framework for deconstructing the knowledge flows in industrial clusters: "There is ample evidence to suggest that knowledge relating to the 3 Ps (products, processes, and practices) gets transferred to cluster firms through a variety of mechanisms" (Basant, 2002, p. 55). Our research considered, among other things, how machinery-embodied technologies impact these 3 Ps, in both manufacturing and vehicle repair. We sought to build upon Basant's (2002) distinctions:

- product: the completed item (or repair-work), ready to be purchased by a client;
- process: the technique used by an individual artisan to make the product; and
- practice: the strategies and organisational mechanisms used within a firm.

#### **E. Innovation in the Informal Sector**

Innovation, as defined in the 3rd edition of the *Oslo Manual* (OECD & Eurostat, 2005), is "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations" (2005, p. 46).

Based on this definition, Rizk et al. (2018) propose a means of understanding and measuring innovation in the informal sector through three pillars of innovation that exist on both the input and output sides of the innovation process: (1) collaboration, (2) human capital development, and (3) knowledge governance. In all three, the hypothesis of the researchers is that significant innovation takes place in Africa. It takes place in a collaborative mode, based on openness, sharing and a wealth of skill development and collaboration, most or all of which go unmeasured. Rizk et al. (2018) provide the following details:

First, we probe **collaboration**, searching for proxies that assess the innovation linkages, interactions, and sources of knowledge within and between different communities and users, as well as with universities and large firms.

Second, on the **human capital development** front, the means of human capital development in Africa are not limited to formal education and training systems. Other means of accumulating knowledge include, but are not limited to: learning by doing, learning by using, learning on the job and apprenticeship. While the role of formal educational and training institutions remains pertinent, it is equally important to capture these other forms of knowledge acquisition, keeping in mind Indigenous learning and tacit flows of knowledge. This pillar will measure the comparative difference between formal and informal training in terms of their contribution to innovation.

Third, in respect of **knowledge governance**, we set out to explore alternative forms of knowledge governance in Africa, and pose the hypothesis that a great portion of African innovative outputs are appropriated and/or shared outside the mainstream IP regime. (Rizk et al., 2018, p. 5)

The conclusions arrived at by Rizk et al. show that there is need to gauge the value of knowledge-sharing and alternative mechanisms of appropriation. This includes measuring the frequency of reliance on formal and informal means of knowledge appropriation, knowledge protection and knowledge-sharing.

## F. Evolution of Technology and Innovation in Suame Magazine

In the course of its history from obscure military armoury, to centre for blacksmithing, to making of agricultural tools, repair of vehicles, and light manufacturing, Suame Magazine has evolved through changes in technology and patterns of innovation. This sub-section considers the changing technology and the accompanying interventions to enhance technological knowledge and skills in the cluster through formal and informal skills training. It also addresses the current challenge to bridge the widening technological and digital gap between Suame Magazine and more developed operations in other countries.

In SMIDO's Masters Survey, as captured in Azongo (2007), an artisan noted that a major change he had seen over the years in Suame Magazine was that artisans now used machines to do jobs for which they had previously used physical labour. He felt that machines had made artisans' work easier. Another artisan attributed this change to the interventions by the National Vocational and Technical Institute (NVTI) and the ITTU at KNUST.

Specialised equipment and parts created by small engineering workshops in Suame Magazine have enabled vehicle repair MSMEs to undertake work that would not have been possible in the absence of this kind of complementary industry (McCormick, 1998). Additionally, these engineering workshops have created a range of products customised for local needs, such as donkey carts and mechanised equipment for food preparation in local cuisine. Many of the artisans involved work creatively with limited raw materials, often incorporating scrap metal and parts in designs which they have newly developed or have adopted and altered.

This confirms the argument put forward by De Beer et al. (2014) that there is no shortage of “epochal innovative and creative accomplishments in virtually all categories of human endeavour” (p. 5). They hold that innovation in the informal sector has particular characteristics: driven by adopting, adapting and improving knowledge to solve problems. Innovation in informal economies is also driven by “large amounts of constraint-based innovations that take place under conditions of survival, scarcity and constraints”, and ideas are adopted quite quickly as a result of restricted learning from apprenticeships and lack of other means to acquire adequate know-how.

Training in the Suame Magazine cluster is based on acquiring skills rather than developing knowledge, and current mechanisms for sharing knowledge throughout the cluster are thus unsuited to rapid change. Despite artisans' continual innovations in vehicle repair and manufacturing, their incremental improvements are insufficient for the innovative leap that is required in Ghana's technical development (Waldman-Brown, Obeng, & Adu-Gyamfi, 2012).

In 1980, KNUST established the Intermediary Technology Transfer Unit (ITTU) to provide both technology-based and knowledge-based support and encourage a shift towards manufacturing. Today, the ITTU is best known among Suame artisans for selling some of the first electric machining tools to artisans on hire-purchase terms, and for training apprentices and leading workshops to introduce new methods and technologies. One notable ITTU introduction was a machining tool called the capstan lathe, which was ten times faster and more reliable than the centre lathes that were currently in operation.

In the 1980s, the Canadian-based volunteer agency CUSO International sent an automobile technician to the ITTU to train artisans in modern auto-repair techniques. The ITTU continues to host an exchange programme for KNUST engineering students in which they gain practical experience by apprenticing themselves to Suame artisans for several months. The ITTU facilitated the growth of Suame Magazine's innovation capabilities by introducing new technologies in the 1970's and 1980's, as outlined in Table 2 below, excerpted from Waldman-Brown et al. (2012, p. 11).

**Table 2: Impact of Machining Tools on Suame Artisans**

Tools Introduced	Knowledge Introduced	Volume Introduced	Impact
Metal fabrication tools (lathe, drill-press, milling machine, etc.)	Manufacture of agricultural processing tools, engine re-boring, customised gears...	Over 100 machining tools	Customised manufacturing and precision work
Small-scale iron foundries and aluminium-spinning	Making of nuts/bolts, tools, millstones...	Currently over 100 small-scale foundries in Kumasi, trained through workshops	Customised manufacturing; improved compatibility of repair tools; introduced scrap-metal collection for iron recycling
Record keeping	Basic accounting skills, literacy	Dozens of workshops for interested artisans	Improved customer relations, advertising, business transactions (primarily big businesses)

Source: Waldman-Brown et al. (2012, p. 11).

Due in large part to the efforts of the ITTU, the stock of machine tools in Suame Magazine grew from just six in 1971 to more than 150 in 1986 (Powell, 1986). By working with government and establishing a precedent for importation of used equipment, the ITTU also helped pave the way for unaffiliated artisans in Suame to import their own machine tools.

