The International Journal Of Engineering And Science (IJES)
||Volume||2 ||Issue|| 8 ||Pages|| 102-112||2013||
ISSN(e): 2319 – 1813 ISSN(p): 2319 – 1805

Analysis of Skills and Training Needs of Metalwork Engineering Enterprises in Ghana

Obeng,G.Y, Adjaloo, M.K, Amrago, D.K

Technology Consultancy Centre, College of Engineering
Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

---ABSTRACT---
This paper analysed skills and training needs of metalwork engineering enterprises in Ghana. Using primary data from cross-sectional survey, empirical analysis was carried out. The data was developed into a database on metalwork engineering enterprises in Kumasi of Ghana. 500 metalwork engineering enterprises were analysed for trends and proportions to provide knowledge and understanding. To determine training priorities, skills gap analysis was used. Pareto chart was also used to analyse priority areas for training, tools for training, best time and duration. The study results showed that although the metalwork engineering enterprises possessed diverse skills, they were limited in knowledge-based skills and training, which adversely impact on productivity and competitiveness. It was revealed that about 86% of the respondents acquired their existing skills through apprenticeship training from master craftsmen over an average period of 4.9 years. From the results, the widest gap in skills was in ICT and Computer Aided Design/Manufacturing (CAD/CAM). Basic skills upgrading is needed in welding and fabrication, agricultural and agro processing equipment manufacture, technical drawing and metalwork fabrication. The results suggested that priority training methods and tools should focus on hands-on and use of basic engineering tools. Majority of metalwork engineering enterprises prefer training duration of 1-3 months and late afternoon (4-7 pm) since the mornings are peak periods for business and income generation. The need for skills upgrading, awareness creation in design processes, well-timed training etc are recommended.

KEYWORDS: *Metalwork enterprises; skills development; training needs; gap analysis; Ghana.*

Date of Submission: 27July2013, Date of Acceptance: 20 August 2013,

I. INTRODUCTION

In most developing countries, several governments have used various strategies and policy instruments to promote productivity of small enterprises, however, these measures have either been ineffective or seen limited results (Kye Woo Lee, 2009). In Ghana, a number of government driven initiatives toward the development of small enterprises have not yielded the expected results, particularly those leading to high levels of skilled manpower and productivity. According to Government of Ghana (2010), low level of skilled manpower is preventing Ghanaian manufacturing enterprises from being competitive. One of the key constraints in both skills and technology development is the limited interaction between public institutions, including polytechnics, universities, public research institutes and the private sector. The result is a general gap in skills, technology, and research output from the public institutions and what is needed by private sector enterprises. In all, it is recognized that a skilled workforce is of critical interest to both public and private sectors. Therefore, skills development as well as hands-on training is of paramount importance to enterprise development and industrial growth (MMYE, 2006).

Ghanaian youth with post-basic education have participated in skills training program, of which majority was involved in apprenticeship (World Bank, 2009). Though several informal training programs are being run through government initiatives, formal training institutions that are dedicated to skills training is limited. Several youth are undertaking training yearly but the skills they are learning do not meet the industrial and entrepreneurial needs of the country, both in terms of relevance and quality. To fill this gap donor funded projects have started competency-based training programs and are beginning to harmonize them with the expectation that technical and vocational training would become more efficient and cost-effective (World Bank, 2009).

The metalwork engineering enterprises in Kumasi, Ghana are a critical subsector for job creation and industrial development of Ghana. It is one of Africa's largest metalwork enterprise clusters where a variety of innovative products is created to cater for the needs of local, national and sub-regional markets. Nevertheless, the metalwork engineering enterprises are confronted with a number of challenges, which require continuous research. Powell (1995) and Obeng (2002) reported that the metalwork engineering enterprises in Kumasi often do not use production and finishing techniques that compare with the quality of imported products. In the light of this, Adeya (2008) recommended that managers of metalwork engineering enterprises in Kumasi should develop process and product upgrading by raising the skills level of the workforce through consistent training.

The objectives of this study were to: review existing skills and mode of acquisition; analyse skills training needs, gaps, training tools and duration essential for the development of metalwork enterprises; and make recommendations for improving skills and training in metalwork engineering enterprises.

II. STUDY AREAS AND METHODOLOGY

2.1 Study Areas

The main survey was carried out in 27 zones according to the Ghana National Association of Garages (GNAG) Classification of metalwork engineering and agricultural mechanization clusters in Kumasi, Ghana. The clusters included Kumasi Suame Magazine (Suame Sub-metro), Asafo (Subin Sub-metro), Krofofrom (Tafo Sub-metro), Sofoline (Kwadaso Sub-metro), Ahinsan (Asukwa Sub-metro), Santasi (Nhyiaeso Sub-metro). (Figure1). The Kumasi metalwork engineering enterprises largely comprised micro and small-scale enterprises (MSEs) working in the informal sector. The size of metalwork engineering enterprises studied was 5-6 persons (Obeng, 2002).

