Vocametric Analysis of the Efficiency of Workers in Sawmill Industries for Optimum Production

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Abstract
Sawmill industries are the integral part of wood processing industries which include conversion of logs into timbers of suitable sizes for construction of furniture and other items. These activities are carried out without any kind of policy backing them for such purposes. Vocametric analysis help to determine the number of products produce daily in sawmill industries. The study was therefore designed to find the effect of vocametric analysis on the efficiency of workers in sawmill industries in Ekiti State. The study adopted observational design. The population consisted of all saw mill industries in Ekiti State. The sample consisted of 30 wood machine operators. Multistage sampling technique was used to select the sample. The criterion validity was used to ensure the validity of the instrument. The simple regression model was used to analyze the data for the study. The findings indicated that there was no significant difference between the estimated parameters ($\hat{b}_o$ and $\hat{b}_i$) and true parameters (b_o and b_1) on converted logs into timbers and the smoothing operations using circular saw and surface planer in saw mill industries. It was also revealed that there was no significant difference between the estimated parameters ($\hat{b}_o$ and $\hat{b}_i$) and true parameters (b_o and b_1) on the production of chairs using different types of machines in saw mill industries. Based on the findings of the study, it was recommended that researchers and experts in woodwork technology should endeavour to use vocametric analysis in determining the quantity of timbers converted on daily basis in sawmill industries.

Keywords: Vocametrics, Efficiency, Workers, Smoothing operations, Sawmill Industries

Introduction

Vocametrics is concerned with the theory and techniques of vocational measurement. It deals with the measurement of skills and knowledge in any respective occupations such as Woodwork technology, Building technology, Automobile technology and Agricultural education technology. Vocational educators at higher level are trained in Vocametrics while undergraduate are trained in preface to vocametrics such as probability, descriptive and inferential statistics. Elementary knowledge of mathematics and statistics is required in studying vocametrics. The understanding of vocametrics depends on the knowledge acquired in mathematics, statistics and metrics. Vocametrics refers to the integration of mathematics, statistical techniques and theories in vocations for explaining the relationships between variables, testing hypotheses and forecasting any vocational phenomena (Olaitan & Ndomi, 2000). Accordingly, vocametrics refers to the integration of vocational theory, mathematics and statistical techniques for the

purpose of testing hypotheses about occupational phenomena, estimating coefficients of relationship and predicting future values of variables in vocations.

Vocametrics can also be defined as the use of vocational theory , statistics , mathematics and computer skills for the purpose of analyzing data in order to predict any vocational phenomena . The use of computer cannot be over emphasised in vocametrics because it stores and processes data into output for predicting vocational phenomena. Vocametrics involves two major types of research tasks. These include theoretical Vocametrics and applied vocametrics. Those who practice vocametrics are called vocametricians. Vocametrics is a function of mathematics, statistics, vocational theories and computer skills for testing and forecasting any vocational phenomena. Vocametrics may use standard statistical models such as linear and multiple regressions to study vocametric problems, but most often they are with observational data, rather than in controlled experiments

In this, the design of observational studies in vocametrics is similar to the design of studies in other observational disciplines, such as Biology, Economics, sociology and political science. Analysis of data from an observational study is guided by the study protocol, although exploratory data analysis may be useful for generating new hypotheses. Hornby in Ede (2001) defined analysis as the process of resolving or breaking up any problem or situation with its components, elements or parts. The component parts of vocametrics include Building Technology, Woodwork Technology, Electrical Technology, Electronic Technology, Auto-mechanic Technology, Metalwork Technology, Business Education, Agricultural Education, Home Economics Education and Computer Education. At technical college level, woodwork trades are broken into Upholstery, Wood Machining, Furniture Making, Carpentry and joinery. (FGN, 2014)

Therefore, vocametric analysis is a procedure of breaking down all the components of vocametrics to determine the teachable contents in terms of operation, tools, processes and technical information to be organized into course of study and arranged in a sequence of difficulty. Consequently, the field of vocametrics has developed methods for identification and estimation of simultaneous-equation models. These methods are analogous to methods used in other areas of science, such as the field of system identification in systems analysis and control theory. Such methods may allow researchers to estimate models and investigate their empirical consequences, without directly manipulating the system.

One of the fundamental statistical methods used by vocametricians is regression analysis. Regression methods are important in vocametrics because vocametricians typically cannot use controlled experiments. All vocametricians should possess advanced training in vocametric testing. Vocametric theory refers to the measurement of variables. The variables could be quantitative and qualitative. Measurement of qualitative is difficult in such that some measures should be adopted to quantify such phenomenon. Vocametrics is quantitative. It deals with figures in all the vocational

areas. It can also be qualitative in nature by assigning numbers to variables in vocation for the purpose of prediction using correlation and regression analysis. Metrics is a parameter used in measurement. Metrics can be used to determine the performance of workers, products and customer satisfaction in industries.