While the direct effects of ITTU have been limited to a small group of firms within Suame, the introduction of new manufacturing technologies provided many of Suame's vehicle repairers with specialised equipment that would not have otherwise been available (McCormick, 1998).

The local production of steel bolts and nuts, as well as gear and chain sprocket wheels, ushered in a new era of vehicle repair (Obeng, 2001). With their new machining technology, the ITTU designed and demonstrated manufacturing processes for products such as palm-oil extractors, soap-boiling tanks, corn mills, carpenters' benches, donkey carts and agricultural tools—and Suame artisans quickly appropriated many of these ideas (Powell, 1990).

By introducing equipment that could be used for the local manufacturing and processing of raw materials, the ITTU's activities helped stimulate the nation's economy and produced a cascade effect of new manufacturing industries (Powell, 1990). For example, the introduction of small-scale foundry technology provided new jobs for foundry-workers, dealers in scrap iron (to be melted down in the furnace), and manufacturers of corn mills who could now buy large volumes of locally made iron grinding mills instead of costly imported versions. After a decade of ITTU operations, the Ministry of Trade and Industry concluded that, as the programme had provided such benefit to Ghana, KNUST should establish a similar workshop and training facility in each region of the country (Powell, 1990).

Figure 3: An artisan at Work at the ITTU



Source: Authors' research, 2017.

### G. The Maker Movement, Internationally and in Ghana

The maker movement, which is a drive to support innovation by collectives of “crafters, hackers, and tinkerers”, began roughly a decade ago in the United States (Hatch, 2013 as cited in Kraemer-Mbula & Armstrong, 2017). The idea of a “maker movement” was popularised by the United States-based platform Maker Media, and refers to a rapidly growing trend towards “democratization of design, engineering, fabrication, and education” (Make, n.d.) by means of do-it-yourself culture, open-source sharing, and small-scale manufacturing and production. “Maker” initiatives include community workshops, events such as Maker Faires and similar festivals worldwide, and support for new inventions (and their inventors) through entrepreneurial competitions and activities. Lipson and Kurman (2013, as cited in Waldman-Brown, Obeng, Adu-Gyamfi, Langevin, & Adam, 2013) name four key topics in the Maker ethos: “community, creativity, social change, and problem solving.”

According to Kraemer-Mbula et al. (2017), Maker Faires aim to popularise the maker concept and introduce it to potential new makers. The core work of “making” occurs in what are known as “makerspaces”. These spaces operate according to a variety of governance, management and funding models, and they vary in terms of the facilities and equipment they provide to their participants. Other names for such spaces are hackerspaces, FabLabs and TechShops. According to Cavalcanti (2013), “FabLab” and “TechShop” are trademarked brands for types of makerspaces. The FabLab brand (FabLab stands for Fabrication Laboratory) originated at the Massachusetts Institute of Technology (MIT). FabLabs are supposed to be free (or very low cost) to the user. TechShops, which began in California, are for-profit makerspace franchises that have been established in several US cities (Cavalcanti, 2013).

Established in June 2004 by MIT’s Centre for Bits and Atoms at the Takoradi Technical University, the Ghana Fab-Lab was the first developing-world FabLab. Three other fabrication spaces have since been started in Ghana: the ARO Fablab, funded by the ARO Centre in Norway and opened in 2009, which has a focus on enabling community members to create their own solutions to daily

problems; Impact Hub Accra, established in 2013; and Kumasi Hive, launched in 2015, which provides spaces and training support for local and grassroots innovators.

There are similarities between the ITTU intervention by KNUST in the informal sector and what is being done by the makerspaces, but their connection with informal-sector clusters like Suame Magazine has not been aggressively pursued.

## V. Field Study Findings

This section presents the profile of study respondents, together with frequency, percentages and means of responses by artisans and other stakeholders in the informal-sector innovation at Suame Magazine in Ghana. In total, 120 respondents were interviewed: 70 were artisans, 30 were customers who patronise artisans' goods and services, and 20 were other stakeholders, including training institution heads, Metropolitan Assembly heads and a Member of Parliament, and government representatives. The analysed data are presented in tables and charts showing the various responses from participants.

### A. Respondents' Profile

Table 5 below gives demographic data such as respondents' ages in years, gender, areas of specialisation and status in the industry in Ghana. The table shows that 70% of the respondents were male, and 30% female; and that 40.83% of the respondents were between the ages of 36 and 50, 13.33% between 51 and 65, and 35% between 20 and 35, with the rest above 65 years (1.67%) or not providing their age (9.17%). In terms of category, 70 respondents (58.33%) were artisans; 30 (25%) were customers of artisans in the service, manufacturing, retail and welding sectors, and 20 (16.67%) were other stakeholders, from government and training institutions.

*Table 3: Respondents' Profile (n = 120)*

Age (years)	Frequency	%
20–35	42	35
36–50	49	40.83
51–65	16	13.33
More than 65	2	1.67
Respondents who provided no	11	9.17
<b>Total</b>	<b>120</b>	<b>100</b>
Gender		
Male	84	70
Female	36	30
<b>Total</b>	<b>120</b>	<b>100</b>
Category of Respondents		
<b>1. Artisans</b>		
<i>Auto Mechanics</i>	20	16.67
<i>Auto Electricians</i>	6	5
<i>Welders</i>	10	8.33
<i>Fabricators</i>	3	2.50
<i>Spare Parts Dealers</i>	3	2.50
<i>Sprayers</i>	10	8.33

<i>Manufacturers</i>	8	6.67
<i>Blacksmiths</i>	5	4.17
<i>Upholsterers</i>	2	1.67
<i>Vulcanisers</i>	3	2.50
<b>2. Customers</b>		
<i>Service</i>	19	15.83
<i>Manufacturing</i>	2	1.67
<i>Retail</i>	5	4.17
<i>Welders</i>	2	1.67
<i>Manufacturing and Welding</i>	1	0.83
<i>Service, Manufacturing and Welding</i>	1	0.83
<b>3. Other stakeholders</b>		
<i>Trainers</i>	12	10
<i>Government Agencies</i>	8	6.67
<b>Total</b>	<b>120</b>	<b>100</b>
<b>Stakeholder Status</b>		
SMIDO	1	5
GNAG	1	5
GRIS Consult	1	5
SSMA	3	15
GCRA	2	10
KVTI	7	35
REP	1	5
KTI	1	5
ITTU	1	5
Mechanical Association	2	10
<b>Total</b>	<b>20</b>	<b>100</b>

Source: Authors' research, 2017.