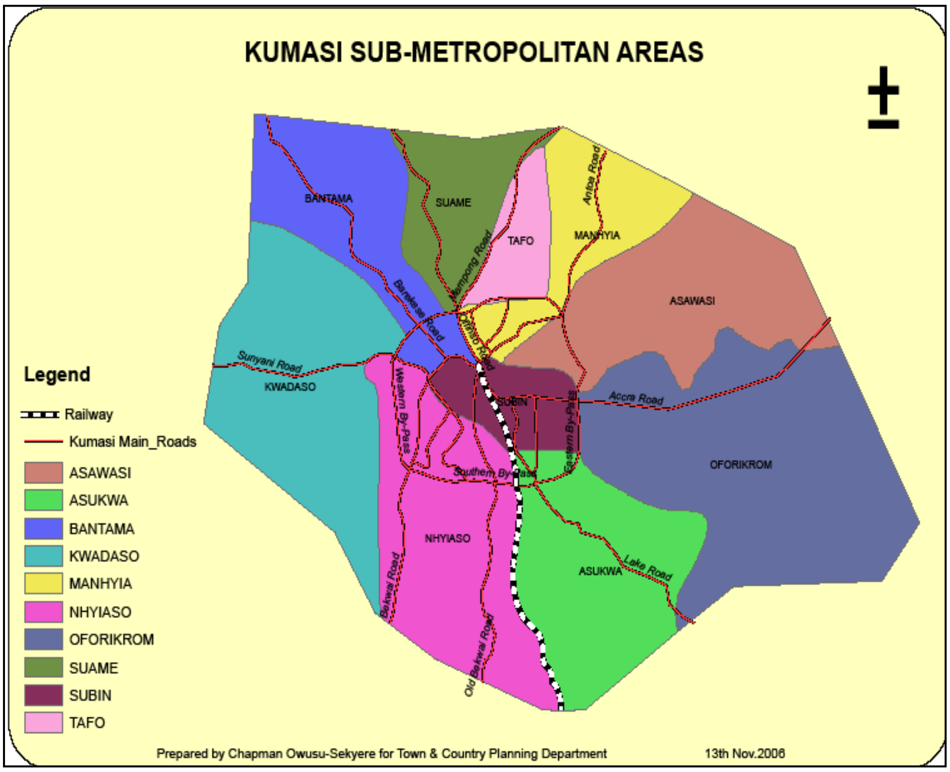

Figure 1: Map of Kumasi Sub-Metropolitan Areas

2.2 Methodology

The main study was preceded by visits to some relevant organizations including Ashanti Regional Trade Office, Ministry of Trade and Industry (MOTI), Ghana National Association of Garages (GNAG) and Suame Magazine Industrial Development Organization (SMIDO) in Kumasi, Ghana. The purpose of the visits was to access the relevant documents such as technical reports, policy papers, and other literature. Preparatory work for field data collection started with a review of existing literature. This provided relevant information relating to the central issues being investigated. Access to information also offered a better understanding of the central issues. The following subsections provide information on sampling, data collection and data analysis.

2.2.1 Sampling

From an estimated population of about 6000-8000 metalwork engineering enterprises, about 500 were sampled. The larger sampling size was assumed to capture the variance among the target group. In view of the homogeneity (technology being employed, similarity in products and services) of the sampled enterprises the sample size of about 500 is statistically adequate for analysis. Several authors consider sample sizes ($n \geq 30$) as statistically large (McClave and Benson, 1988; Spiegel and Stephens, 1999). However, most researchers would probably recommend a sample size of at least 100 as adequate for statistical data analysis (Singleton et al, 1993). The selected sample size of about 500 is consistent with those recommended by Saunders et al (1997) for a population size of about 10,000, using a margin of error of 3-5%.

2.2.2 Data Collection

Questionnaire was developed from the initial review of relevant documents and responses obtained from key stakeholders. In order to meet the objectives of the study, the questionnaire was designed in simple but exhaustive manner. 50 questionnaires were pretested in two clusters, namely Kumasi Suame Magazine and Asafo clusters. The purpose of the pretesting was to determine the relevance and the suitability of the set of questions and time required for administering the questionnaires. A combination of methods including interviews, questionnaire administration, and observations were employed for data collection in the main study. Representatives of trade associations including GNAG and SMIDO were engaged in a focus group meeting to validate the study findings.

