



Impact of Plant Layout on the Performance of Masters Energy Industries Limited, Abia State

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ABSTRACT

The impact of plant layout on organizational performance of masters energy industries limited, Abia State has been examined. The specific objectives of the study is to; examine the effect of product layout on organizational growth, ascertain the impact of process layout on organizational productivity, investigate the effect of fixed position layout on organizational efficiency and identify the challenges militating against plant layout implementation in an organization. The study will be guided by a survey design because it gives detailed information about issues, problems, events and describes events as they are. The population of the study is 140 employees and the sample size of 104 respondents was obtained using Taro Yamane techniques. We used questionnaire for data collection. The data gathered for the study was analyzed using descriptive analysis. Pearson correlation was used to test hypotheses with the aid of statistical packages for social sciences (SPSS). The study revealed that there was a positive effect of product layout on organizational growth. Also, process layout had a positive impact on organizational productivity. There is no significant effect of fixed position layout on organizational efficiency. Ineffective leadership and poor organizational policy were among the challenges militating against plant layout implementation in an organization. The study recommended that since there was a positive effect of product layout on organizational growth, organisations should make improvement on their product layout as to enhance the organizational growth

1. Introduction

Plant layout is a method of arranging various equipment and plant services within the factory to enable the production of the greatest amount of high-quality output at the lowest possible overall cost. It refers to the positioning of tools, workspaces, and material handling equipment as well as the movement and storage of various goods like furniture, tools, and other fixtures. One of the keys to success in factory management is a well-designed plant layout. There are many different designs for the same product, but the best one is the one that will ultimately cost less [1]

A facility's layout and design are crucial to a company's overall operations because they can both meet the needs of employees and maximize the efficiency of the production process. The main goal of layout is to make sure that work, materials, and information flow through a system smoothly. The

area where a business's operations take place is the basic definition of a facility. The manner in which materials, information, and work are done and moved throughout the system are significantly impacted by the layout and design of the work space. Integrating the requirements of people (staff and customers), materials (raw, finished, and in-process), and equipment in such a way as to produce a single, efficient system is the key to good facility layout and design [2]

The term "plant layout" describes how physical facilities such as machinery, equipment, furniture, etc. are arranged within a factory structure in order to have the fastest material flow possible, at the lowest possible cost, and with the least amount of handling during the processing of the product, from the receipt of raw materials to the shipment of the finished good [3]

Since plant layout is responsible for an orderly flow of materials, productivity and morale of the workers, it is necessary to have systematic layout planning. With the rising costs of the land, labor, and building materials, this has become absolutely necessary. Layout should be such that, it can be changed without much difficulty due to expansion, diversification, change in product design or change in technology [4]. In such cases we need to minimise the effects of dislocation i.e., the transition has to be made quickly from old layout to new layout, so as to minimise the production loss. Most of the handling operations are performed repeatedly throughout the course of production, therefore, if shortest manner of handling is not adopted, this will result wastage of time and shall loose total effectiveness [5]. A good layout minimizes handling time and effort, conserves floor space, reduces material travel distance, boosts production, and lowers costs by more effectively utilizing labor. If the layout is disorganized, the products won't be cost-effective and the price could be very high, which will result in losses. The layout of a plant represents a long-term commitment, so it is an important choice [6]. The best possible relationship between output, floor space, and manufacturing process should be offered by the layout of the ideal plant. It makes efficient use of the building, encourages effective manpower utilization, and facilitates the production process while minimizing material handling, time, and cost. It also provides for employee convenience, safety, and comfort at work as well as maximum exposure to natural light and ventilation. Additionally, it is significant because it influences the movement of goods and processes, labor productivity, oversight and control, utilization of space, and potential for expansion, among other things [7].

Small companies involved in manufacturing or the production of goods must properly align their production and operations to convert raw materials into finished products. During this process, company management may assign workers to assembly lines, or group employees by function. Production functions in a plant might include painting or mixing, for example. Operational functions may include finance and engineering. Employees may also work at fixed stations for exceptionally large products like jets. The problems come when business executives see the need to combine different layout styles for production and operations [8, 9].