## B. Means of Knowledge and Skills Acquisition

The study assessed the responses of artisans to the question of how artisans acquire knowledge and skills for their trade in three categories:

- formal education;
- apprenticeship training; and
- other.

The responses were specifically from artisans (all categories; 70 in all) and “other stakeholders” (20 in all).

**Table 4: Means of Knowledge and Skills Acquisition**

Means of acquisition of knowledge or skills	Formal education		Apprenticeship training		Other		Formal education and apprenticeship		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%
Artisans	5	7.14	59	84.29	5	7.14	1	1.43	70	100
Other stakeholders	2	10	14	70	0	0	4	20	20	100

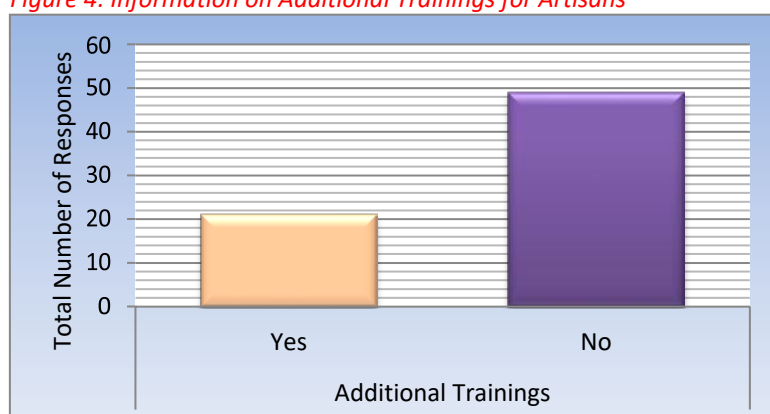
Source: Authors' research, 2017.

Table 4, indicating how knowledge and skills were acquired, shows that 59 respondent artisans (84.29% of artisans) indicated that they had acquired their current knowledge or skills through apprenticeship training from their masters and friends. Five artisans (7.14% of artisans) indicated acquisition of knowledge and skills through formal education, a further five (7.14%), apparently quite talented, said they did not have to go through extensive training via formal education or apprenticeship as their means of acquiring their current knowledge or skills, and one artisan (1.43% of artisans) indicated both formal education and apprenticeship training as means of skills acquisition, commenting as follows:

At Suame Magazine, apprenticeship is the main means of acquiring skills, however, artisans have means of upgrading their skills even though it might not be enough just that some artisans fail to take advantage of it. (interviewee 10, 2016)

Among stakeholders, two (10% of stakeholders) indicated that artisans acquired their knowledge or skills through formal education, 14 (70% of stakeholders) indicated that artisans acquired their knowledge or skills through apprenticeship training, and the remaining four (20% of stakeholders) indicated that artisans acquired skills for their current trade through both formal and apprenticeship training.

**Figure 4: Information on Additional Trainings for Artisans**



Source: Authors' research, 2017.

When artisans were asked about additional trainings they had undertaken, only 21 (30% of those interviewed) responded that they had undergone training beyond their initial training and the remaining 49 (70%) responded that they had not. Their responses are presented in Figure 3. The additional training for the 21 artisans who had received it was in the areas of mechanics (using

diagnostic machines, spraying, welding, and fabrication) and capacity building in business management (record keeping, financial management, and business planning), from associations they belonged to such as GNAG, SMIDO and the Mechanical Association, and from training institutions such as COTVET, Kumasi Vocational Training Institute (KVTI) and GRIS Consult. For instance, interviewee 11 stated that

SMIDO's training on auto diagnostics some years back was good as it has enabled me to diagnose new cars which are electronic to repair them quickly to earn more money. Previously, I will turn down such work or will do try and error and will spend so much time that I was not able to make enough money or satisfy customers. (interviewee 11, 2016)

The majority of the artisans had acquired their current skills through apprenticeship training, as evident in the results. The apprenticeship model serves as one of the systems for knowledge and innovation sharing and dissemination of information in business development. However, artisans also indicated that the information they received through the apprenticeship system may not be adequate. It was also observed that an obstacle to improvement of the apprenticeship system is that master craftsmen themselves have limited formal education and means of access to improved knowledge. They are unable to update their training of artisans, which is mainly practical and hands-on training. Low level of record keeping in apprenticeship workshops means that knowledge, information and innovations are mostly undocumented.

### C. How Skills, Knowledge and Innovation Are Shared in the Cluster

This section of the study assessed responses on how information, skills, knowledge and innovations are shared in the cluster. It considered responses from artisans themselves and from other stakeholders, including government and training institutions. Skills, knowledge and innovations are shared through colleagues, training institutions, informal-sector apprenticeships, and associations, and from customer specifications.

Below are views expressed by two interviewees, a welder and a sprayer, on means of sharing knowledge and skills:

As a welder, I spent close to six years to apprentice where I gained knowledge in the work I do and also share[d] with my colleagues new techniques that I pick[ed] up on the job. Currently, I mainly share my knowledge and skills with colleagues to meet customer specifications. (interviewee 13, 2016)

Sprayers like myself have to keep up to date with information to meet customer specifications. In view of this, I mainly collaborate with my colleagues, share knowledge, and gain from them to be relevant to customers. (interviewee 25, 2016)

Table 5 below shows the total number of responses of both artisans and stakeholders on where artisans access skills, knowledge and innovation within the cluster. Both artisans (21; 23.33%) and other stakeholders (7; 7.78%) indicated that artisans' information is mostly accessed from their colleagues. Four artisans (4.44%) did not give any response. The "Combination of sources" column indicates responses from artisans and other stakeholders on combinations of colleagues, training institutions, customers and artisans' associations as the sources of knowledge for the artisans.