2.2.3 Data Analysis

In order to analyse the quantitative data, Statistical Package for Social Sciences (SPSS) software (version 16.0) was used. The data were cleaned by visually cross-checking with the individual questionnaires to find out wrong entries; and by using box-plot to identify extreme values and outliers. To provide understanding of trends and proportions descriptive statistics and cross-tabulation were used for data analysis. In order to determine the training priorities, there was the need to understand the skills deficiencies. For this purpose skill gap analysis was used. The first step in the skill gap analysis was to match and compare the existing skills of the enterprises against skills needed for future tasks and identify the gaps. This process helped to focus analysis on the skill areas required to excel and levels, which required development. Tables, Bar chart and Pareto chart were used to analyse priority areas, namely skills training needs, tools for training, best time and duration for training. Statistical significant difference was computed at $p<0.05$.

III. RESULTS

3.1 Existing Skills, Acquisition, Programmes Attended and Institutions

The major skills existing in the surveyed engineering enterprises are described in Table 1. The results showed that welding, metal fabrication, general machining, foundry, blacksmithing and aluminium metal fabication and glazing appear to be the major skills existing in the metalworks and agricultural mechanisation subsector.

Table 1: Major Existing Skills in the Enterprises

Type of Enterprise	Major Existing Skills
Metalwork	Arc and gas welding, metal fabrication, metal forming, marking out and cutting, riveting, seaming, soldering, pattern and template development, surface finishing, spraying, aluminium joining, glazing, sealing
Agricultural Mechanisation	General machining, welding, fabrication, metal forming, marking out and cutting, riveting, seaming, soldering, pattern and template development, surface finishing, spraying
Foundry	Pattern making, sand moulding, pouring, ferrous and non-ferrous metal founding, surface finishing.
Blacksmith	Cold and hot forging, tempering, annealing, forming
Aluminium metal fabrication and glazing	Fabication of aluminium sliding doors and windows, aluminium metal and glass cabinets and showcases

In Table 2, the results revealed that about 86% of the respondents acquired their existing skills through apprenticeship training from master craftsmen over a period of 1-10 years. The results also indicated that about 6% acquired their skills through a combination of apprenticeship and technical/vocational training, apprenticeship and attachment with companies, industrial attachment and self coaching. About 8% had their skills training from technical or vocational schools, self coaching, industrial attachments and experiences from companies they worked. On average, the length of skills acquisition is 4.9 years (Table 3).

Table 2: Acquisition of Existing Skills and Duration

Acquisition of Skills	Count	Valid Percent	Duration (years)
Apprenticeship	434	85.6%	0.5-10
Apprenticeship & Industrial Attachment	7	1.4%	3-4
Apprenticeship & Self coaching	6	1.2%	1-3
Apprenticeship & Technical/Vocational	16	3.1%	2-7
Apprenticeship & Worked with company	5	1%	2-5
Industrial Attachment	2	0.4%	4-5
Industrial Attachment & Technical/Vocational	6	1.2%	4-8
On-the-job training	2	0.4%	4-10
Self coaching	7	1.4%	1-8
Technical/ Vocational	16	3.1%	3-10
Worked with companies	6	1.2%	1-10
Total	**507**	**100%**	

Table 3: Length of Skills Acquisition

Length of Skills Acquisition	Mean	4.92
	Median	4.00
	Std. Deviation	2.929

While 19% of the respondents were found to have had further skill training in their respective trades after apprenticeship, a whopping 81% of the surveyed enterprises have never attended any skills training (Table 4). The training institutions included: Kwame Nkrumah University of Science and Technology, Kumasi; Japanese International Cooperation Agency (JICA), National Vocation Technical Institute (NVTI), National Board for Small Scale Industries (NBSSI), Intermediate Technology Transfer Unit (ITTU), Ministry of Trade and Industry (MOTI), Neoplan Ghana Ltd, International Development Enetrprise (IDE) Ghana; Kumasi Technical Institute (KTI), and Gulf Aluminium and Metal System Company

Table 4: Skills Programme Attended, Type and Training Institution

Attendance of Skills Training	Count	Valid Percent	Type	Training Institution
Attended	96	19%	Welding and fabrication	JICA
			Cook stove (Ahebenso)	Suame ITTU
			Arc welding, Body works	Neoplan Ghana
			Basic and general engineering	JICA
			Surface finishing, Metal works	NVTI
			Basic Foundry	JICA, KNUST, NBSSI
			Modern engineering drawing	JICA
			CAD/CAM, ICT	KNUST
			Metal forming	Suame ITTU
			Basic engineering & entrepreneurship	Suame ITTU, MOTI, JICA
			Hand pump manufacture	IDE
			Welding design	Gulf aluminum and metal system company
			Vehicle body building	Kumasi Institute of Tech.
Not Attended	405	81%		
Total	501	100%		

3.2 Use of Design Processes

The use of design processes for the development of products was also investigated. The study revealed that 52% of the enterprises employed some form of design processes (Table 5). It was also found that 23% of the enterprises that used design processes were also aware of established standards for their products, while 29% of the enterprises that used design processes to develop their products claimed they were not aware of any standards. Interestingly 43% claimed they are not aware of established standards and do not use any design processes in their production. Overall about 72% were not aware of established standards for their products.

