Effect of the combination of Mode of training and Business location on product quality: The Case Study of Arc Welding in Small Scale Metalworking Enterprises in Kenya

Charles M.M. Ondieki

***Abstract*— The quality of products from the micro and small enterprise sector is affected by both the entrepreneur's and enterprise's attributes. This paper presents and discusses findings of a study that was designed to investigate experimentally the relationship between the quality of arc welding in the Small Scale Metalwork sub-sector and the combined effect of the artisan's mode of training and business location. A total of 36 artisans with secondary education and 36 artisans with primary education consisting of formally (35) and informally (37) trained artisans from urban (29 artisans) and rural (43 artisans) areas participated in the evaluation. A mild steel product was fabricated by each participating artisan, assessed and scores awarded based on the quality of arc welding. The analysis of variance (ANOVA) was used to show any variation in the quality of arc welding; comparisons of means using the Least Significant Difference (LSD) at the alpha level of 5% were done to determine which pairs of artisans affected quality significantly. The study found out that informally trained artisans working in urban areas exhibited the highest quality of arc welding. The informally trained artisans working in rural areas exhibited the lowest quality of arc welding. The study found out that artisans from urban areas performed better than those from rural areas. Generally, formal training does not have a significant effect on urban artisans, but it does improve product quality of arc welding from rural artisans. The findings of the study provide evidence that formal training can improve product quality from artisans working in rural areas, and therefore more resources should be channeled to training of rural artisans.**

***Index Terms*— Mode of Training, Business location, product quality, MSE, metalworking sub-sector, arc welding.**

I. INTRODUCTION

The quality of products from the MSE sector is affected by both the entrepreneur's and enterprise's attributes. Many school leavers, retirees and retrenchees as well as those dissatisfied with formal wage employment resort to entrepreneurial activities within this sector as a means of earning a living. However, the Micro and Small Enterprise (MSE) sector entrepreneurs suffer various deficiencies in business management. These deficiencies are attributable to their low education levels and training, which in turn adversely affect their ability to produce high quality products among others. The influence of the entrepreneur's attributes such as age, gender, educational level, mode of training, work experience and membership to business support groups on the productivity and performance of enterprises has been reported. Similarly, enterprise attributes such as its age, location, ownership structure, and formal status and business activity determine production outcomes (Kimuyu, 2001).

This paper discusses the findings of a study that was designed to investigate experimentally the relationship between the quality of arc welding in the Small Scale Metalwork sub-sector and the combined effect of the artisan's mode of training and business location. The understanding and validation of this relationship is important for the effective marketing of the MSE products.

Appropriate business knowledge gained through various paths such as school, previous employment experience and networking influence the entrepreneurial process (Baucus and Human, 1994). According to this study, informed people are likely to take fewer steps and easily succeed in overcoming business obstacles than the less informed ones. Product quality and value are directly dependent on technical and business knowledge. The ability for a product to compete in an open market would therefore depend on the quality of labour utilized in its production, which in turn depends on knowledge and skill levels among other factors. There is a need to show how the mode of training affect product quality quantitatively.

Most of the MSE literature available is on financial support to the sector followed by education and training. However, there is no literature on performance in the sector and the interaction of mode of training and business location. Most of the previous studies obtained their data through the use of one or more of the following instruments: questionnaires, desk reviews, observations, interviews, focus group discussions, and content analysis. These studies were either qualitative or survey researches, while the present study was mainly experimental research (with a bit of qualitative using observation as far as the use of welding equipment and welding techniques are concerned to find out which groups – secondary/primary or formally trained/informally trained or urban based/rural/based - were proficient or understood the welding process).

