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Evaluation of Production Process and Capacity Utilization (A Case Study of UNIBEN Water Factory)

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Abstract

This paper examined the problems encountered in the production process of UNIBEN water factory (from raw materials acquisition to installed capacity utilization) adopting a design approach known as Case Study Survey, which is found to be the most relevant for the study. Results revealed that time; cost and manpower are the major variables of the company. Results further showed, the company keeps her annual report, is very competitive. The factory's cost of operation and administration, services rendered, production planning and control techniques are in place. However, product volume coupled with the dwindling economic resources, consumer purchasing power and high cost of goods are major challenges faced by the company.

1. Introduction

Production Management is an essential and basic key to all organizations processes either manufacturing or services [1]. The survival of an organization is dependent on how its production processes are managed [1]. Over the years, water factories in Nigeria have passed through a stage of total importation of foreign products to a stage where some now source their raw materials locally [2]. As Nigeria population grew and industries increased, the supply of water by the public utilities became inadequate in quality and quantity [2]. This led to the emergence and proliferation of private water enterprises that operated side by side with the government-owned public water utilities, [3]. Between 1992 and 1996, sachet water production began to sprout; the rate of increase of the country's total water supply for industrial, agricultural, and domestic uses was 1.0 percent while the population growth rate was 2.84 percent [2]. The implication of this is that the population would be larger than the available water supply, the result of which is scarcity or inadequacy of water supply [4, 5]. History reveals that sachet water was introduced to the Nigerian markets around 1990 but its regulation by the National Agency for Food and Drug Administration and Control started in 2001. It is relatively affordable and available even at the remote areas of the country [6, 7]. UNIBEN Enterprises, is the producer of UNIBEN sachet and bottled water. This research examined problems encountered when getting the raw materials used in the production process, problems of inventory management and policies, problems encountered in the utilization of the installed capacity and problems in the production process of UNIBEN water factory.

2. Methodology

This study is centered on the evaluation of production process and capacity utilization while adopting a design known as the Case Study Survey which is found out to be the most relevant and appropriate for this research work. A case study is a research approach that is used to generate an in-depth, multi-faceted understanding of a complex issue in its real life context [8]. Case Study Survey research is a research design in which a Survey is administered to a case, either a small sample or an entire population of individuals, to describe an aspect or characteristics of that population [9]. The case survey method presents a powerful approach for identifying and statistically testing patterns across case studies [10, 11].

2.1 Research Design

The researchers adopted a design known as Case Study Survey. Case Study Survey research is a research design in which a Survey is administered to a case, either a small sample or an entire population of individuals, to describe an aspect or characteristics of that population [11].

2.2 Method of Data Collection

This research was conducted in University of Benin, Ekehuan Road Campus, Benin-City, Edo State, Nigeria. The population of the Water Factory where this survey was conducted is around 70 persons.

The methods for data collection are personal interview, questionnaires and field visit. The researchers interviewed the production manager, administrative manager and the research and planning manager of the water factory. 70 questionnaires were administered to respondents who are workers of the water factory. Questionnaire used in this research is the 4-point Likert type scale questionnaire.

2.5 Method of Data Analysis

Data analysis was presented in both numbers and percentages. Discussions of the observations from the data were presented and results tabulated.

Hypothesis testing was carried out in three (3) steps:

STEP 1: Equation (1) was used to testing the null and alternative hypothesis

$$X^2 = \sum \frac{(E - O_n)^2}{E} \quad (1)$$

STEP 2: Equation (2) was used to obtain the degree of freedom as (k – 1)

$$DF = k - 1 = 4 - 1 = 3 \quad (2)$$

STEP 3: we determined and compared the calculated critical value to the critical value from standard table using Table 1.