Table 5: Awareness of Standards for Products and Use of Design Processes

	Awareness of Established Standards for Products		
Use Design processes to Develop Products	Aware	Not Aware	TOTAL (%)
Use design processes	115 (23%)	146 (29%)	261 (52%)
Do not use design processes	27 (5%)	213 (43%)	240 (48%)
TOTAL	142 (28%)	359 (72%)	501 (100%)

3.3 Skills Gap Analysis and Technical Skill Training Needs

Table 6 shows the skills considered important for future career, skills rating and skills gap. From the results, skills gap in Information and Communications Technology (ICT) and Computer Aided Design/Manufacturing (CAD/CAM) appear to be the widest. Skills needed in the areas of ICT and CAD/CAM were rated 2,3,4 and 5. This means skills gap from the level of *awareness but not sufficient to use skill* to *fully competent*. The second skills gap of interest is the area of design in metal works. Skills required to excel in a typical metalwork enterprise were rated 3, 4 and 5, that is lack of skills from the level of *familiar with and able to use skill* to *fully competent level*. Welding and Fabrication, basic engineering and technical skills, production of automatic doors and aluminium metal fabrication had skills gap rating of 4 and 5, which means from the level of *somehow competent* and *fully competent*. Lastly, the results revealed that *full competent skills* are needed by enterprises engaged in agricultural implements and agro-processing, metal fabrication techniques, welding technology, foundry technology, machining, machine building, and blacksmithing.

Table 6: Skills Required For Future Career

Skills considered Important for future career		**Skills Rating (1-5)**					**Gap** (Skills level to develop)
		1	2	3	4	5	
1. Welding and Fabrication	Existing skills						
	Skills needed						**4, 5**
2. Basic engineering & technical skills (drawings, use of standards, and metrology)	Existing skills						
	Skills needed						**4, 5**
3. Agricultural implements & agro-processing	Existing skills						
	Skills needed						**5**
4. Metal fabrication techniques	Existing skills						
	Skills needed						**5**
5. Welding technology	Existing skills						
	Skills needed						**5**
6. Foundry technology	Existing skills						
	Skills needed						**5**
7. Machining	Existing skills						
	Skills needed						**5**
8. Machine building	Existing skills						
	Skills needed						**5**
9. Production of automatic doors	Existing skills						
	Skills needed						**4, 5**
10. Blacksmithing	Existing skills						
	Skills needed						**5**
11. Design in metal works	Existing skills						
	Skills needed						**3, 4, 5**
12. ICT & CAD/CAM	Existing skills						
	Skills needed						**2, 3, 4, 5**
13. Aluminium metal fabrication and glazing	Existing skills						
	Skills needed						**4, 5**

Note:

1=low awareness and low skill level, 2=awareness but not sufficient to use skill; 3=familiar with and able to use skill; 4= somehow competent; 5=fully competent

The need for upgrading of existing skills was highly emphasized by the enterprises. Most of them have for some time felt the need for upgrading their skills but do not know where to have such training. Others have cited lack of financial resources and inappropriate timing of training as among the main constraints. Training needs were grouped into two priority areas as indicated in Table 7. The first priority area, which constitutes 86% of the training needs, covers skill upgrading in welding and fabrication, manufacturing techniques in agricultural and agro processing equipment, basic engineering and technical skills, metal fabrication techniques, welding technology and foundry technology. The second priority areas were skills in machining, machine building, blacksmithing, metalwork design, ICT and CAD/CAM, aluminium metal fabrication and glazing.