In arc welding processes the most common defects are either surface defects (cracks, distortion, overlaps and rolls, undercuts, excessive spatter, and bad weld surface appearance) or subsurface (hidden) weld defects. These defects (Parmar, 1997) come as a result of:

Charles M.M. Ondieki: Associate Professor at Multimedia University of Kenya and Chairman of TVET CDACC

a) Improper selection of process, for example, using a very deep penetrating heat source on a narrow Vee angle so causing cracking in the root run due to large depth-to width ratio;
b) Applying the welding process incorrectly for the particular application, such as incorrect current setting or excess weld metal deposition;
c) The interaction of the weld metal with prior defects in the base metal, e.g. laminations and impurities like phosphorous, sulphur, and silicate, etc. that cause brittle and weak zones resulting in lamellar tearing;
d) Undesirable metallurgical structure with respect to grain size and hardness as well as undesirable inclusions such as tungsten oxide and slag. Hydrogen is a most undesirable inclusion as it is often the main cause of cold cracking in steels;
e) Undesirable shape and size of weld bead due to overfill and/or poor profile;
f) Incorrect joint preparations and poor fit-up leading to inaccessibility and lack of fusion, cracking, etc.;
g) Stray arcing, tool marks, undercuts, inclusions, poor finish, lack of fusion and penetration, and incorrect weld shape causing a reduction in fatigue life and joint strength;

All these are consequences of the level of education and training, experience and equipment used. For one to produce a quality product the sequence of welding techniques commonly used (Parmar, 1997), are:

(a) The preliminary operations like cleaning, edge preparation, and the fixing of tab-in and tab-out plates are accomplished;
(b) Parts are assembled by tack welding or by employing jigs and fixtures;
(c) The assembled work piece is presented to the machine or vice versa;
(d) Welding is initiated by striking the arc for fusion welding or by bringing electrodes in contact with the work and switching on the current for resistance welding;
(e) Relative movement between the welding head and the work to attain the desired welding speed is created;
(f) The welding variables like arc voltage, welding current, and wire feed rate is controlled - controlling the welding variables like arc voltage controls the arc length, welding current, and wire feed rate;
(g) Welding process is stopped by stopping the relative movement between the welding head and the work;
(h) The welding head is shifted to the position the next welding cycle is to be initiated;
(i) The completed work is removed.

1.1 Objective of the study

The objective of this study was to investigate the *Effect of the combination of Mode of training and Business location on product quality from artisans in the metalworking sub-sector*. The specific objectives were: To assess the relationship between the quality of arc welding and (a) Mode of training; (b) Business location; and (c) the combination of Mode of training and Business location.

1.2 Hypotheses

To achieve the objectives of this research study the following hypotheses were postulated:

a) The Effect of Mode of training on Product quality:
   i) There is no significant difference in product quality between all formally trained artisans and all informally trained artisans.

b) The Effect of Business location on Product quality:
   ii) There is no significant difference in product quality between all artisans working in urban areas and all artisans working in rural areas.

c) The Effect of the combination of Mode of training and Business location on product quality
   iii) There is no significant difference in product quality between all formally trained artisans working in urban areas and all informally trained artisans working in urban areas.
   iv) There is no significant difference in product quality between all formally trained artisans working in rural areas and all informally trained artisans working in rural areas.
   v) There is no significant difference in product quality between all formally trained artisans working in urban areas and all formally trained artisans working in rural areas.
   vi) There is no significant difference in product quality between all informally trained artisans working in urban areas and all informally trained artisans working in rural areas.

II. Methodology

Sampling: The target population of the study consisted of experienced formally and informally trained artisans who were based in urban areas and experienced formally and informally trained artisans who were based in rural areas. The Kenyan MSE sector engages about 8.33 million operators (Government of Kenya, 2010). Out of this the *Jua Kali* sector (the MSEs that are engaged in technical work) is about 18% according to the National MSE baseline Survey conducted in 1999. The most widely used welding method is an arc welding for mild steel products, and according to the survey the number of artisans engaged in welding and fabrication is about 37,485 (Government of Kenya, 1999). About 60% and 40% of this number comprise primary education class eight graduates and secondary education form four graduates respectively (Government of Kenya, 2004). Based on these figures the total population for primary class eight artisans was taken to be 22,491 and for the secondary form four were taken to be 14,994. A total of 36 artisans with primary education class eight and a total of 36 artisans with secondary education form four were selected for assessment. The sample size determination was based on the relation:

$$n = \frac{Nc^2}{c^2 + (N-1)e^2}; \text{where } n = \text{sample size, and } N = \text{population size, } c = \text{coefficient of variation, } (\leq 30\%), \text{and } e = \text{error of margin, } (\leq 5\%).$$

This formula enabled the researcher to minimize the error and enhance stability of the estimates (Nassiuma, 2000). In this study c was taken to be 30% and e to be 5% (using the maximum percentage in each case). Table 1 show the number and category of artisans who participated in this study. The National Industrial Training Authority (NITA) (formally

DIT) testing centers were used for this research. This was meant to minimize the effect on the quality of the fabricated products due to the condition of the welding equipment; (the welding equipment used in all NITA testing centers are more else of the same working condition).