Performance of workers in sawmill industries depends on the efficiency of carrying out various operations. Sawmill industries are primary wood industries that involve the production of logs and related products into timber, veneer and other related products like ice- cream sticks(Irland & Murdoch,1992). Operations on various types of machines can be achieved if industries follow the best methods of application of technology commonly referred as technical efficiency. These operations are basic and each of them can be learned if not together, mastered with practice and experience (Ibeneme in Olaoye & Ogunmilade, 2014). It is necessary to convert logs into timbers of suitable sizes as soon as they get to sawmill industries in order to avoid shrinkage. Many activities are carried out in saw mill industries .These include construction of furniture items and planing both surface sides and surface edges of pieces of wood. The efficiency with which hardwood sawmills convert logs to timber has become increasingly important. Safety precautions should be taken into consideration to avoid hazards in saw mill industries .These hazards include point of operation and kick back hazards. Point of operation hazards occur when the hands of the operator moves close to the blade particularly when working on small piece of wood. To avoid hazards, safety should be a paramount importance to the workers in industries. Safety is an attempt to avoid hazards (Ede, 2001).Sawmill industries in Ekiti State, Nigeria engage in conversion of logs which come from the following trees- Iroko, Mansonia, Mahogany, Obeche, Ebony and Iron wood. An iron wood is very hard and difficult to convert. Saw millers are experiencing problems of the availability of hardwood logs and standing wood (Michael, Steven, Philip & Philip, 1992).In a situation where the woods are available, workers are still confronting some problems in sawmill industries. These depend on the technical capabilities possessed by the workers, scale of operations and identification of technological advancement needed to process the available materials in wood processing industries (Olaoye, 2016). Workers encounter the following problems in industries. These include pressure to meet production target, failure to learn lessons from previous incident, communication issues between shifts, excessive working hours resulting in mental fatigue , updates to equipment without operator's knowledge and inadequate safety management systems, (Juliet and Nicholas, 2006). Managers in wood based industries such as sawmills need to care about the hazardous working conditions, health and safety of their workers. Technology has changed sawmill operations using horizontal band saw to convert logs into timbers of different sizes and surface planer to plane the pieces to the required thickness.

Many operations are carried out in various sawmill industries. These include ripping, cross cutting, mitring, mortising, conversion of logs into timbers of suitable sizes, construction of furniture items, planing both surface sides and edges of the pieces of

wood. Choosing the right machines can depend on the operations that are carried out on the machines. The different operations performed in wood working can be summarized as follows: marking and laying out, sawing, planing, mortising, tenoning, boring, moulding, grooving and tonguing, rebating and recessing (Ragbuwanshi, 2008). Workers engage in these activities for effective production of timber products. Some workers produce small quantity of products while others produce large quantity of products daily. It appears that some workers are very lazy in carrying out their activities to meet the production target because no appropriate policy for wood based industries on the production of timber and wood products. It is very difficult to determine the number of products to produce daily.

It is therefore, appropriate to project for workers in various sawmill industries using vocametric analysis to determine the number of products to produce daily. With the help of vocametric analysis, workers could determine the number of products to produce daily in saw mill industries. This could improve the production in sawmill industries and enable workers perform their functions effectively.

The main purpose of the study was to find the effect of vocametric analysis on the efficiency of workers in sawmill industries. Specifically, the study sought to:

1 *Determine the extent to which conversion of logs using sawing machines enhance the production of timbers*

2 *Examine the level of smoothing operations using surface planers*

3 *Determine the extent to which the use of machines by workers in sawmill industries enhance the production of chairs.*

The following research questions guided the study

1. *To what extent is the conversion of logs into timbers using horizontal band saw machines enhance the production of timbers in saw mill industries?*

2. *What is the level of smoothing operations using surface planer* in saw mill industries*?*

3. *What is the level in which the use of* different types of *machines by workers in sawmills industries enhances the production of chairs?*

Three null hypotheses were tested 0.05 level of significance.

1 There is no significant difference between the estimated parameters and true parameters on the conversion of logs into timbers using horizontal band saw machine in saw mill industries (the true parameters are traditionally considered to be zero)

2 There is no significant difference between the estimated parameters and true parameters on the smoothing operations using surface planer in saw mill industries. (true parameters are traditionally considered to be zero).

3 There is no significant difference between the estimated parameters and true parameters on the production of chairs using different types of machines in saw mill industries. (true parameters are traditionally considered to be zero).

Methodology

The study adopted observational design. In observational research, an attempt is made to observe a phenomenon. It must be noted that observational research method may be used to collect data in non descriptive studies. (Ofo, 1994). For example, in experimental study where the conditions for determining the efficiency of workers in sawmill industries are necessary.