Table 7: Priority Skill Training Needs of the Enterprises

		Type of Skill Training Needed	Number of Enterprises	Percent
PRIORITY 1	1.	Welding and fabrication	136	31%
	2.	Basic engineering & technical skills (drawings, use of standards, basic measurements and metrology)	74	17%
	3.	Agricultural implements & agro-processing	71	16%
	4.	Metal fabrication techniques	46	11%
	5.	Welding technology	30	7%
	6.	Foundry technology	19	4%
	7.	Machining	12	3%
PRIORITY 2	8.	Machine building	9	2%
	9.	Production of automatic doors	9	2%
	10.	Blacksmithing	8	2%
	11.	Design in metal works	9	2%
	12.	ICT & CAD/CAM	5	1%
	13.	Aluminium metal fabrication and glazing	5	1%
		TOTAL	433	100

3.4 Training Tools, Duration and Time

It is demonstrated in Table 8 that participatory training methods were suggested by 68% of the respondents who preferred a combination of the following tools for training: (1) hands-on and use of basic engineering tools (25%); (2) hands-on only (23%); (3) films and hands-on (7%); (4) hands-on, manuals with pictures and basic engineering tools (7%); and (5) films, hands-on and manuals with pictures (6%) for any future training. However, the results suggested that the priority training tools, which constituted approximately 50%, were: hands-on only and a combination of hands-on and use of basic engineering tools.

Table 8: Tools for Training

	Training Tools	Number of Enterprises	Percent
1	Hands-on & use of basic engineering tools	104	25%
	Hands-on only	99	23%
2	Films & hands-on	28	7%
	Hands-on, manual with pictures and basic engineering tools	29	7%
	Films, hands-on, manual with pictures	25	6%
3	Manual with pictures	22	5%
	basic engineering tools	22	5%
	Films, hands-on & basic engineering tools	15	4%
	Films	13	3%
	Hands-on, manual with pictures	11	3%
	Films, manual with pictures	14	3%
	Manuals with pictures & basic engineering tools	8	2%
	Patterns/Templates	9	2%
	Films, basic engineering tools	3	1%
	Films, hands-on, manual with pictures and basic engineering tools	6	1%
	Films, hands-on, manual with pictures, patterns and templates	4	1%
	Films, hands-on, manual with pictures, templates & basic engineering tools	4	1%
	Patterns/Templates and basic engineering tools	4	1%
	Films, pattern/templates	2	0%
	TOTAL	422	100%

Figure 2 indicated that majority (80%) of respondents will prefer to have their skills training in late afternoon from 4-6 pm (21%) and 5-7 pm (59%). They are less interested in morning and early afternoon training sessions as these times are the peak periods for business and income generation.

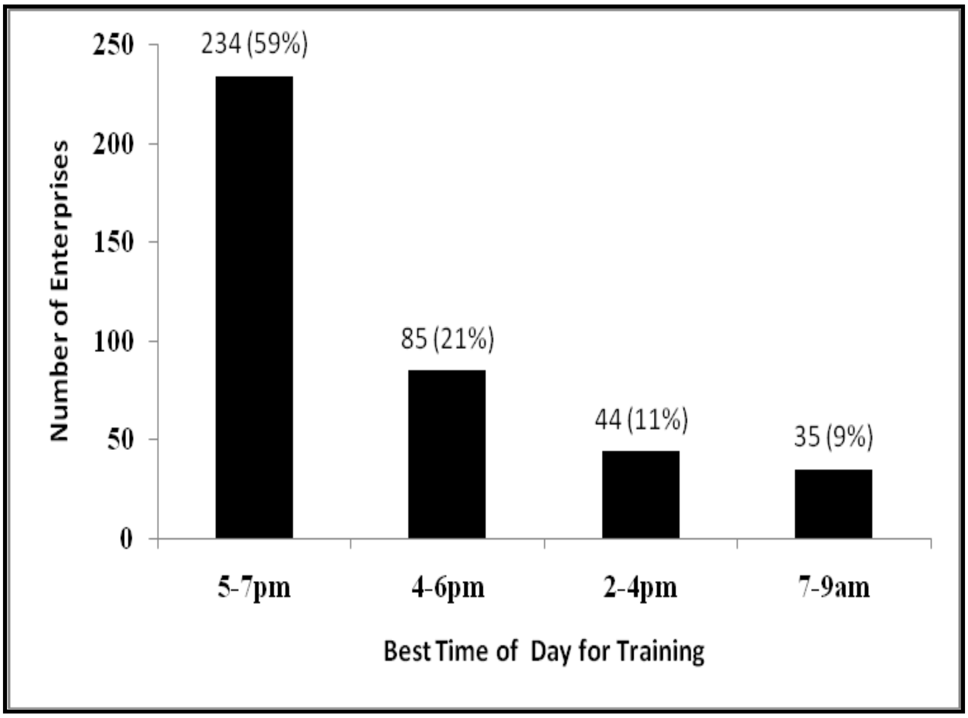

Figure 2: Pareto Chart Showing Best Time of Day for Training

In Figure 3, the results indicated that about 66% prefer training periods between 1 and 3 months to relatively long training periods due to the nature of their work. On the other hand 21% would be comfortable with any preferred training which would last between 6 and 12 months.