Table 1: Number and category of participating artisans

Mode of Training	Business Location		Total
	Artisans in Urban areas	Artisans in Rural areas	
Formally Trained	11	24	35
Informally Trained	18	19	37
Total	**29**	**43**	**72**

Source: Author (2012)

The selected NITA testing centers were those with high concentrations of welders, and easily accessible by the researchers. A total of ten (10) NITA testing centers were used as shown in Table 2. Work started at the same time in all testing centers. Research assistants (who had been selected from among the NITA trained examiners) were used to supervise the participating artisans.

Table 2: DIT Testing Centers and Number of Participating Artisans

NITA Centre (Region)	Mode of Training	Business Location		Total
		Urban	Rural	
1. NIVTC (Nairobi)	Formal	4	0	4
	Informal	5	1	6
2. Ruaraka (Nairobi)	Formal	2	0	2
	Informal	2	0	2
3. Kakamega (Western)	Formal	0	2	2
	Informal	0	1	1
4. Turbo (Western)	Formal	0	15	15
	Informal	0	1	1
5. Kiambu (Central)	Formal	0	2	2
	Informal	0	3	3
6. Machakos (Eastern)	Formal	0	3	3
	Informal	0	9	9
7.Mombasa (Coast)	Formal	1	0	1
	Informal	7	1	8
8. Eldoret (Rift Valley)	Formal	0	0	0
	Informal	1	0	1
9. Nakuru (Rift Valley)	Formal	1	1	2
	Informal	0	1	1
10.Kisumu (Nyanza)	Formal	3	1	4
	Informal	3	2	5
Total		**29**	**43**	**72**
Formally Trained Artisans = 35			**Informally Trained Artisans = 37**	

Source: Author (2012)

The participating artisans were categorized into eight groups or strata as follows:

(a) Four strata (designated by G1 – G4) with secondary education Form IV:
  (i) Formally trained artisans in urban areas (G1),
  (ii) Formally trained artisans in rural areas G2),
  (iii) Informally trained (Trained-on-the-job) artisans in urban areas (G3),
  (iv) Informally trained (Trained-on-the-job) artisans in rural areas (G4),

(b) Four strata (designated by G5 – G8) with primary education standard VIII:
  (i) Formally trained artisans in urban areas (G5),
  (ii) Formally trained artisans in rural areas (G6),
  (iii) Informally trained (Trained-on-the-job) artisans in urban areas (G7),
  (iv) Informally trained (Trained-on-the-job) artisans in rural areas (G8),

Table 3: The Eight Groups of Participating Artisans

Education Level	Urban Location (29)		Rural Location (43)		TOTAL
	Formally Trained	Informally Trained	Formally Trained	Informally Trained	
Secondary	Group 1 (5)	Group 3(10)	Group 2(14)	Group 4(7)	**36**
Primary	Group 5 (6)	Group 7(8)	Group 6(10)	Group 8(12)	**36**
TOTAL	**11**	**18**	**24**	**19**	**72**

Number of artisans per group is given in the brackets

Table 4: Mean Scores and Standard Deviations of Combined Groups of Artisans

Combined Group	Primary Groups	No. of Artisans	Mean Score	Standard Deviation
G15 (F/U)	Group 1 G1) and Group 5 (G5)	11	67.55	5.18
G37 (I/U)	Group 3(G3) and Group 7 (G7)	18	72.03	6.15
G26 (F/R)	Group 2 G2) and Group 6 (G6)	24	65.90	12.62
G48 (I/R)	Group 4 G4) and Group 8 (G8)	19	56.11	15.70

***F/U** – Formal Urban; F/**R** – Formal Rural; I/**U** – Informal Urban; I/**R** – Informal Rural*

2.1 The Evaluation of the Variables of the Study

The independent variables of the study were the artisan's attribute (mode of training) and the business characteristics (business location), while the dependent variable was the scores awarded to indicate the quality of the product fabricated by the artisan by using arc welding processes.