Table 1: Standard critical values given degree of freedom and sample size

Critical values of the Chi-square distribution with *d* degrees of freedom

	Probability of exceeding the critical value						
d	0.05	0.01	0.001	*d*	0.05	0.01	0.001
1	3.841	6.635	10.828	11	19.675	24.725	31.264
2	5.991	9.210	13.816	12	21.026	26.217	32.910
3	7.815	11.345	16.266	13	22.362	27.688	34.528
4	9.488	13.277	18.467	14	23.685	29.141	36.123
5	11.070	15.086	20.515	15	24.996	30.578	37.697
6	12.592	16.812	22.458	16	26.296	32.000	39.252
7	14.067	18.475	24.322	17	27.587	33.409	40.790
8	15.507	20.090	26.125	18	28.869	34.805	42.312
9	16.919	21.666	27.877	19	30.144	36.191	43.820
10	18.307	23.209	29.588	20	31.410	37.566	45.315

INTRODUCTION TO POPULATION GENETICS, Table D.1

3. Results and Discussion

TABLE 2: Major variables of the water factory

Responses	**No. of respondents**	**Percentage (%)**
Time	5	8.33
Cost	6	10
Manpower	5	8.33
All of the above	44	73.33
Total	60	100

Table 2 presents responses for major variables of the water factory. From Table 2, 8.33% agreed that time was the major variables of the company, while 73.33% agreed that time, cost and manpower are the major variables of the company. The implication is that the water factory should be conscious of the time of production, cost of materials before production and manpower needed for production.

	TABLE 3: Company's annual report		**TABLE 4:** Management of materials and stock since the company was established?		**TABLE 5:** Product volume versus market situation?	
Responses	**No. of respondents**	**Percentage (%)**	**No. of respondents**	**Percentage (%)**	**No. of respondents**	**Percentage (%)**
Agree	45	75	39	65	40	75
Strongly Agree	13	21.66	11	18.33	5	8.33
Disagree	2	3.34	5	8.33	10	16.66
Strongly Disagree	0	0	5	8.33	5	8.33
Total	60	100	60	100	60	100

Table 3 presents responses for company's annual report. Reponses from Table 3 shows that 75% agreed that the company has annual report 3.34% disagreed that the company has annual report. This shows that the company has yearly annual report

From Table 4, 65% agreed that there is better management of materials and stock, and 8.33% disagreed that there is better management of materials and stock. It can be said that there is better management of materials and stock since the inception of the water factory.

From the Table 5, it was observed that 75% agreed and 16.66% disagreed that there is no product volume in the market situation. The implication is that product volume in market situation is well managed.

TABLE 6: the competitive situation in your company

Responses	**No. of respondents**	**Percentage (%)**
Very competitive	35	58.33
Competitive	10	16.66
Not very competitive	10	16.66
Not competitive	5	8.35
Total	60	100

In determining how the company compares its competiveness to other companies Table 6 showed that, 58.33% agreed that the company is very competitive, while 16.66% agreed that the company is not very competitive. It could be opined that the company is competitive.

TABLE 7: Raw materials procurement and distribution

Responses	**No. of respondents**	**Percentage (%)**
Procurement is centralized	23	38.33
Procurement is not centralized	11	18.33
Distribution is centralized	20	33.33
Distribution is not centralized	6	10.01
Total	60	100

In Table 7, a total of 71.66% agreed that raw materials procurement and distribution was centralized and a total of 28.34% agreed otherwise. More than 70% of the respondents agreed that the raw materials were procured and distributed effectively in their respective departments.

TABLE 8: Effect of reducing the cost of operations and administration on the general efficiency of the services provided?

Responses	**No. of respondents**	**Percentage (%)**
Very high	34	56.66
Very low	11	18.33

High	9	15
Low	6	10.01
Total	60	100

In Table 8, it was observed that 56.66% agreed that high materials cost has reduced the cost of operations and administration. The implication could be that more respondents agreed that materialization has made capacity utilization more generally effective in the services of their respective departments.

TABLE 9: Production Planning and Control in the Water Factory

Responses	**No. of respondents**	**Percentage (%)**
Weekly appraisal	11	18.33
Forecasting	7	11.66
Monitoring	2	3.33
All of the above	40	66.66
Total	60	100

In Table 9, 18.33% agreed that production planning and control is weekly appraised, 11.66% agreed that they are forecasting, 3.33% said monitoring and 66.66% agreed that production planning and control takes place thereby improving productivity in the company.

TABLE 10: Production Process of the Water Factory

Responses	**No. of respondents**	**Percentage (%)**
Product production	10	16.66
Storage	5	8.33
Packing	5	8.33
All of the above	40	66.66

From Table 10, 66.66% agreed that they accepted all the steps in the production process. This shows the important of production process in the Water Factory has improved productivity.