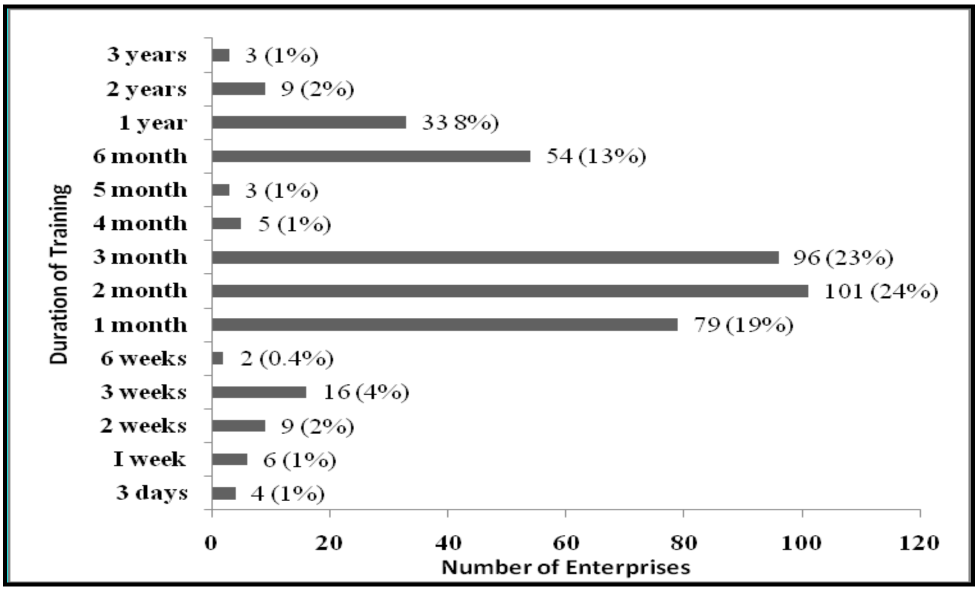

Figure 3: Bar Chart Showing Duration of Training by Enterprises

IV. DISCUSSION

The study indicated that metal fabrication and welding, general machining, foundry and blacksmithing are the major skills existing in the metalworks enterprises in Kumasi. However, there are some emerging metalwork engineering enterprises including production of automatic doors and aluminiun metal fabrication and glazing. In general, majority of the entrepreneurs, about 86% acquired their existing skills through apprenticeship training of 4-5 years. Dawson (1988) noted that apprenticeships are directly linked to industry and preserve traditional technology, however, apprenticeship limits development of products, production and minimize trainees' connections to existing technological advances, theory and practical job processes (World Bank, 2009).

Now, if a whopping 81% of the entrepreneurs had not attended any skills training programme, then the implication is that majority of them would be limited in knowledge and this could adversely impact on their productivity and competitiveness. This finding is consistent with Government of Ghana (2010), which suggests that low productivity and low levels of skilled manpower are preventing Ghanaian manufacturing enterprises from being competitive. The findings therefore suggest that formal training of entrepreneurs is likely to contribute to local enterprises to compete with imports, and this is consistent with the proposal of McCormick (1998).

From the study, over 70% of the metalwork engineering enterprises were not aware of any standards for their manufacturing processes and products. However, about half of the enterprises used some form of design processes, which were mainly learned on-the-job. This is not surprising since some of the entrepreneurs were attached to industry or worked with large-scale firms and others attended technical/vocational institutes. Owing to lack of formal training in mechanical design process, engineering, technology development or other related technical courses, most metalwork engineering enterprises assess the quality of their products by equating customer satisfaction with product quality (Obeng et al., 2011). However, the effectiveness of design process is measured by product cost, quality and time to market (Ullman, 2003). The global marketplace has fostered the need to develop new products at a very rapid pace and therefore to compete requires that a firm be very efficient in the design of its products (Ullman, 2003).

Skills gap analysis was carried out as a process of matching and comparing the existing skills of the entrepreneurs with those that are needed for future tasks in metalwork fabrication and identifying where there were gaps. This matching process helps in focusing better on the skill areas which need to be developed. In this study, full competence is the target level required by the enterprises to be fully effective in meeting customer needs. Overall, the results indicate lack of full competency in all the skills areas considered important for future endeavours in metalwork fabrication. In areas such as agricultural implements and agro-processing, metal fabrication techniques, welding technology, foundry technology, machining,

machine building, and blacksmithing, the existing skills of the surveyed enterprises were rated as somehow competent. This implies that in some ways, the enterprises are able to manufacture products that meet the functional needs of their customers. However, owing to lack of full skills and capability underpinned by education and innovation, the enterprises are deficient in standards, and use of design process to increase productivity and competitiveness on the global market. Of significance among the skills gap identified is information technology based skills (ICT and CAD/CAM). In this area, the gap continues to be widened since new computer programmes and systems are frequently introduced.