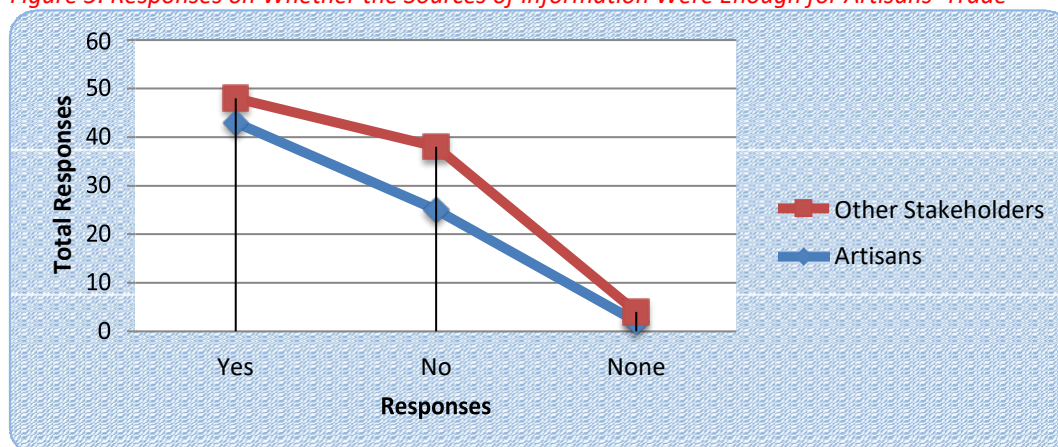
*Table 5: Responses on Where Skills, Knowledge and Innovations are Accessed in the Cluster*

Respondent	Colleagues	Training institutions	Customers	Personal	Associations	"No" response	Combination of sources
Artisans	21	5	3	12	6	4	19
Other stakeholders	7	4	0	0	0	0	9
<b>Total</b>	<b>28</b>	<b>9</b>	<b>3</b>	<b>12</b>	<b>6</b>	<b>4</b>	<b>28</b>

Source: Authors' research, 2017.

Figure 5 below presents the views ("Yes" or "No") of artisans and other stakeholders in response to whether the sources of information were enough for artisans' trade.

*Figure 5: Responses on Whether the Sources of Information Were Enough for Artisans' Trade*



Source: Authors' research, 2017.

Forty-three artisans (47.78% of total respondents) indicated that the current sources of information were enough for their work, and 25 (27.78%) indicated that the sources of information were not sufficient, as they needed more information to compete in the current technological world. Two artisans (2.22%) gave no response on this issue. Only five (5.56% of total respondents) regarded the current sources of information as sufficient for an artisans' trade. The majority of other stakeholders (13; 14.44% of total respondents) regarded the current sources as insufficient, and the remaining two did not respond.

#### **D. Knowledge- and Innovation-Sharing in the Cluster**

This section looked at the system that governs the process of knowledge and innovation sharing in the cluster. Responses were from artisans and other stakeholders.

The current system of governance supports open collaboration and sharing among artisans. Artisans' associations also have a system that brings artisans together for knowledge and innovation sharing, sub-contracting of work through private sector jobs makes it possible for artisans to work together and enjoy work-related support from companies, and key drivers of innovation play a role in ensuring

that knowledge and innovation are shared in the cluster. There were, however, a good number of interviewed artisans who preferred that certain aspects of their innovations, which they regarded as their intellectual property, be protected within the open innovation environment that currently exists at Suame Magazine.

Table 6 below shows the responses on knowledge and innovation sharing in the cluster. A majority of the artisan respondents (58; 64.44% of total respondents) affirmed that knowledge and innovations were shared among themselves and their colleagues. A similar affirmation was made by nine other stakeholder respondents (10% of total).

*Table 6: Responses on Knowledge- and Innovation-Sharing*

Respondent	Association	Colleagues	Observation	Trainings	Others	None	Total %
		%	%	%	%	%	%
Artisans	6	6.67	49	54.44	3	3.33	77.78
Other stakeholders	2	2.22	9	10.00	0	0.00	22.22
							100.00

Source: Authors' research, 2017.

Three artisan respondents (3.33% of total) and two other stakeholder respondents (2.22% of total) did not respond to the question.

Nine artisan respondents (10% of total), in the "Others" column, indicated that they never shared knowledge or innovation because they were protecting their intellectual property. Likewise, four stakeholder respondents (4.44% of total) indicated that artisans were not sharing their knowledge and innovation because they were protecting their intellectual property. This point was insisted upon emphatically by interviewee 12:

At Suame Magazine, people just snoop around for information and new techniques of doing things. If they get to know, they will just quickly develop a product and because they may have money, they will be on the market and you cannot do same. You then lose in the end and that is why some of us want to protect our knowledge. (interviewee 12, 2016)

Table 7 below shows that 43 artisans and 19 other stakeholders supported protection of artisans' intellectual property, as they believed that their knowledge or innovations was what they depended on for their livelihood and survival. In contrast, 26 artisans (28.89%) and one other stakeholder (1.11%) did not think there was need to protect artisans' knowledge or innovations since their activities took place in an open environment. One artisan did not respond to the question posed in the questionnaire. This gives a clear indication that informal-sector artisans at Suame Magazine would appreciate an innovation environment where it is possible to both protect and share your intellectual property.

**Table 7: Responses on Protection of Knowledge and Innovations**

Respondent	Yes	%	No	%	None	%	Total %
Artisans	43	47.78	26	28.89	1	1.11	77.78
Other stakeholders	19	21.11	1	1.11	0	0.00	22.22
							<b>100</b>

Source: Authors' research, 2017.

As shown in Table 8 below, a preponderance of artisans strongly agreed, or agreed, that they did not have access to information on innovation, while roughly a one third disagreed or strongly disagreed with this statement. Other stakeholders were more divided on the issue, with a slight majority disagreeing or in a few instances strongly disagreeing.

**Table 8: Effects of Innovation on Industry**

Innovation	Artisans		Other Stakeholders	
	Number	%	Number	%
<b>Artisans do not have access to information on innovations</b>				
Strongly agree	26	37.15	3	15
Agree	21	30	6	30
Disagree	11	15.71	10	50
Strongly disagree	12	17.14	1	5
<b>Total</b>	<b>70</b>	<b>100</b>	<b>20</b>	<b>100</b>
<b>Government is supporting artisans in knowledge acquisition</b>				
Strongly agree	1	1.43	2	10
Agree	6	8.57	10	50
Disagree	12	17.14	7	35
Strongly disagree	51	72.86	1	5
<b>Total</b>	<b>70</b>	<b>100</b>	<b>20</b>	<b>100</b>
<b>Other Stakeholders support in training and knowledge acquisition</b>				
Strongly agree	3	4.28	2	10
Agree	19	27.14	18	90
Disagree	24	34.29	0	0
Strongly disagree	24	34.29	0	0
<b>Total</b>	<b>70</b>	<b>100</b>	<b>20</b>	<b>100</b>
<b>Artisans are innovative to the extent that, they are able to put their own ideas into a product</b>				
Strongly agree	39	55.71	5	25
Agree	23	32.86	10	50
Disagree	2	2.86	4	20
Strongly disagree	6	8.57	1	5
<b>Total</b>	<b>70</b>	<b>100</b>	<b>20</b>	<b>100</b>

Source: Authors' research, 2017.