TABLE 11: Receipts and inspection procedure

Responses	**No. of respondents**	**Percentage (%)**
Direct suspension by various departmental managers	15	25
Line Bosses	3	5
Factory managers	2	3.33

All of the above	40	66.66
Total	60	100

66.66% of respondents from Table 11 agreed that receipts and inspection procedure are followed in the water factory.

TABLE 12: Problems faced by the company

Responses	**No. of respondents**	**Percentage (%)**
Dwindling national economic stability	9	15
Competition	5	8.33
Consumer purchasing power	2	3.33
All of the above	44	73.34
Total	60	100

Table 12 shows that 15% agreed that dwindling national economic stability are the problems faced by the company, 8.33% said competition are the problems faced by the company, 3.33% said consumer purchasing power are the problems faced in the company, 73.4% said all the problems mentioned in Table 12 are faced by the company.

TABLE 13: Source of raw materials used in the production processes

Responses	**No. of respondents**	**Percentage (%)**
Locally	18	30
Imported	18	30
Both	24	40
No idea	0	0
Total	60	100

Table 13 shows that 30% agreed that raw materials are locally sourced, 30% agreed that raw materials are imported, 40% agreed that raw materials are both locally sourced and imported for the production processes.

3.1 Hypothesis Testing

3.1.1 Testing the Null and the Alternative Hypothesis

Hypothesis One

Ho:- The company's process planning and design does not take place by the advice of its technical partners.

Hi:- The company's process planning and design takes place by the advice of its technical partner.

Question 1: Does the company's process planning and design takes place by the advice of its technical partners?

TABLE 14: Response from question 1

Responses	No. of respondents	Percentage (%)
Agree	39	65
Strongly Agree	6	10
Disagree	10	16.66
Strongly Disagree	5	8.33
Total	60	100

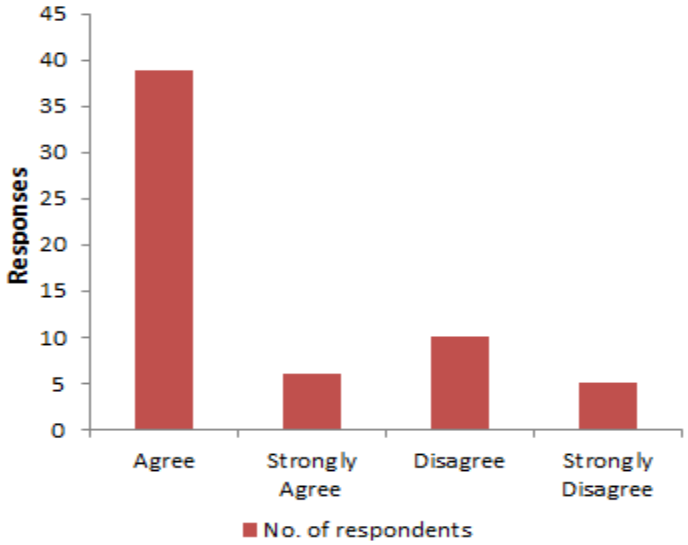

Figure 1. Reference plot for question 1 showing responses verse number of respondents

Table 14 shows that 65% agreed that the company's process planning and design takes place by the advice of its technical partners, and 16.66% disagrees that the company's process planning and design takes place by the advice of its technical partners. The implication of this is that on a larger percentage the company's process planning and design takes place by the advice of its technical partners. Table 14 shows that there is a stronger correlation between company's process planning and design and its technical partners as results showed that over 70% of respondents agreed to this fact. These findings agreed with the works of [11] [12]

The Test Statistics

The degree of freedom is 3 as obtained from Equation (2)

The critical value from standard table of $X^2 = 7.8200$ (Table 1)

From Equation (1), X^2 is given as

$$X^2 = \frac{(60-39)^2}{(60)^2} + \frac{(60-6)^2}{(60)^2} + \frac{(60-10)^2}{(60)^2} + \frac{(60-5)^2}{(60)^2} = 2.4671 \quad (3)$$

Since the calculated value ($X^2 = 2.4671$) is lesser than the standard critical (Table 1) value ($X^2 = 7.8200$), we reject the null hypothesis and accept the alternative hypothesis. So we conclude that the company's process planning and design takes places by the advice of its technical partner.