The technical skills training needs of the metalwork engineering enterprises were grouped into two main priorities (Table 7). Priority 1 covered skills upgrading in seven areas and these can be considered as the most essential for skills development. For skills developers, priority 2 skills can be considered for a second round training programme since the results indicate a comparatively lower skills training need. It was realised that priority 2 skills showed wider skills gap than priority 1 skills (Table 6). The result could be explained in terms of the level of education. The surveyed entrepreneurs have low level of education, and are therefore less exposed to ICT based skills. Some have never used any ICT device let alone learning the ICT and CAD/CAM which are often taught at the technical and other tertiary instituitions, hence the rating shows wider skills gap in ICT and CAD/CAM.

In general, training to the full competence level is needed for all the skills considered important for future endeavours. The data perhaps give credence to the observation in the Private Sector Development Strategy (PSDS II) that Ghanaian firms in the manufacturing sector are significantly less productive than those in comparative countries because they have less capital, are less skill intensive and relatively smaller in size (Government of Ghana, 2010). While the median manufacturing firm in Ghana produces about US$1,000 of value-added per worker, firms in Thailand and Kenya produce between six and seven times as much as per worker, firms in Malaysia produce about 14 times as much, and firms in South Africa produce over twenty-five times as much (ibid). The lack of competitiveness of the manufacturing sector has prevented Ghana from growing faster and needs to be addressed to ensure high sustained growth (Government of Ghana, 2010).
PSDS II supports technical and enterprise skills development by attempting to improve productivity, particularly its focus on training and enterprise development services. The strategy also highlights the need for agriculture to become more productive. This process can be supported through the expanded use of agricultural technology produced by Kumasi's metal fabrication sub-cluster. Specifically, two of the PSDS II's strategic initiatives support enterprise skills training to increase productivity, especially among small enterprises. The development of relevant skills is one of the important interventions needed to increase enterprise productivity (Adams, 2008).

The Government of Ghana has identified skills development and technology as key focus areas and has developed policies and plans to support initiatives. Such policies and plans include a 10-year plan for economic development, the National Education Reform Program (NERP) and the Science, Technology and Innovation (STI) Policy. In 2006, the Council for Technical Vocational Education and Training (COTVET) was established to support skills development through technical and vocational education. These initiatives have not yet proffered the full benefits to close the skills gap identified in the metalwork and other similar sectors of the economy.

The results also suggest that hands-on and a combination of hands-on and use of basic engineering tools are the priority training tools that are required to effectively build the capacity of entrepreneurs. Given the existing educational levels of majority of the entrepreneurs, there is the need to take into consideration the specific tools identified for training in order to derive maximum benefit. Besides, short-term training programmes of 1-3 months duration scheduled for late afternoon (5-7 pm) appear to be appropriate to meet the needs of the enterprises. This is so because private firms need to generate income during peak hours of the day and therefore they are likely to focus on training courses during off-peak hours. Additionally, key to effective training is good interaction between the private sector enterprises and public institutions, particularly polytechnics, universities, research institutes and skills development centres.

V. CONCLUSION AND RECOMMENDATIONS

The paper has analysed and discussed a number of issues regarding existing skills, mode of acquisition, training issues and needs among metalwork engineering enterprises. The paper took into consideration the challenges being faced by the engineering enterprises and focused on addressing these challenges. From the results, the widest gap in skills was in ICT and Computer Aided Design/Manufacturing (CAD/CAM). Basic skills upgrading is needed in welding and fabrication, agricultural and agro processing equipment manufacture, technical drawing and metalwork fabrication. The results suggested that priority training methods and tools should focus on hands-on and use of basic engineering tools. The following are some key recommendations made from the study findings:

1. The need for upgrading of existing skills was highly emphasized by the enterprises. However, most of them do not know where to have such training. Public and private institutions in charge of skills development and training should arrange with some of the technical institutions and universities to organize needs-based training programmes.

2. The relevant government ministry and agencies responsible for the development of metalwork engineering enterprises and skills development should work in collaboration with cluster leadership to create awareness and organise capacity development programmes on design process and standards focusing on use of technical drawings, model development, use of templates, product cost, quality and product marketing.