Multiple layout styles may cause confusion among workers. For example, a small parts manufacturer that uses an assembly line to construct its parts can confuse workers by adding a new functional station for tightening components. Assembly workers may not fully understand how tightly to screw components by hand, or at what point they should pass units on to the special tightening unit. Separate supervisors may be needed for the assembly and tightening processes, possibly leading to confusion of authority on certain production issues [10].

The effects of too many layout styles on production and operations management can also cause a lack of control. For example, a small company may decide to start creating customized orders for certain customers in addition to the usual ones. This customized area would represent a separate layout style. If customers can place these specialized orders at any time without advanced notice from the sales department, the plant supervisor may assign certain assembly line workers from different areas to fill the customized orders. The loss of these workers in the general assembly line

could throw overall production off, causing some of the workers to be pulled from the customized work back to the general assembly line. Hence, the plant supervisor starts to lose control of his production goals and workers [11, 12, 13, 14].

Small companies often spend more money to execute multiple layout styles in production and operations management. A company can enjoy economies of scale when mass-producing its products. It makes greater use of the available resources. Any additional layout structures that hamper production, though, especially those involving functional processes, can lead to higher unit costs.

The main objective of the study is to examine the impact of plant layout on organizational efficiency, a study of Masters Energy Industries Limited in Abia State. The specific objectives of the study is to;

- i. examine the effect of product layout on organizational growth
- ii. ascertain the impact of process layout on organizational productivity
- iii. investigate the effect of fixed position layout on organizational efficiency
- iv. identify the challenges militating against plant layout implementation in an organization

Olusegun et al [15] carried out a study on Analysis of Plant Layout Design for Operational Efficiency with Craft Algorithms. The study revealed that such attempt could push total costs beyond the current amount of 34Thai-Bait because the minimum possible cost was obtained. Consequently, the best layout for the departments in terms of material handling cost is the first improved layout obtained by Craft method Therefore, it is recommended that operation managers should adopt the Craft algorithm program to overcome material flow obstruction and ineffective operations resulting from ineffective layout designs.

Saenz [16] in their study assessed the Impact of Facility Layout Design over the Process Productivity and Costs. The main objective of the study was to focus on the impact of facility layout design over the process productivity and costs. The research was based on a single case study the company Urupanel. The study found out that the impact of facility layout design is greater on cost reduction rather than on process productivity. In addition, the facility layout factor with the greatest contribution to these impacts is the material handling factor.

Wangari et al. [4] examined the impact Assessment of a Facility Layout on Manufacturing Cycle Time and Throughput: A Case Study of a Tannery in Central Kenya. The research found out that manufacturing cycle time was found to be 19 days, which exceeds the standard time by 4 days. 17.42% of the manufacturing cycle time consisted of non-value. Adding time of which transportation of materials between workstations was the highest contributor as established by Pareto analysis. According to the throughput analysis, increased material handling was the primary factor that contributed to the throughput rate being significantly less than the theoretical 235,294 kg of leather per month. Redesigning an ideal layout was suggested to minimize material handling, which would reduce manufacturing cycle time and boost throughput rate.

An empirical study using a simulation model by Kamaruddin et al. [5] examined the impact of layout design on productivity. The WITNESS simulation package was used to build the simulation model, and the F-test and Newman-Keuls tests were used to evaluate the simulation output. The production system for radio cassette players was used as an empirical study in this study. The findings demonstrate that headcount and model variability have an effect on how well flow lines, job shops, and cellular layouts perform. The literature on the effects of product layout on organizational growth, process layout on organizational productivity, fixed position layout on organizational

efficiency, and obstacles to plant layout implementation in an organization is scarce, according to the studies that are currently available. This study intends to fill the gap.