A systematic observation was carried out by the researcher to find out the number of pieces of timbers converted on circular sawing machines for a period of ten days, the number of pieces of timbers smoothed on surface planer and production of chairs using different types of machines in sawmill industries. The researcher also observed the machine operators and collected the data for the specified period. This was done by stating the numbers of timbers converted using circular sawing machines and production of chairs per day in order to realize the specific objectives of the study. Basavanthappa in Oluwatayo and Ibitayo (2017) described observational technique as a basic and one of the oldest research methods to gather data where the observer is not merely looking at what is happening but rather is watching with a trained eye for certain specific events.

The population consisted of all the wood machine operators in saw mill industries in Ekiti State. The sample consisted of 30 wood machine operators. Multistage sampling technique was used to select the sample. The first stage involved the use of random sampling technique to select one local government from each senatorial district of Ekiti State, Nigeria. Stage two was done with the adoption of purposive sampling technique to select one saw mill industry from each local government and at third stage, simple random sampling technique was used to select 10 workers. The sample was 30 wood machine operators. The instrument used was observational technique. Observation can be used to collect data when there is need to see and describe human behaviour naturally, watch people, events or situations to see the trends, trends of behaviours are to be compared and reported, study calls for situational report (Uzoagulu, 2011).

The criterion validity was used to ensure the validity of the instrument. This reliability was used because it was based on standard that is ability of the workers to construct chairs and to convert logs into timbers of suitable sizes. The simple regression model was used to analyse the data used for the study. The dependent variable here refers to wood planed, production of chairs and conversion of logs while the wood operators using the machines refer to independent variable.

The explicit form of the model becomes:
$Y = b_o + b_1X + ...+ U$
Where
Y= Wood planed, production of chairs and conversion of logs
b_o and b_1 = True parameters
X= Wood Operators using Machines
U = Stochastic disturbance/Error term.

Results

Hypothesis 1

There is no significant difference between the estimated parameters and true parameters on the conversion of logs into timbers using circular saw machines in saw mill industries (the true parameters are traditionally considered to be zero).

Table 1: True and Estimated Parameters of Converted Logs into Timbers using Circular Saw

Machines in Sawmill Industries

Items	**Parameter**	**Standard Error**	**Df**	**t-cal**	**t-tab**	**Decision**
True Parameters	31.0352	50.148	8	0.6188	2.306	N/S
Estimated Parameters	7.634	6.70145		1.1391		

$\hat{b}_o$ and $\hat{b}_i$ = Estimated parameters
bo and bi = True parameters
S_{bo}= True Variance= Standard Error= 50.148
S_{bi}= True Variance = Standard Error= 6.70145
N=10, df=10-2 = 8

The t-test for true parameter was 0.6188 while the t-test for estimated parameter was 1.1391. The table value of t at 0.05 level of significance with df= 8 was 2.306. Both t_0 and t_1 were less than the t value of 2.306.The hypothesis was accepted. This implies that there was no significant difference between the estimated parameters (($\hat{b}_o$ and $\hat{b}_i$)) and true parameters (b_o and b_1) on the conversion of logs into timbers using circular saw machines

Hypothesis 2

There is no significant difference between the estimated parameters and true parameters on the smoothing operations using surface planer in saw mill industries.(true parameters are traditionally considered to be zero).

Table 2: True and Estimated Parameters of Smoothing Operations using Surface Planer

in Sawmill Industries

Item	Parameter	Standard Error	Df	t-cal	t-tab	Decision
True Parameters	27.12	1.9793	8	13.7018	2.306	S
Estimated Parameters	1.66	0.1013		16.3869		

$\hat{b}_o$ and $\hat{b}_i$ = Estimated parameters
b_o and b_i = True parameters
S_{bo}= True Variance= Standard Error= 1.9793
S_{bi}= True Variance = Standard Error= 0.1013
N=10, df =10-2 = 8

The table value of t at 0.05 level of significance with df= 8 was 2.3060.Both t_o and t_1 are bigger than the table value of 2.3060. The hypothesis was rejected. This implies that there is significant difference between the estimated parameters ($\hat{b}_o$ and $\hat{b}_i$) and true parameters (b_o and b_1) on the chairs produced using machines by workers in saw mill industries. (true parameters are traditionally considered to be zero)

Hypothesis 3
There is no significant difference between the estimated parameters and true parameters on the production of chairs using machines in saw mill industries.(true parameters are traditionally considered to be zero).