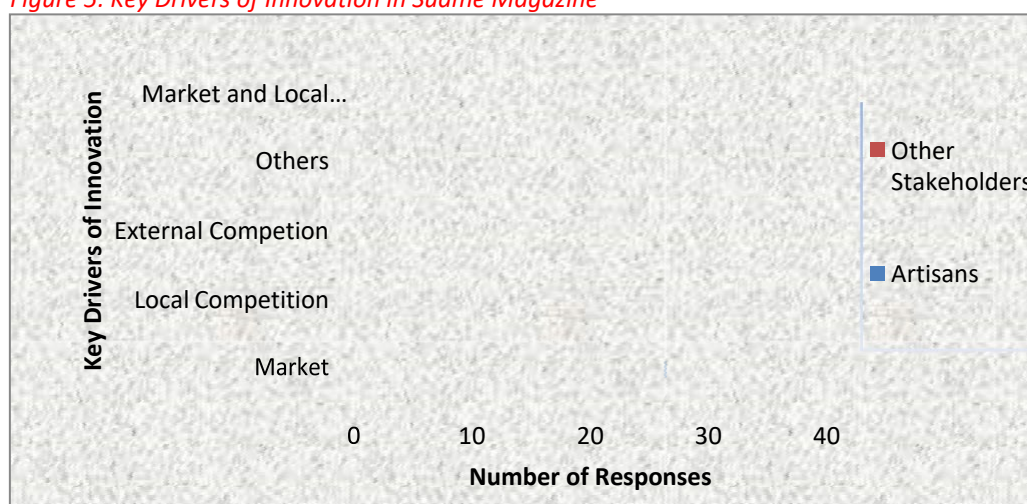
Very few artisans were of the opinion that there was government support for knowledge acquisition by artisans, whereas 60% of other stakeholders did think that this kind of support was provided.

On other stakeholders' support in training and knowledge acquisition, roughly two thirds of the artisans disagreed or strongly disagreed that this kind of support was forthcoming, whereas all of the other stakeholder respondents agreed, and in some cases strongly agreed, that artisans were being given this support.

Last, on the issue of whether artisans were innovative to the extent of putting their own ideas into products, there was broad agreement from both parties, artisans and the other stakeholders, with just a few dissenters, that this was true.

Figure 5 below shows that both artisans and other stakeholders saw the market as the key driver of innovation in Suame Magazine.

*Figure 5: Key Drivers of Innovation in Suame Magazine*



Source: Authors' research, 2017.

## E. Connections to the Maker Movement

In interviews, few of the artisans, and fewer still of the other stakeholders, reported having any knowledge of the global maker movement and its activities (Table 9 below).

*Table 9: Responses on Global Maker Movement from Artisans and Other Stakeholders*

Stakeholder Expectations	Artisans		Other Stakeholders	
	Number	%	Number	%
<b>Have you ever heard of the maker movement?</b>				
Yes	12	17.14	2	10
No	58	82.86	18	90
<b>Total</b>	<b>70</b>	<b>100</b>	<b>20</b>	<b>100</b>
<b>If Yes, how did you get their information?</b>				

Internet	0	0	1	50
Product	0	0	1	50
Association	3	25	0	0
Colleagues	5	41.67	0	0
Television and Radio	4	33.33	0	0
<b>Total</b>	<b>12</b>	<b>100</b>	<b>2</b>	<b>100</b>

Source: Authors' research, 2017.

With those who did have some knowledge of the global maker movement it was mostly acquired from colleagues and their associations (GNAG and SMIDO) or from the media. This indicates that the maker movement's connection with the informal sector in Ghana is limited. Mean responses, confirming this finding, were calculated by adding the responses for the two groups (artisans and other stakeholders) to arrive at totals for both responses (Table 10 below).

*Table 10: Mean Responses for Artisans and other Stakeholders on Awareness of Global Maker Movement*

Stakeholders	Value	Value
	Yes	No
Artisans	12	58
Other Stakeholders	2	18
<b>Total</b>	<b>14</b>	<b>76</b>

Source: Authors' research, 2017.

## VI. Discussion of Findings

Our research supports the assertion by Waldman-Brown et al. (2012) that artisans at Suame Magazine require continued external support to facilitate innovation. The involvement of craftsmen with improved education has remained relatively low in the cluster, and formal-sector companies have had low involvement with artisans. This means that outside interventions are important in keeping Suame Magazine up to date with modern technology. Given the success of the ITTU's program to upgrade machining capabilities, KVTI's training and retraining of artisans, SMIDO's computing and auto-diagnostic training, we hypothesise that similar strategies will work to enhance knowledge and the process of continuous innovation. Even though the apprenticeship system is the predominant channel for acquiring knowledge, trade associations at the Suame Magazine play a key role in mobilisation of training.

Any strategy to enhance the process of acquiring knowledge and skills of Suame Magazine artisans, should therefore include building the capacity of the associations to engage in strategy implementation and in expanding the means of knowledge and technology acquisition. The sale of a few dozen machine tools to artisans through the ITTU program had a ripple effect throughout the cluster, and a similarly broad impact could be expected from introduction of industrial innovation hubs for both manufacturing and auto diagnostics in which artisans with different skill sets and from different associations can work together.

Industrial innovation hubs, or industrial makerspace, with modern CNC or a 3-D printer can provide improved manufacturing services and specialised components for hundreds of artisans. At the industrial innovation hub within the cluster, a technically literate artisan with a computer and auto-diagnostic tools can assist hundreds of Suame mechanics.

SMIDO, set up in 2006 by the dynamic spare parts dealers' association, with support from the Business Sector Advocacy Challenge (BUSAC), to interact with external institutions for improved infrastructure and the introduction of ICT to the artisans, trained dozens of artisans in ICT skills in a comprehensive training program that combined ICT, literacy, business support and engineering skills, but interest waned when artisans were unable to afford their own computers after graduation. More recently, under pressure from land tenure issues, SMIDO has been collaborating with other organisations to bring diagnostic equipment into Suame Magazine, although the focus has been on constructing industrial workshops outside of the present cluster that provide Suame auto mechanics with modern facilities. Our research indicates that efforts to introduce computerised tools to expand the process of skills and knowledge acquisition has been insufficient. Additional exogenous interventions are necessary if Suame artisans are to improve their capacity for innovation and regain their former competitiveness. We consider below some of the different challenges that need to be addressed, such as the need for an improved working environment. Also discussed are issues of open sharing of innovation, intellectual property and upscaling.