2.2 Evaluation of the Effect of Mode of Training

The effect of mode of training was evaluated by comparing the mean scores of the following attributes:

a) All formally trained artisans and all informally trained artisans (G**F/I**).

2.3 Evaluation of the Effect of Business Location

The effect of business location was evaluated by comparing the mean scores of the following attributes:

a) All artisans working in urban areas and all artisans working in rural areas (G**U/R**).

2.4 Evaluation of the Effect of the combination of Mode of training and Business location

The effect of the combination of Mode of training and Business location was evaluated by comparing the mean scores of the following attributes:

a) All formally trained artisans working in urban areas and all informally trained artisans working in urban areas (G15/37) i.e., business location is constant.
b) All formally trained artisans working in rural areas and all informally trained artisans working in rural areas (G26/48) i.e., business location is constant.
c) All formally trained artisans working in urban areas and all formally trained artisans working in rural areas (G15/26) i.e., mode of training is constant.
d) All informally trained artisans working in urban areas and all informally trained artisans working in rural areas (G37/48) i.e., mode of training is constant.

2.5 Data Generation Tools

Two instruments were used to collect the required data. These were: i) Structured questionnaires, and ii) Assessment of fabricated product. The questionnaire was used mainly to get information regarding the artisan's attributes and business characteristics. The participating artisans were generally observed to find out how proficient they were in using the welding equipment and methods/techniques as outlined in the introduction.

2.6 Assessment of Product Design

The product shown in figures 1 was drawn and used as the welding project in the research study. The welding project was marked out 100%. The product was designed in such a way that most of the welding techniques were to be used in fabricating it. In this study, manual welding was employed; the artisans were given materials in the form of sheets and they were supposed to measure and cut the parts to the sizes shown. The parts were joined together using arc welding processes. The assessment was carried out by checking for the correct part sizes (by using Vernier calipers), and examining for the correct part alignment, correct welding and product finish; visual inspection was used to detect surface defects. Careful visual inspection of welds can detect about 80% to 90% of the defects and flaws (Parmar, 1997). The quality of welded joints depends upon the design of the product, the performance of welding equipment, the welding procedures followed, and the skill of the operator. In this study any deficiency in the design and equipment affected all artisans equally. Therefore, the skill of the welder was to determine the scores obtained.

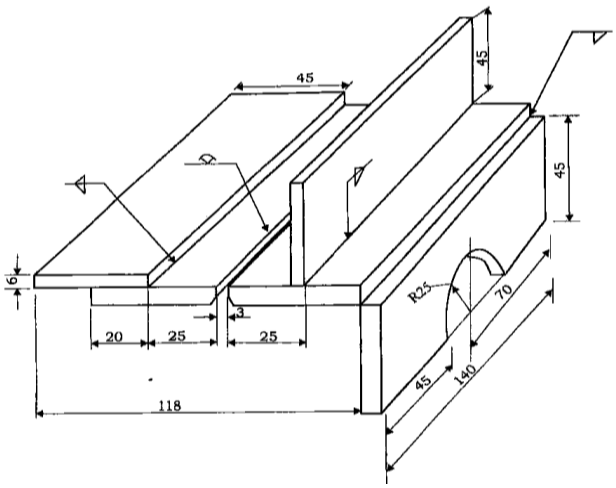

Figure 1. Mild steel welding project

2.7 Data Analysis

2.7.1 Data Analysis with the Use of SAS and ANOVA

There were eight groups of data of participating artisans collected during the study; standard deviations for each group of artisans were calculated. The data (scores) collected were analyzed using the Statistical Analysis System (SAS) and Excel spreadsheet. The means and standard deviations were generated to describe the quality of arc welding with regard to education level and mode of training. The scores were matched with the artisans' attributes to find their relationships.

Since we were dealing with many factors that are influencing the experimental units, that is, the product quality from artisans, the ANOVA result was further analyzed using factorial analysis so as to find the factor with more influence on the artisans. This would enable one to test simultaneously the effects on the quality of arc welding of two different factors such as education level and mode of training.