Hypothesis Two

H_0: The level of product/services quality is not high.

H_1: The level of product/services quality is high

Question 2: Do you think that the level of products or services quality is high?

TABLE 15: Level of products/services quality

Responses	**No. of respondents**	**Percentage (%)**
Agree	40	66.66
Strongly Agree	13	21.66
Disagree	6	10
Strongly Disagree	1	1.68
Total	60	100

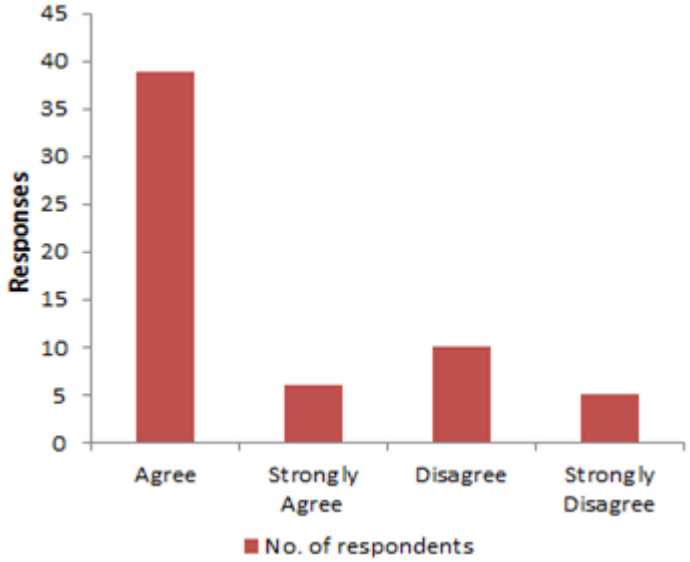

Figure 2. Reference plot for question 2 showing responses verse number of respondents

Table 15 shows that 66.66% agreed that the company's level of products/service quality is high, and 10% disagrees that the company's products/services quality is high. The implication of this is that on a larger percentage the level of the company's products/services quality is good. These findings agreed with the works of [11] [12].

The Test Statistics

The degree of freedom is 3 as obtained from Equation (2)

The critical value from standard table of $X^2 = 7.8200$ (Table 1)

From Equation (1), X^2 is given as

$$X^2 = \frac{(60-40)^2}{(60)^2} + \frac{(60-13)^2}{(60)^2} + \frac{(60-6)^2}{(60)^2} + \frac{(60-1)^2}{(60)^2} = 2.5016 \quad (4)$$

Since the calculated value (X^2 = 2.5016) is lesser than the standard critical (Table 1) value (X^2 = 7.8200), we reject the null hypothesis and accept the alternative hypothesis. So we conclude that the company's level of product/services is high.

Hypothesis Three

H_0: The Company does not manage their inventory

H_1: The Company manages their inventory

Question 3: Does the Company manage their inventory?

TABLE 16: Company management of inventory

Responses	**No. of respondents**	**Percentage (%)**
Agree	37	61.66
Strongly Agree	15	25
Disagree	3	5
Strongly Disagree	5	8.33
Total	60	100

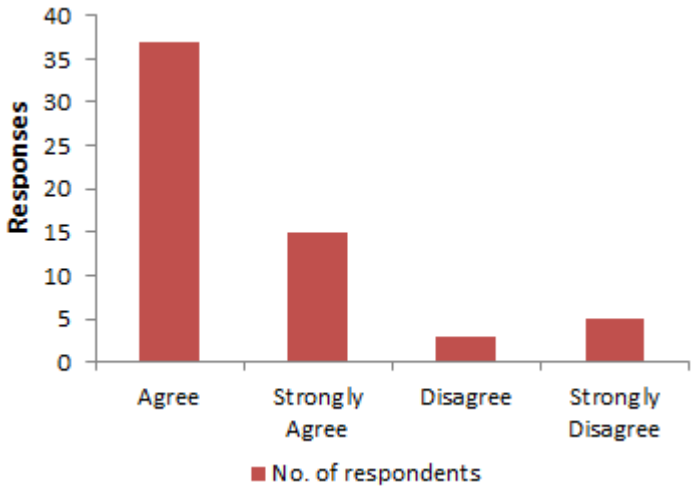

Figure 3. Reference plot for question 3 showing responses verse number of respondents

Table 16 shows that 61.66% agreed that the company manages inventory, and 5% disagreed that the company manages inventory. The implication of this is that to a great extent the company management of her inventory is good.