### **A. An Improved Working Environment Needed**

The crowded nature of the cluster, with several thousands of workshops in need of stable electrical power, has meant that the current electrical grid is unable to provide the reliable power needed to service computerised and centralised charging stations for electronic components. At the moment, with unstable and unreliable power, digital machining tools, which are particularly sensitive to power fluctuations, will be difficult to operate there. Policy also plays a key role in support of innovation in the cluster, and affordable importation taxes will make spare parts for broken machines available and affordable. Government commitment in the 2017 budget statement to removing import duties on vehicle spare parts addresses a significant business challenge for spare parts merchants, but well-coordinated and integrated external intervention will be needed in address the hydra-headed challenges of the Suame Magazine. More is needed than simply reduction in taxes to improve the working environment of the cluster; also required is enhancement of supply chains for the introduction of modern equipment in Suame Magazine, improvement in infrastructure, and commitment to medium- and long-term funding of education for artisans.

### **B. Improved Quality Controls Necessary**

For Suame artisans to make more significant contribution to Ghana's industrialisation, they must improve the quality of their products and services. The research shows that eight out of 10 artisans acquire their knowledge through the apprenticeship system in which master craftsmen rely on decades-old methods in supporting the development of their apprentices. Master craftsmen generally lack the requisite modern technical knowledge, and there is little incentive to change their methods. For instance, the report by Adedamola (2009) notes that Suame artisans frequently perform unsafe alterations on flatbed trucks. They can go a third higher than the maximum legal height, which raises the centre of gravity and can lead to vehicles tipping over in negotiating bends

or sliding backwards on hills. The same trucks may be up to 10 feet longer and considerably heavier than regulations permit and many have had modifications to leaf springs and other structural vehicle components. Adedamola (2009) concludes that “mechanics at Suame Magazine do not see any connection between the modifications they carry out and safety. They relate modification exclusively to vehicle performance” (Adedamola, 2009, p. 54). Their limited training means that Suame artisans are not able to undertake a full investigation of a truck’s make and model, and it is often impossible to know the weight and length limits. Worse still, the few Suame artisans who are literate rarely keep records. Motivation for change thus rests with government or with the regulatory authority mandated to enforce standards that should support artisans to attain these standards. If vehicle owners demand safer trucks, Suame artisans will figure out how to comply. Kwofie, Andrews and Mensah (2011) point out that the Suame manufacturing cluster suffers from failure to enforce regulations, especially with regard to food-processing equipment. Several Suame foundries manned by workers with little knowledge of metallurgy manufacture iron grinding plates for use in corn mills; the Suame-made plates can subsequently wear out 3 to 10 times faster than foreign imports, thus shedding iron filings into the milled corn. One day’s supply of corn meal may contain up to five times more iron than is recommended for daily consumption, with hazardous consequences for the body’s metabolism. The research further posits that with the right collaboration, as proved by ITTU’s early program in 1990s, corn milling grinding plates can be made to international standards in small-scale crucible furnaces, given the correct metallurgical composition. If given proper training and access to funding for improving their foundries, Suame artisans could easily produce safer and more durable grinding mills by replacing cupola furnaces in which the iron composition cannot be controlled, leading to poor quality product.

### **C. Open Sharing of Innovation, but with Challenges**

Our research confirms that there is open sharing of information and innovation at Suame Magazine. Seventy-four out of 90 respondents noted that artisans share skills, knowledge and innovations—through colleagues, artisan associations, customer specifications and training institutions within the industrial cluster. Information sharing among colleagues and other stakeholders within trade associations, confirmed by 21 artisans and seven other stakeholders, remains the principal channel through which information is disseminated within the cluster. However, with known data pointing to limited level of education and low level of technology penetration in the cluster, information sharing in use of technology tends to remain deficient because it is outdated, inadequate or irrelevant.

Customers of artisans (individuals, the public sector and private institutions) play two key roles. Firstly, they support the sharing of skills, knowledge and innovations through purchase of products and services where specifications are agreed upon and new perspectives on both sides are brought to bear on the work. For example, a private sector mining company may place an order for the fabrication of roller plates which will come with clear standards and specifications to which the artisans are to conform. The artisans then work with supervisors from that company to produce the results. In most cases, artisans are able to innovate because enough raw materials will be provided in the contract to make up for any errors. Such motivation usually does not exist when there is not a steady market. Secondly, individuals who contract with artisans also demand adherence to standards and specifications, without which they will discontinue working with a particular artisan. These demands have an effect on the way that skills, knowledge and innovation are shared.

From our research, the system that governs sharing of skills, knowledge and innovations is largely informal, channelled through open-sourcing, sub-contracting, associations, and key drivers of innovation. In the Suame Magazine cluster, these key drivers of innovation, as categorised by artisans and stakeholders, are markets, internal competition, external competition, and ingenuity. Of these four, access to steady markets and internal competition seem the most important drivers of innovation within the cluster.

#### **D. Intellectual Property in the Midst of Openness**

Even though there is a high level of open innovation and information sharing in the Suame Magazine, there are concerns over the lack of protection for some innovations and the limited implementation of intellectual property law in Ghana. Officers of the intellectual property law office in Ghana confirm these concerns, stating explicitly that there is not enough commitment to protection of informal-sector innovations within the confines of the law. They agree that the intellectual property office should be working more closely with the informal-sector artisans at Suame Magazine to explain the benefits of the law and its intended purposes. In this regard, more than two thirds of the respondents, artisans and stakeholders (government agency and training institutions leaders), indicated that innovations and knowledge should be protected. However, almost a third of the respondents did not support protection of innovations in the cluster, with one abstention. This points to a future where informal and formal governance systems, including IP, coexist and govern knowledge and innovation. This way, benefits of both governance systems can be balanced. At the same time, there should be systems in place to continuously promote sharing of knowledge and innovation as it now pertains. This can be done by enhancing the medium through which information- and knowledge-sharing is done. For instance, artisans' associations are examples of the forums in which knowledge and innovations are shared but often bedevilled with governance challenges, leading to low membership.

Addressing these governance challenges will position these associations to promote the professional interests of the artisans and remain relevant. For sharing of knowledge and innovation to thrive, key steps that should be taken are public-private partnerships to set up industrial makerspaces at strategic locations in Suame Magazine, retooling of the ITTU at KNUST, and resourcing of the NVTI at Suame Magazine. In this way, it will be possible to apply intellectual property law to protect some of the artisanal knowledge and innovation and, at the same time, to promote continuous sharing of knowledge and innovations. Innovations and knowledge for public and private interests need to be clearly defined for this to succeed.

More effective capturing of innovation in Africa will mean that policymakers are better informed about the fields of innovation and entrepreneurship, but it will also benefit people's livelihoods in its effect on the wider realm of development planning. Local policymakers will be in a better position to create an environment conducive to innovation. For example, science and technology policies could complement their focus on formal intellectual property acquisition with initiatives to encourage knowledge-sharing and open business models. Intellectual property models could be encouraged if and when shown to enhance innovation in particular contexts such as traditional knowledge and community-shared innovation (Rizk et al., 2018).