The analysis of variance (ANOVA) was also used to show any variation in the quality of arc welding in each of the eight groups of participants/artisans due to the different treatments (e.g. modes of training and business location). Comparisons of all possible pairs of means using the alternative Least Significant Difference (LSD) method (this method is more appropriate to test unbalanced designs according to Webster, 1995, p.560) with alpha set at 5% were done to determine which pairs of artisans engendered quality performances that were significantly different. Besides the analysis of variance results, differences in means of pairs of different primary groups and combined groups (i.e. Combination of various primary groups) was also analyzed using the alternative LSD method.

2.7.2 Data Analysis with the Use of STATA Software

Multicollinearity and heteroscedasticity were tested by the use of STATA software. Since the independent variables were categorical, a logistic model was derived and estimated using Ordinary Least Squares (OLS) through STATA software.

Multicollinearity refers to the extent to which an independent variable can be explained by other independent variables in the analysis and if too high this can have harmful effects on multiple regressions. Heteroscedasticity is a violation of one of the classical linear regression model assumptions that requires that the disturbances have the same variance. It is caused by several factors including the presence of outliers in the data, omitted variables, incorrect functional forms, and it is much more present in cross-sectional data.

2.7.3 Data Analysis with the Use of SAS and ANOVA

The data scores collected were analyzed using the Statistical Analysis System (SAS) and excel spreadsheet. The means and standard deviations were generated to describe the quality of arc welding with regard to the mode of training and business location. The scores were matched with the artisans' attributes and business characteristics to find their relationships. The analysis of variance (ANOVA) was used to show any variation in the quality of arc welding in each of the eight groups of artisans due to the different treatments, that is, mode of training and business location. Comparisons of all possible pairs of means using the Least Significant Difference (LSD) method with alpha set at 5% were done to determine which

pairs of artisans with quality performances that was significantly different. The participating artisans totaling 35 formally trained and 37 informally trained were further sub-divided into two groups of 29 artisans based in the urban areas and 43 artisans based in the rural areas. The artisans' scores awarded for quality of arc welding provided the data for determining the impact of education level and mode of training on product quality.

III. Results and Discussion

3.1 Effect of the Independent Variables on Product Quality

The results of the investigation into the impact of the independent variables on product quality are presented in this section. The results of the investigation into the impact of the mode of training on product quality from artisans are presented first. The impacts of business locations on product quality from the artisans are presented in the second sub-section. In each sub-section the results are presented in a table. The table shows mean scores of product quality from combined groups of artisans for a particular attribute. Each column in this table contains pairs of artisans with a combination of attributes except one attribute which is common; here it is only one attribute being compared with, say mode of training while the other (business location) is assumed to have negligible effect on product quality. For example, in section one where the impact of mode of training is being investigated, all the two groups, in say column one, have business location as common and, which is being compared with mode of training.

3.2 Effect of mode of training on product quality

In terms of mode of training, the artisans could broadly be divided into two: formally trained artisans and informally trained artisans. A total of 35 participants/artisans who were formally trained were selected, while a total of 37 participants/artisans who were informally trained were selected for evaluation in this study. The artisans' scores awarded for quality of arc welding provided the data for determining the effects or impact of mode of training on product quality.

The first specific objective was to find out whether there is any relationship between product quality (quality of arc welding) and mode of training. The analysis of variance was carried out and the results are presented in Table 5. The table shows mean scores of product quality for modes of training from artisans.

Table 5: Mean scores of product quality for modes of training from artisans with the two combined attributes (i.e., mode of training and business location)

Modes of Training	Business Location		Overall Mean
	Urban	Rural	
Formal	G16: 67.55[a]	G27: 65.90[b]	**GF: 66.41[a]**
Informal	G38: 72.03[a]	G49: 56.11[c]	**GI: 63.85[a]**

The means followed by the same letter in the same column are not significantly different at $\alpha = 5\%$ using LSD.
Source: Author (2012)

Table 5 shows that there are no significant differences in the mean scores in the urban column and the overall mean column, but there a significant difference in the mean scores in the rural column. This means that the performance of both formally and informally trained artisans working in urban areas does not significantly differ. The implication is that the mode of training does not have a significant impact on product quality when products are produced (using arc welding) by artisans working in urban areas. However, there is a significant difference in the mean scores in the rural column. This implies that the mode of training has significant impact on product quality when products are produced (using arc welding) by artisans working in rural areas. Overall, as the last column shows, there is no significant difference in mean scores between the formal training and the informal training; however, the formally trained artisans mean score is slightly better than that from artisans with informal training.