This paper presents a comparative study that uses simulation to investigate the performance of different layout designs with respect to different levels of model and head count variability. There are three types of layout designs being examined in this paper: flow line, job shop and cellular layout. These three layouts are evaluated based on three selected performance measures which are throughput time, lateness and labour productivity. These three performance measures are selected because they relate with the overall layout productivity. The simulation model is built by using the WITNESS simulation package and the simulation results are tested in the F-test and Newman-Keuls test. In this study, the radio-cassette player production system has been used as an empirical study. The results show that the effect of headcount variability and model variability do create an impact towards the performance of flow line, job shop and cellular layout. This paper presents a comparative study that uses simulation to investigate the performance of different layout designs with respect to different levels of model and head count variability. There are three types of layout designs being examined in this paper: flow line, job shop and cellular layout. These three layouts are evaluated based on three selected performance measures which are throughput time, lateness and labour productivity. These three performance measures are selected because they relate with the overall layout productivity. The simulation model is built by using the WITNESS simulation package and the simulation results are tested in the F-test and Newman-Keuls test. In this study, the radio-cassette player production system has been used as an empirical study. The results show that the effect of headcount variability and model variability do create an impact towards the performance of flow line, job shop and cellular layout.

2. Methodology

2.1 Research Design

Survey design method was adopted in the study. Survey design method is a blue print and scheme that allowed the researcher to provide solution to the problem on how to get data for the study, what to study and who to study. It comprised of using well-structured questionnaire administered to the respondents in order to gather some vital, accurate and up to date information needed for the research work.

2.2 Sources of Data

Structured questionnaire was used to elicit data the staff of the study area.

2.3 Population of the Study

The population of this study comprised of 140 senior, junior and contract staff of Masters Energy Industries Limited in Abia State.

Table 1: Population Table

Masters Energy Industries Limited	No of staff
Senior staff	35
Junior staff	75
Contract staff	30
Total	140

Source: Field Survey, 2022

2.4 Sample Size Determination

Taro Yamene's formular was used to get the total number of a workable sample size.

$$\text{Using } n, = \frac{N}{1 + N(e)^2}$$

Where; n = Samples Size
 N = Population size
 I = Constant
 e = Degree of error

Thus, substituting the values in the formular

$$n = \frac{140}{1 + 140(0.0025)}$$

$$n = \frac{140}{1.35}$$

$$= 103.7 = 104$$

$$\text{Sample size for senior staff} = \frac{35 \times 104}{140}$$

$$= 26$$

$$\text{Sample size for junior staff} = \frac{75 \times 104}{140}$$

$$= 56$$

$$\text{Sample size for contract staff} = \frac{30 \times 104}{140}$$

$$= 22.3$$

$$= 22$$

2.5 Sampling Technique

Simple random sampling technique was used by the researcher in obtaining information for the research. The sampling technique provide employees the same and known chances of being nominated.

2.6 Description of the Research Instrument

We extensively used structured format of questionnaire which was formal and standardized. It followed a pattern of questions which the researcher used to obtain the required data. The questionnaire used by the researcher was in line with the research questions as well as research objectives of the study. Five Likert Scale Format of Strongly Agree - SD, Agree – A, Neutral- N, Disagree – D and Strongly Disagree – SD was adopted in the study.

2.7 Validity of the Research Instrument

Validity is the extent to which a measuring instrument on application performs the function for which it is designed. To ascertain the validity of the instrument, face and content validity was adopted. Face and content validity was done by the supervisor and other experts in business administration who are lecturers. After their corrections the instrument was approved for production. Face validity is the extent to which a test is subjectively viewed as covering the concept it purports to measure. It refers to the transparency or relevance of a test as it appears to test participants while

Content validity refers to the extent to which the items on a test are fairly representative of the entire domain the test seeks to measure. Basically, no interesting aspect of the study was omitted in designing the survey questions, coupled with the fact that the oral questions was also cross-checked through the questions in the questionnaire as a confirmation of responses received in either case.