The Test Statistics

The degree of freedom is 3 as obtained from Equation (2)

The critical value from standard table of X^2 = 7.8200 (Table 1)

From Equation (1), X^2 is given as

$$X^2 = \frac{(60-37)^2}{(60)^2} + \frac{(60-15)^2}{(60)^2} + \frac{(60-3)^2}{(60)^2} + \frac{(60-5)^2}{(60)^2} = 2.4521 \quad (5)$$

Since the calculated value (X^2 = 2.4521) is lesser than the standard critical (Table 1) value (X^2 = 7.8200), we reject the null hypothesis and accept the alternative hypothesis. So, we conclude that the company's level of product/services is high.

Hypothesis Four

H_0: The capacity utilization of production system has not affected the services rendered by your company

H_1: The capacity utilization of production system has affected the services rendered by your company

Question 4: Has the capacity utilization of production system affected the services rendered by your company?

TABLE 17: Effect of capacity utilization of production system on services rendered

Responses	No. of respondents	Percentage (%)
Agree	30	50
Strongly Agree	7	11.66
Disagree	13	21.66
Strongly Disagree	10	16.66
Total	60	100

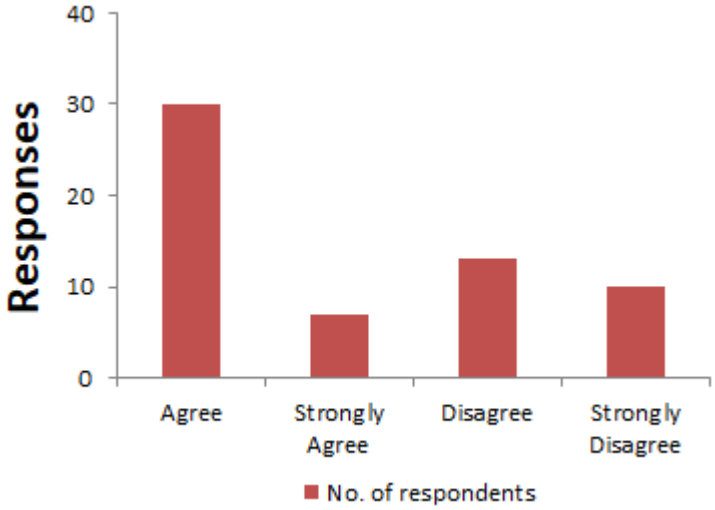

Figure 4. Reference plot for question 3 showing responses verse number of respondents

Table 17 shows that 50% agrees that capacity utilization of production system have affected the services rendered, and 21.66% disagrees that capacity utilization of production system has affected the services rendered. The implication of this is that capacity utilization of the production system has really affected the services rendered by the company. Table 17 shows that there is a stronger correlation between company's capacity utilization of production system and services rendered as results showed that over 55% of respondents agreed to this fact. These findings agreed with the works of [11] and [12].

The Test Statistics

The degree of freedom is 3 as obtained from Equation (2)

The critical value from standard table of $X^2 = 7.8200$ (Table 1)

From Equation (1), X^2 is given as

$$X^2 = \frac{(60-30)^2}{(60)^2} + \frac{(60-7)^2}{(60)^2} + \frac{(60-13)^2}{(60)^2} + \frac{(60-10)^2}{(60)^2} = 2.3382 \quad (6)$$

Since the calculated value ($X^2 = 2.3382$) is lesser than the standard critical (Table 1) value ($X^2 = 7.8200$), we reject the null hypothesis and accept the alternative hypothesis. So we conclude that the company's level of product/services is high.

4. Conclusion

In this work, the production process and capacity utilization of UNIBEN Water Factory has been evaluated using the case study survey. After general analysis, we found out that the installed capacity of the Factory is utilized, the raw materials used in the production process are sourced both foreign and locally, process planning and design takes place by the advice of its technical partners, product and services quality is high, and the Factory copes with the management of its inventories, thereby achieving the objectives of this study.

Nomenclature

E	Expected/Total Frequency
K	Number of options
O_n	Observed Frequencies

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