These results are consistent with the findings of Mullei (2003). In his study on small manufacturing firms Mullei (2003) sought to identify factors that determine firm growth and transformation among small firms in Kenya. His study covered food processing, woodworking, textile and garments, and metal working sub-sectors. The study found out that for an enterprise to graduate from, say micro to small enterprise, the education of the manager/owner and the sector to which the enterprise belonged to, had a significant influence on enterprise graduation. Education was found to have a marginal effect on graduation, probably indicating the importance of vocational training skills (formal training), which are lacking among many small producers.

Mullei (2003) also found out that more than half of small producers were primary school graduates whose ability to assimilate new technologies, innovate and imitate perfectly is limited. The study, therefore, recommends the raising of managerial, vocational and technical skills of small entrepreneurs for long-term industrial development. This shows the importance of higher level of education and formal training.

In his study Haan (2001) reported that a tracer study of the World Bank Training Voucher Scheme (MSETTP) had found out the mean sales of MSEs who did not participate in the training decreased by 2% while the mean sales of the MSEs who participated in the training voucher scheme more than doubled: from KSh. 8,342 to KSh. 18,235 per month. The beneficiaries of the scheme performed better than the control group on almost all variables studied such as assets, volume of sales, and diversification of products, business creation, and employment creation. This is an indication that organized training significantly improves the performance of the MSEs. Most of the survey results suggest a relationship between the possession of vocational training certificates and income, but weaker than in the case of education (Haan, 2001).

From these analyses it can be concluded that formal training has very little impact on artisans working in urban areas, but it has a significant impact on artisans working in rural areas. The formal training improves product quality from artisans working in the rural areas. The urban artisans perform better than the rural artisans because they have more exposure and more information, have more work and therefore more

experience, more competition, use standard tools similar to those used at NITA centres, better methods of working, more contact with more experienced artisans etc.

From the results generated using analysis of variance (ANOVA) and alternative LSD tests with mean scores for product quality from artisans presented in tables 5, and as discussed above, it can be concluded that:

i) *the first hypothesis*: The null hypothesis that there is no significant difference in product quality between all formally trained artisans and all informally trained artisans is accepted.

3.3 Effect of business location on product quality

In terms of business location, the artisans could broadly be divided into two: those artisans who were based in the urban areas and those artisans who were based in the rural areas. A total of 29 participants/artisans who were based in the urban areas were selected, while a total of 43 participants/artisans who were based in the rural areas were selected for evaluation in this study. The artisans' scores awarded for quality of arc welding provided the data for determining the effects or impact of business location on product quality.

The second specific objective was to find out whether there is any relationship between product quality (quality of arc welding) and business location. The analysis of variance was carried out and the results are presented in Table 6. The table shows mean scores of product quality for business locations from artisans.

Table 6: Mean scores of product quality for business locations from artisans with the two combined attributes (i.e., mode of training and business location)

Business Location	Mode of Training		Overall Mean Scores
	Formally Trained	Informally Trained	
Urban	G15: 67.55[b]	G37: 72.03[a]	**GU: 70.33[a]**
Rural	G26: 65.90[b]	G48: 56.11[c]	**GR: 61.57[b]**

The means followed by the same letter in the same column are not significantly different at $\alpha = 5\%$ using LSD

Source: Author (2012)

The mean score (the lowest mean score) for the informally trained artisans working in rural areas is significantly different from the other mean scores. The majority in this group are of primary education class eight artisans (12 out of 19 artisans). It is evident from Tables 6 that the informally trained artisans working in urban areas perform better than their counterparts who are formally trained.