### **E. Upscaling at Suame Magazine**

As defined in our research, upscaling of innovation is where an artisan is able to expand the scope of his or her innovation and business and has access to improved technology and knowledge to enhance products and services. This corresponds with key findings of our research in which 43 out of 70 artisans interviewed (61.43%) indicated that in their view upscaling meant improvement in their innovations and high level of patronage of their products and services. As they saw it, external interventions in the area of education, improved technology and provision of requisite infrastructure would lead to business growth. Respondents also alluded to factors such as use of quality materials, adherence to standards and continuous sharing of ideas as leading to increased productivity. On the other hand, 15 artisans also noted a decline in innovation because skilled and educated labour was leaving the cluster; problems they cited were lack of external interventions together with land tenure issues affecting the availability of business premises.

We conclude, accordingly, that access to market is an incentive for artisans to acquire new skills, and to grow and expand their businesses. Access to markets also puts pressure on artisans to become more innovative and improve their skills in response clients' needs and demands.

## **VII. Recommendations and Conclusion**

The Suame industrial cluster is currently facing a period of decline even though a majority of artisans expressed optimism that with improvement in innovations and a steady market, supported by external interventions, products and services from the cluster could become more competitive. With retooling of Suame ITTU; resourcing of the KVTI to provide continuous training and innovation support; improvement in quality management and production control; infrastructure; and steady markets, the cluster artisans could upscale their innovations and dominate a substantial part of the West African market. In this situation, Suame Magazine could supply jobs and professional training to thousands of Ghanaians throughout the country on an annual basis.

The sustainability of the Suame Magazine depends on the ability of artisans to adapt to changes that are increasingly affected by global trends. The cluster needs a comprehensive and integrated program to upgrade its innovation capabilities.

We accordingly offer four recommendations for interventions, followed by a final conclusion.

### **A. Replication of the ITTU's Historical Successes**

This will involve the set-up of an industrial makerspace, using modern production units to demonstrate computerised machines such as CNC tools, 3D printers, automated drills and presses and auto diagnostics, so artisans can learn how to use these new technologies. It will also require informal artisans to collaborate with the private sector (companies, non-profits, and social organisations), government, and academia.

This intervention, as explained, will have impact on the way knowledge and innovations are shared in the cluster. Currently, artisans share knowledge and innovations mainly through colleagues and

trade associations, and to some extent through their interface with customers. Providing support to associations for improving their governance and management systems and making use of technology to share innovations and knowledge will help to drive collaborative technological upscaling. There is also potential for external interventions and new businesses to provide Suame artisans with training and equipment. The ITTU's most successful projects were those that quickly turned a profit, such as fabrication of bolts and nuts and sale of new machinery on hire-purchase terms (Powell, 1995). Educated entrepreneurs could set up workshops to provide auto-diagnostic services or train auto mechanics in modern techniques, engineers could improve agricultural processing equipment by adding low-cost sensors, and importers could market equipment such as 3D printers to wealthier workshop owners. Even though there is a multitude of business opportunities in the cluster for professional engineers, those with formal education tend to look down upon Suame Magazine. This can be remedied by improving education about the informal sector and expanding exchange programs to bring students into industrial clusters (Waldman-Brown et al., 2012).

## **B. Support from Private Sector and Government**

We recommend that the private sector in Ghana be encouraged to support Suame Magazine industrial cluster and thereby potentially reduce costs by purchasing wares from local artisans. For instance, the Association of Ghana Industries, Ghana Chamber of Mines and the Ghana Institution of Engineers could use their supply chains to provide market support along with standardisation and training that will enable artisans to upscale through improved innovation. Government agricultural and food-processing policies also need to put more focus on integrated support and resourcing for Suame Magazine so that artisans are enabled to provide the requisite engineering and fabrication. This may require longer-term partnership to upgrade artisans' facilities and improve product quality, coupled with retooling of the ITTU to respond to artisans' current skills development and technology needs.

Despite the significant contributions that Suame Magazine has made to Ghana's economy, its social and productive potentials have historically been disregarded in national development policies (Obeng, 2001). Lack of government support is a major barrier for Suame Magazine, although the failure of most Suame artisans to register their businesses (and the corresponding lack of tax revenue) may lead officials to disregard the cluster's potential. Adeya (2008) outlines possible roles for government: encouragement of training centres and programmes, subsidisation of new equipment, provision of adequate infrastructure, and resolution of issues regarding land tenure to enable the establishment of permanent structures. NGOs can also facilitate interactions between all stakeholders and help upgrade technological capabilities.

## **C. Involvement of Academia**

Academics can help artisans to upscale by developing improved methods and standards for manufactured goods and vehicle repair, and through research investigating how the cluster operates so that interventions can be optimised.

Adeya (2008) and Alexander et al. (2010) conclude that the Suame artisans need a well-organised umbrella development organisation to advocate for the cluster's members, lobby for better services, and facilitate external interventions. The establishment of SMIDO in 2007 was intended to fill that

gap, but the organisation has been crippled by the governance problems that have existed in many of the now-failed associations in Suame Magazine. The number of trade-specific organisations in the cluster has continued to grow as a result of dissatisfaction with existing associations. Adeya (2008) found that these groups focus on “social welfare issues and are rarely concerned with supply-side matters, markets, and technology” (2008, p. 18). Recent years have seen declining participation in these groups, and two thirds of business owners in a SMIDO survey (Alexander et al., 2010) were not part of any business association. This is confirmed by our own research, which found that a similar two thirds of artisans were not part of any association.

The challenges and dynamics of operating in Suame Magazine, typical of many clusters across Africa, are having a deleterious effect on the processes and means of innovation. Fast-paced changes in technology mean that Suame Magazine artisans need more training and assistance, and such building of the national pool of skills and infrastructure in informal repair and manufacturing can also benefit formal-sector institutions. But before the cluster can function at full potential, there needs to be a conscious effort, led by national government, to narrow the divide between those who study engineering in schools and colleges and the Suame artisans who actually work on the machinery and develop their own appropriate technologies and innovations.