2.8 Reliability of the Research Instrument

Test reliability refers to the consistency of reproducibility of the result of a test. To ensure reliability of the instrument, the researcher adopted a test re-test method in which the researcher distributed 10 copies of the questionnaires to the employees of the organizations understudied. After some days, the instrument was collected and re-administered for the second time. The questionnaire distributed were completed and returned using Spearman rank order correlation coefficient which was found to be high.

2.9 Methods of Data Analyses

Data gathered for the study was analyzed using descriptive analysis i.e. frequency, standard deviation and mean values. Hypotheses one and two was tested with Pearson correlation coefficient while hypotheses three and four was tested with ANOVA and Pearson Chi-Square Tests with the aid of Statistical Packages for Social Sciences (SPSS) Version 23.

Decision Rule:

If the calculated is greater than the tabulated, you reject the null and accept the alternate but if otherwise reject the alternate.

3. Results and Discussion

3.1 Return Rate of Questionnaire

Table 2 the table below shows the return pattern of the questionnaire

Organization	Distributed Questionnaire	Percentage (%)	Returned Questionnaire	Percentage (%)	Questionnaire not returned	Percentage (%)
Senior staff	26	25	20	19.2	6	5.8
Junior staff	56	53.8	52	50	4	3.9
Contract staff	22	21.2	20	19.2	2	1.9
Total	104	100%	92	88.5%	12	11.5%

Source: Field Survey, 2022

Table 2 above showed that a total of 104 questionnaire were distributed 92 was correctly filled and returned with a percentage rate of 88.5% and 12 were not returned with a percentage rate of 11.5%. Therefore, the researcher made use of 92.

Table 3: To examine the effect of product layout on organizational growth

S/N	Item statement	SA	A	N	D	SD	\bar{X}	sd	Remark
A	Product layout enhance organizational performance	31	25	12	12	12	3.55	1.40	Accept
B	Employee effectiveness can be fostered through product layout	52	18	7	7	8	4.08	1.32	Accept
C	Product layout encourages knowledge sharing	31	27	11	11	12	3.59	1.40	Accept

D	There is a positive relationship between organizational growth and product layout	35	29	9	9	10	3.76	1.34	Accept
E	Improved product quality can be attained through product layout	32	23	13	12	12	3.55	1.41	Accept

Source: Field Survey, 2022.

Key

- SA = Strongly agree
- A = Agree
- N = Neutral
- D = disagree
- SD = Strongly Disagree
- \bar{X} = Mean
- sd = Standard deviation

The effect of product layout on organizational growth was examined with a criterion mean score of 2.50 and a five point item statement. Based on the results obtained, respondents with mean score of 3.55 reported that product layout enhance organizational performance, respondents with mean score of 4.08 agreed that employee effectiveness can be fostered through product layout, respondents with mean score of 3.59 attested that product layout encourages knowledge sharing, respondents with mean score of 3.76 submitted that there is a positive relationship between organizational growth and product layout, finally, respondents with mean score of 3.55 revealed that improved product quality can be attained through product layout.

Table 4: To ascertain the impact of process layout on organizational productivity

S/N	Item statement	SA	A	N	D	SD	\bar{X}	Sd	Remark
A	Process layout and organizational growth aid organizational expansion	17	49	8	9	9	3.61	1.18	Accept
B	They boost organizational efficiency	35	20	13	12	12	3.59	1.43	Accept
C	Technological advancement can be fostered through process layout	22	11	10	23	26	2.78	1.56	Accept
D	They boost organizational competitive advantage	36	14	14	14	14	3.48	1.50	Accept
E	process layout enhance organizational profitability	45	12	12	11	12	3.73	1.49	Accept

Source: Field Survey, 2022.

Key

- \bar{X} = Mean
- sd = Standard deviation

The impact of process layout on organizational productivity was analyzed with a criterion mean score of 2.50 and five item statement. Based on the results obtained, respondents with a mean score of 3.51 attested that process layout and organizational growth aid organizational expansion, respondents with a mean score of 3.59 agreed that they boost organizational efficiency, respondents with a mean score of 2.78 reported that technological advancement can be fostered through process layout, respondents with a mean score of 3.48 agreed that they boost organizational competitive

advantage, finally, respondents with a mean score of 3.73 agreed that process layout enhance organizational profitability.