However, it was expected that the formally trained could perform better than those informally trained since they are all working in the same urban areas. From the questionnaires it was found out that more than 60% of the formally trained artisans (both secondary and primary graduates) working in urban areas planned to look for formal employment, while less than 20% of those artisans trained-on-the-job (both secondary and primary graduates) working in urban areas planned to look for formal employment. In the case of those in rural areas the result was different; less than 25% of the formally trained artisans and less than 10% those trained-on-the-job planned to look for formal employment. This means that the formally trained artisans in urban areas are not contented with their self-employment and therefore do not concentrate on their work as much as those without formal training do. This therefore could probably explain why the informally trained artisans in urban areas perform better than the formally trained artisans. The formally trained artisans can easily get formal employment because they hold certificates, while those trained-on-the-jobs find it difficult to be employed in the formal sector without certificates. On the other hand, those in the rural have very little opportunity for formal employment as most formal employment is found in urban areas, hence even those formally trained artisans concentrate on their jobs as much as those without formal training do.

From this analysis it can be concluded that the urban artisans perform better than the rural artisans because they have more exposure and more information, have more work and therefore more experience, more competition, better equipment and tools, better methods of working, and more contact with more experienced artisans.

From the results generated using analysis of variance (ANOVA) and alternative LSD tests with mean scores for product quality from artisans presented in Table 6, and as discussed above, it can be concluded that:

i) *the second hypothesis:* The null hypothesis that there is no significant difference in product quality between all artisans working in urban areas and all artisans working in rural areas is rejected.

3.4 Effect of the combination of Mode of training and Business location

The third specific objective was to find out whether there is any relationship between product quality (quality of arc welding) and the combination of Mode of training and Business location. The analysis of variance was carried out and the results are presented in Tables 5 and 6, which are used to evaluate the effect of the combination of Mode of training and Business location. The tables show mean scores of product quality for the combination of Mode of training and Business location from artisans.

From the results generated using analysis of variance (ANOVA) and alternative LSD tests with mean scores for product quality from artisans presented in tables 5, and as discussed in section 3.2 above, it can be concluded that:

i) *the third hypothesis*: The null hypothesis that there is no significant difference in product quality between all formally trained artisans working in urban areas and all informally trained artisans working in urban areas is accepted.

ii) *the fourth hypothesis*: The null hypothesis that there is no significant difference in product quality between all formally trained artisans working in rural areas and all informally trained artisans working in rural areas is rejected.

From the results generated using analysis of variance (ANOVA) and alternative LSD tests with mean scores for product quality from artisans presented in Table 6, and as discussed in section 3.3 above, it can be concluded that:

i) *the fifth hypothesis:* The null hypothesis that there is no significant difference in product quality between all formally trained artisans working in urban areas and all formally trained artisans working in rural areas is accepted.

ii) *the sixth hypothesis:* The null hypothesis that there is no significant difference in product quality between all informally trained artisans working in urban areas and all informally trained artisans working in rural areas is rejected.

IV. Conclusions and Recommendations

4.1 Conclusions

The following are the conclusions drawn from this study:

(a) The quality of arc welding from artisans with formal training was slightly higher than the quality of arc welding from artisans without formal training (i.e. Trained-on-the-job).

(b) The quality of arc welding from artisans working in the urban areas is higher than the quality of arc welding from artisans working in rural areas.

(c) Although formal training is extremely important for those artisans working in the rural areas, it does not, however, make any significant difference to those working in urban areas.

(d) The product quality from groups of informally trained artisans and based in the rural areas has been rated the poorest, while ttheir counterparts who also work in the rural areas, but formally trained, performed better.

(e) The highest quality of product quality came from artisans based in urban areas.

(f) The informally trained artisans working in urban areas emerged with the overall best workmanship. This shows clearly that formal training is extremely important only for those artisans working in the rural areas.

(g) Overall, the null hypothesis that there is no significant difference in product quality between formally trained artisans and informally trained artisans is accepted as evidenced from the last columns of table 5 of mean scores. This implies that training alone does not have a significant impact on product quality.

(h) Overall, the null hypothesis that there is no significant difference in product quality between artisans working in urban areas and artisans working in rural areas are rejected as evidenced from the last column of table 6 of mean scores. This implies that business location alone has significant impact on product quality.

4.2 Recommendations

More resources should be channeled to train artisans in the rural areas, and less resources to train urban artisans.

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