#### **D. Maker Movement as an Enabler**

Although an overwhelming majority of artisans and stakeholders indicated not knowing of the maker movement or of any connection between Suame Magazine and the global phenomenon, we believe the maker movement and makerspaces can play a role in upgrading the informal industrial environment of Suame Magazine. Our investigation through secondary and primary sources has shown that the artisans of Suame Magazine require continued external support to facilitate innovation. In view of the success of ITTU, a similar strategy could work to introduce digital manufacturing technologies. This will require cooperation between informal artisans and the private sector, government, development organisations and academia. The maker movement in Ghana also needs to make an effort to involve local artisans, facilitate the importation of digital technologies, and pursue projects that are rooted in the realities of informal manufacturing. The movement must seek resources and funding so that equipment can be made available and attractive to informal artisans who would otherwise dismiss the workshops as purely academic. Even a relatively modest quantity of imported digital manufacturing tools could have a substantial impact on the community, since machines are often shared across workshops (Waldman-Brown et al., 2012).

The success of the Suame ITTU throughout the 1980s provides useful recommendations on what will likely make an impact in the Suame Magazine. In particular, there is the need for continuous collaboration across sectors, which is seen as crucial for creation and proliferation of new technology-based industries. Unlike centralised organisational structures such as those in most developing-world makerspaces/FabLabs, the informal sector is characterised by decentralised systems that ensure collective efficiency but could make it difficult to gather grassroots support. Historically, schools and governments have failed to provide appropriate training for small-scale manufacturers and the failure continues. Therefore, it may be useful to follow the model of the Suame ITTU and locate new makerspaces/FabLabs in the middle of Suame Magazine. If the Suame Magazine artisans deem makerspaces/FabLabs to be useful, the local associations could then initiate their own—similar to the way that such spaces have emerged across the developed world. With exogenous

makerspaces/FabLabs as external interventions, local unions and influential artisans from the informal sector need to participate in determining workshop activities and organising new classes.

Reiterating our previous comment on the need for better information about opportunities in the informal sector, creative informal artisans could be provided with fellowship or apprenticeship opportunities to spend time in workshops such as makerspaces.

According to Waldman-Brown et al. (2012), the ITTU example indicates that informal artisans, as potential users of FabLabs for local manufacturing, need to recognise the relevance of FabLab technologies. Therefore, new technologies and methods must not seem too difficult to learn and must exhibit their potential for increasing profit or livelihood of informal artisans.

There is also need for the maker movement to adapt their technical capabilities to the local environment. For instance, the majority of manufacturing businesses in the informal sector of Suame Magazine use large-scale industrial tools and resources rather than the precise, small-scale prototyping equipment available in makerspaces/FabLabs. As a direct intervention, microprocessors could be useful for integrating sensors into agricultural processing equipment, but if maker movement staff are unfamiliar with industrial machinery they may have difficulty making sufficiently robust product to satisfy customers.

## E. Conclusion

Ultimately, the motivation for improving collaboration among the private sector, government and academia must come from the private formal sector. Our research sought to establish a connection between the Suame Magazine and the maker movement, where, for now, there is still a wide gap even though the possibilities for connection and collaboration are enormous. Workshops and institutions across the formal sector have access to extensive resources that need to be tapped to assist the development and promotion of small-scale manufacturing. However, if any new technology is to thrive and benefit Suame Magazine, there will need to be increased collaboration with end-users, which in most cases are the artisans.

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## Appendix

### Questionnaire for Suame Artisans and Associations

This questionnaire is designed to assist the researcher to make objective assessment of how artisans acquire and develop their skills, innovate, and share ideas at Suame Magazine.

The exercise is basically academic and your answers will be treated with the utmost confidentiality they deserve. Your maximum co-operation is highly expected. Please tick (✓) or fill in ...../ ( ) where appropriate.

**1. Name:**

**2. Location (Closest Landmark):**

**3. Contact Phone Number:**

**4. Your area of trade or specialisation:**

**5. Number of years in your trade or area of specialisation:**

a) 0–5 ( )      b) 6–10 ( )      c) 11–15 ( )      d) More than 15 ( )

**6. How did you acquire the skills for this trade?**

a) Formal education ( ) b) Apprenticeship training ( ) others ( )

Please specify the source:

**7. How many years did you spend in receiving the training for the trade?**

a) 0–2 ( )      b) 3–5 ( )      c) 6–8 ( )

**8. Aside the first training to acquire your skill, have you undergone any other training(s)**

Please specify the training(s) and its(their) source(s):

**9. How have you benefited from your additional trainings?**

**10. Do you get any form of support for your area of specialization? Yes ( ) No ( )**

If “Yes”, please specify:

**11. How do you see your business for the next five (5) years?**

**12. Currently, what is/are your main source(s) of information or new ideas for your trade? What part of your business requires new knowledge/skill?**

**13. Is your source(s) of information enough for knowledge acquisition? Yes ( ) No ( )**

If “Yes”, please specify:

If “No”, please specify:

**14. If you are offered the opportunity of getting other sources of information to help you in your work, will you accept?** Yes ( ) No ( )

**15. How do you compare your knowledge and skill in the trade to your colleagues in the other businesses?**

**16. What is your perspective about the future of innovation at Suame Magazine?**

**17. What are the problems and constraints faced by artisans at Suame Magazine?**

Please rank them in the order of importance (on a scale of 1–5, with 1 being the highest and 5 the least)

- a) Land Acquisition ( )
- b) Tax System ( )
- c) Technical Training ( )
- d) Access to Loan Facilities ( )
- e) Marketing of Products ( )

**18. Apart from the above problems, are there any other challenges you face?**

- i.
- ii.
- iii.
- iv.
- v.

**19. Have you ever heard of the Maker Movement?** Yes ( ) No ( )

If “Yes”, how did you get their information?

**20. Do you belong to any Association at your workplace?** Yes ( ) No ( )

If “Yes”, please specify:

**21. Have you ever developed a unique product or service in your trade before?** Yes ( ) No ( )

If “Yes”, please describe:

If “No”, why?

**22. How do you share knowledge and innovations among artisans/businesses?**

**23. The extent to which innovation has affected industry in Ghana:**

Please tick the answer that satisfies your expectation for each option (✓).

Options	Strongly Agree	Agree	Disagree	Strongly Disagree
a. Artisans do not have access to information on innovations.				
b. Government is supporting artisans in knowledge acquisition.				
c. Other stakeholders support in training and knowledge acquisition.				
d. Artisans are innovative to the extent that, they are able to put their own ideas into a product.				

**24. In your opinion, what do you think are the key drivers of innovation (new ideas, new processes, etc.) in Suame Magazine?**

a) Market ( )    b) Local competition ( )    c) External competition ( )    d) Others ( )

**25. Do you get assistance to develop your idea or innovation?**

**26. Do you agree that those who develop innovations need protection for their work?**

Yes ( )    No ( )

**27. What challenges do you face in protecting your ideas or innovation?**

**28. How and why do you want your idea or innovation to be protected?**



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