3. The results suggested that priority training tools for metalwork engineering enterprises include hands-on, a combination of hands-on and use of basic engineering tools. Given the educational levels of majority of metalwork entrepreneurs, there is the need to take into consideration the specific tools identified for training in order to derive maximum benefit.

4. Short-term training programmes of 1-3 months duration scheduled for late afternoon appear to be appropriate because private firms need to generate income during peak hours of the day and therefore are likely to focus on training courses during off-peak hours.

5. Training to the level of full-competency is needed for all the skills considered important for future endeavours. However, to close the skills gap ICT based technologies and applications are needed and can be delivered through short courses taking into consideration the training tools identified in the study.

ACKNOWLEDGEMENTS

Special thanks must be given to the Italian Government, Ministry of Trade and Industry and the Ghana Private Sector Development Facility (GPSDF) in Accra, Ghana for providing funding for the fieldwork in Kumasi, Ghana. The authors are grateful to the Technology Consultancy Centre of Kwame Nkrumah University of Science and Technology, Kumasi for providing logistics, which made it possible to focus on writing this paper.

REFERENCES

[1] Adams, A.V. (2008). Skills Development in the Informal Sector of Sub-Saharan Africa. August, World Bank Report.
[2] Adeya, C. N. (2008). The Suame Manufacturing Cluster in Ghana. In D. Z. Zeng (Ed.), *Knowledge, Technology, and Cluster-Based Growth: Africa* (pp. 15-24). Washington, DC: The International Bank for Reconstruction and Development / The World Bank.
[3] Bangasser, P (2000), "The ILO and the Informal Sector: An Institutional History," ILO Employment Paper 2000/9, Geneva.
[4] Dawson, J. (1988) Small Scale Industry in Ghana: A case of Kumasi. Report presented toESCOR -ODA, London, United Kingdom.
[5] GDRC (2011). The GDRC's Economy Sphere: The Informal Sector. Global Development Research Centre (GDRC) Report. [http://www.gdrc.org/informal/index.html], (Accessed August 2012)
[6] Government of Ghana (2010). Private Sector Development Strategy 2010-2015. Ministry of Trade and Industry, Government of Ghana, Accra, Ghana. Unpublished.
[7] Kye Woo Lee (2009) Productivity Increases in SMEs: With Special Emphasis on In-Service Training of Workers in Korea. Social Protection and Labour. *World Bank Report*
[8] Liimatainen, M-R (2002). "Training and Skills Acquisition in the Informal Sector: A Literature Review." ILO InFocus Programme on Skills, Knowledge and Employability, Informal Economy Series, Geneva.
[9] MMYE (2006). Report on the Restructuring of the National Vocational Training Insttitute. Ministry of Manpower, Youth and Employment (MMYE), Accra, Ghana.
[10] McClave, J.T. and Benson, P.G. (1988) *Statistics for Business and Economics* (4th Edition), San Francisco: Dellen Publishing Company.
[11] McCormick, D. (1998). *Enterprise clusters in Africa: on the way to industrialisation?* : IDS Discussion Paper No. 366
[12] Obeng, G.Y., Donkor, P,. and Quansah, J. (2011). Needs Assessment of Capacity Building for Cluster Development in the Metal Fabrication Sub-sector in the Kumasi Metropolis. A Ghana Private Sector Development Facility (GPSDF)/TCC Report, Kumasi, Ghana.
[13] Obeng, G.Y. (2002). Kumasi Suame Magazine - A Background Paper. http://www.alternative-finance.org.uk/cgi-bin/summary.pl?id=329
[14] Powell J. W (1995). The Intermediate Technology Transfer Unit: A Handbook on Operations. Printed by SRP Exeter, UK.
[15] Saunders, M., Lewis, P., Thornhill, A. (1997). *Research Methods for Business Students*, Pitman Publishing, London.
[16] Schmitz, H. (1997). *Collective efficiency and increasing returns* (Working Paper No. 50). Sussex, UK: IDS.
[17] Singleton, R. A., Straits, B.C., and Straits, M.M (1993). Approaches to Social Research (2nd Edition). New York: Oxford University Press.
[18] Spiegel, M.R. and Stephens, L.R. (1999). *Schaum's Outline of Theory and Problems of Statistics* (Third Edition). New York: McGraw-Hill.

[19] Ullman, D.G. (2003). The Mechanical Design Process. Third Edition, McGraw Hill Publishing, New York. ISBN 978-0-07-237338-7
[20] UNIDO (1980). Appropriate Industrial Technology for Light Industries and Rural Workshops, United Nations Industrial Development Organisation (UNIDO), New York.
[21] World Bank. (2009). *Project Information Document Concept Stage: Ghana Skills and Technology Development Project* (No. AB5244), World Bank, Washington.