Table 5: To investigate the effect of fixed position layout on organizational efficiency

S/No	Item statement	SA	A	N	D	SD	\bar{X}	sd	Remark
A	Fixed position layout encourages organizational innovativeness	35	15	15	13	14	3.48	1.493	Accept
B	Less space is needed for placing machines	38	15	13	13	13	3.57	1.492	Accept
C	It encourages better utilisation of machines and labour.	24	25	14	14	15	3.32	1.429	Accept
D	Fixed position layout minimises counting, inspecting, clerical work	26	26	13	13	14	3.40	1.422	Accept
E	It encourages organisational efficiency	17	26	17	14	18	3.11	1.402	Accept

Source: Field Survey, 2022.

Key

\bar{X} = Mean

sd = Standard deviation

The effect of fixed position layout on organizational efficiency was examined with five item statement and a criterion mean score of 2.50. based on the results obtained, respondents with a mean score of 3.48 reported that fixed position layout encourages organizational innovativeness, respondents with a mean score of 3.57 agreed that less space is needed for placing machines, respondents with a mean score of 3.32 submitted that it encourages better utilisation of machines and labour, respondents with a mean score of 3.40 claimed that fixed position layout minimises counting, inspecting, clerical work. Finally, respondents with a mean score of 4.11 agreed that it encourages organizational efficiency.

Table 6: To identify the challenges militating against plant layout implementation in an organization

S/No	Item Statement	SA	A	N	D	SD	\bar{X}	sd	Remark
a.	Inadequate staff training	27	22	9	26	8	3.37	1.388	Accept
b.	Poor organizational policy	52	18	7	7	8	4.08	1.320	Accept
c.	Ineffective leadership	43	24	8	8	9	3.91	1.340	Accept
d.	Inadequate working space	28	50	4	5	5	3.99	1.032	Accept
e.	Poor working environment	32	23	13	12	12	3.55	1.417	Accept

Source: Field Survey, 2022.

Key

\bar{X} = Mean

sd = Standard deviation

The challenges militating against plant layout implementation in an organization was analysed with five item statement and a criterion mean score of 2.50. Based on the results obtained, the respondent generally accepted that inadequate staff training, poor organizational policy ineffective leadership, inadequate working space and poor working environment were the challenges militating against plant layout implementation in an organization.

3.2 Test of Hypotheses

H01: There is no significant effect of product layout on organizational growth

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.690 ^a	.240	.234	1.403

a. Predictors: (Constant), organizational growth

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	70.371	1	70.371	35.776	.000 ^b
	Residual	222.272	91	1.967		
	Total	292.643	92			

a. Dependent Variable: product layout

b. Predictors: (Constant), organizational growth

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.264	.391		3.233	.002
	organizational growth	.594	.099	.490	5.981	.000

a. Dependent Variable: product layout

Hypothesis one stated thus there is no significant effect of product layout on organizational growth was tested using simple regression. The regression coefficient $r = 0.690$ (69%) which shows a strong positive relationship the variables. The p value = 0.002 which is lower than 0.05 which implies that the relationship is significant. Therefore, pending other statistical evidence we therefore reject the null hypothesis and accept the alternate hypothesis that there was a positive effect of product layout on organizational growth.