Table 3: True and Estimated Parameters on Production of Chairs in Sawmill Industries

Item	Parameter	Standard Error	Df	t-cal	t-tab	Decision
True Parameters	2.82	2.452	8	1.15	2.306	N/S
Estimated Parameters	0.054	0.2696		0.20		

$\hat{b}_o$ and $\hat{b}_i$ = Estimated parameters
b_o and b_i = True parameters
S_{bo}= True Variance= Standard Error= 2.452
S_{bi}= True Variance = Standard Error= 0.2696
N=10, df=10-2 = 8

The table value of t at 0.05 level of significance with df= 8 was 2.3060.Both t_o and t_1 are smaller than the table value of 2.3060. The hypothesis was accepted. This implies that there is no significant difference between the estimated parameters ($\hat{b}_o$ and $\hat{b}_i$) and true parameters (b_o and b_1) on the production of chairs using machines in saw mill industries

Discussion of Findings

The findings from Table 1 indicated that there was no significant difference between the estimated parameters ($\hat{b}_o$ and $\hat{b}_i$) and true parameters (b_o and b_1) on the conversion of logs into timbers using circular Saw machines in saw mill industries .This is in line with the finding of Wade, Bullard, Steele and Araman (1992) who stated that the level of technology in hardwood sawmills may be best determined by the conversion efficiency of raw materials to timbers. Therefore, better information on current hardwood sawmill conversion efficiency and the factors that influence it should aid in developing more accurate estimates of future improvement in technology on timber resources. The logs can be converted for commercial or private use. The methods of converting logs vary, according to the class of timber, the quality and sizes of logs and market requirements. Kerf which is cut made by saw could influence the sawing accuracy of the machine during sawing process. The forecasting power of vocametrics was tested using t-test distribution. This implied that the model was good.

The findings in Table 2 indicated that there was significant difference between the estimated parameters ($\hat{b}_o$ and $\hat{b}_i$) and true parameters (b_o and b_1) on the smoothing operations using surface planer in saw mill industries. The findings indicated that machine operators in saw mill industries had different opinion on the smoothing operations using surface planer in saw mill industries. Significant difference occurred due to exposure of machine operators to wood dust emanating from wood processing activities and interlocking grains during planing operations in various sawmill industries. Workers in wood processing industries such as sawmills are at the risk of developing cancer and lung diseases due to their exposure to wood dust and other substances emanating from wood processing activities (Olaoye, 2013). The degree at which pieces of timbers are planed depends on their texture, green and seasoned characteristics. The model was poor. Olaitan and Ndomi (2000) indicated that possible remedies to model with poor forecasting power include:

Introducing newly observed relevant independent variable(s) in the model which will cushion the effects of its/ their non-inclusion on the random disturbance, hence improving the prediction power of the model. For example, In table 1

Y_F= 31.0352 + 7.364 X_1.

i. Introducing appropriate dummy variables in the model to remediate its poor forecasting power.

ii. Increasing the sample size and re-compute the structural parameters of the model. A larger sample may possess more traits of the population.

iii. Splitting any independent variable into two or more independent variables if possible and desirable .For instance, in an equation where water is a function of crop yield of a farm in a rainy season, the variable X(water) can be categorized into amount for water from natural precipitation(X_1) and that from supplementary irrigation($X_{2)}$, Similarly, cow feed(X) can be divided into concentrate(X_1) and grass(X_2).

iv. Introducing two or more equations where a two-way causation is observed to have characteristics of simultaneous equations model. Obviously, when X is a function of Y and Y is a function of X at the same time a single equation model of Y= f(X) cannot be a good predictor of the dependent variable(Y).

The findings in Table 3 indicated that there was no significant difference between the estimated parameters ($\hat{b}_o$ and $\hat{b}_i$) and true parameters (b_o and b_1) on the production of chairs using machines in saw mill industries.

Conclusions

It was concluded from the findings of the study that there was no significant difference between the estimated parameters (($\hat{b}_o$ and $\hat{b}_i$)) and true parameters (b_o and b_1) on the conversion of logs into timbers using circular saw machines. The findings also indicated that there was significant difference between the estimated parameters (($\hat{b}_o$ and $\hat{b}_i$)) and true parameter s(b_o and b_1) on the smoothing operations using surface planer in saw mill industries. It was also revealed that there was no significant difference between the estimated parameters ($\hat{b}_o$ and $\hat{b}_i$) and true parameters (b_o and b_1) on the production of chairs using machines in saw mill industries.

Recommendations

Based on the findings of the study, the following recommendation were made.

i. Woodworkers in various sawmills in Nigeria and other countries should endeavour to forecast on suitable methods of converting logs into timber using linear regression.

ii. Researchers and experts in woodwork technology should use the findings of this study to predict the quantity of timbers engaged in smoothing operations on surface planer in saw mill industries.

iii. Researchers and experts in woodwork technology should also endeavour to use the

findings of this study in determining the quantity of timbers converted on daily basis in wood industries.

iv. Saw millers should develop computer programme software that facilitates the calculations necessary to employ the linear regression. This software will allow a saw miller to simply input data on machine to ease the sale of timber products.

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