H02: Process layout has no significant impact on organizational productivity

Descriptive Statistics

	Mean	Std. Deviation	N
Process layout	3.64	1.523	92
Organizational Productivity	3.34	1.661	92

Correlations

		Process layout	Organizational Productivity
Process layout	Pearson Correlation	1	.654**
	Sig. (2-tailed)		.001
	N	92	92
Organizational Productivity	Pearson Correlation	.654**	1
	Sig. (2-tailed)	.001	
	N	92	92

** . Correlation is significant at the 0.01 level (2-tailed).

Hypothesis two stated thus; process layout has no significant impact on organizational productivity was tested using Pearson correlation. The Pearson correlation coefficient $r = 0.654$ (65.4%) which shows a strong positive relationship between the variables. The p value = 0.001 which is lower than 0.05 which implies that the relationship is significant. Therefore, pending other statistical evidence we therefore reject the null hypothesis and accept the alternate hypothesis that process layout had a positive impact on organizational productivity.

H03: There is no significant effect of fixed position layout on organizational efficiency

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Fixed position layout minimises counting, inspecting, clerical work	3.40	92	1.422	.148
	Organizational performance.	3.32	92	1.429	.149

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Fixed position layout minimises counting, inspecting, clerical work & Organizational performance.	92	.953	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Fixed position layout minimises counting, inspecting, clerical work - Organizational performance.	.087	.436	.045	-.003	.177	1.913	91	.001

Hypothesis three stated thus; there is no significant effect of fixed position layout on organizational efficiency was tested using T test. The correlation coefficient $r = 0.953$ (95.3%) which shows a strong positive relationship between the variables. The p value = 0.001 which is lower than 0.05 which implies that the relationship is significant. Therefore, pending other statistical evidence we therefore reject the null hypothesis and accept the alternate hypothesis that there is significant effect of fixed position layout on organizational efficiency.

3.3 Discussion

The study submitted that there was a positive effect of product layout on organizational growth. The effect of product layout on organizational growth revealed that product layout enhance organizational performance, employee effectiveness can be fostered through product layout, product layout encourages knowledge sharing, there is a positive relationship between organizational growth and product layout, finally, respondents agreed that improved product quality can be attained through product layout. The result of the study is in line with the findings of Anucha et al. [1] that product layout encourages knowledge sharing.

Secondly, the study agreed that process layout had a positive impact on organizational productivity. The impact of process layout on organizational productivity revealed that process layout and organizational growth aid organizational expansion, they boost organizational efficiency, technological advancement can be fostered through process layout, they boost organizational

competitive advantage and process layout enhance organizational profitability. The outcome of the study submits to the observation of Telsang [11] that technological advancement can be fostered through process layout.

Thirdly, the study showed that there is no significant effect of fixed position layout on organizational efficiency. The effect of fixed position layout on organizational efficiency showed that fixed position layout encourages organizational innovativeness, less space is needed for placing machines, it encourages better utilisation of machines and labour, fixed position layout minimises counting, inspecting, clerical work and it encourages organisational efficiency. The outcome of the study agrees with the result of Yifei [14] that fixed position layout encourages better utilisation of machines.

The challenges militating against plant layout implementation in an organization was analysed with five item statement and a criterion mean score of 2.50. Based on the results obtained, the respondent generally accepted that inadequate staff training, poor organizational policy ineffective leadership, inadequate working space and poor working environment were the challenges militating against plant layout implementation in an organization. The result of the study corresponds to the findings of Parveen and Ravi [6] inadequate staff training can affect plant layout implementation.

4. Conclusion

The key findings of the study include;

- i. There was a positive effect of product layout on organizational growth.
- ii. Process layout had a positive impact on organizational productivity
- iii. There is no significant effect of fixed position layout on organizational efficiency
- iv. Ineffective leadership and poor organisational policy were among the challenges militating against plant layout implementation in an organization

Based on the findings of the study, the study recommended the following in view of indispensable role of career planning in achieving organizational goals.

- i. Since there was a positive effect of product layout on organizational growth, organisations should make improve their product layout as to enhance the organizational growth
- ii. The management of Masters Energy Industries Limited in Abia State should improve their process layout as to foster their organizational productivity
- iii. The management should make provisions for fixed position layout as a way of enhancing their organizational performance
- iv. The management should provide an enabling environment that will encourage effective leadership and organisational policy as this will foster plant layout implementation in the organization.

v.

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