Assessment of Partial and Multi Factor Productivity on Messebo Cement Factory (Ethiopia)

Alubel Kassaw

Department of management, Wolaita Sodo University, Ethiopia

Kirubel Bruck

Department of management, Adigrat University, Ethiopia

Abstract

The study is conducted basically to assess the partial (labor and machine) and multifactor productivity of Messebo cement factory with the objective of analyzing the productivity status of the factory, analyzing the trends in productivity growth of the factory, analyze the factors that affect productivity of the factory and providing suggestions to improve the productivity performance of the factory because they are vital in measuring the competency of any company. The study used primary and secondary data as input. The primary data was collected observation and through interview conducted with the production department of the factory. The most important data for the study was gained from secondary sources like annual production report of the organization. The data was presented through table and analyzed by using a descriptive statistics. The study found that Messebo Cement is facing a problem of reduction in its productivity while we are comparing the trends of its productivity. The emergence of Derba cements factory leads to the decrease in demand of Messebo's cement. Using of technology intelligently, the increase in the demand of cement, market price of cement and investing in human capital are important factors of productivity in Messebo cement. Having appropriate work-force leads Messebo to raise its productivity in 2010/11.

Keywords: productivity, cement

1. Introduction

Productivity is connected to the use and availability of resources (Tangen, 2002). According to Muthukrishnan, (2002), productivity has become a catchword in the industrial field which is measure of the economic soundness of the means of production. Productivity is one of the most important factors that affect overall performance of any industry (Attar *et al*, n.d).

The cement industry is one of the industries which can be affected by the level of productivity. Cement is a capital intensive industry which means that competition is limited to mainly small groups of large industrial houses which is a relatively stable product and susceptible to rapid usage declines or obsolescence (Muthukrishnan, 2002).

When we consider the history of cement industry establishment in Ethiopia, a cement factory was established by Italians in 1936 during the five year fascist occupation of the Country. The Dire Dawa Cement Factory is the first factory established in the country (Ethiopian Investment Agency, 2008). Messebo cement is one of the cement producing factors established in 1999. The plant is located in the northern part of Ethiopia, 7 km from Mekele city. It produces mainly two types of cement Ordinary Portland cement (OPC) and Portland Pozolona Cement (PPC).

2. Objective of the study

The main objectives of the study are as follows
- ➢ To analyze the productivity status of Messebo cement factory
- ➢ To analyze the trends in productivity growth of the factory
- ➢ To analyze the factors that affect productivity of the factory
- ➢ To provide suggestions to improve the productivity performance of the factory

3. Literature review

3.1 Productivity

Productivity is a very comprehensive concept, both in its aim and also in its operational content (Naresh Roy, 2005). Although the concept of productivity is a widely discussed subject by politicians, economists, managers and media, it is often vaguely defined and poorly understood (Tangen, 2002).

Kumar and Suresh (2008) defined productivity as it is the quantitative relation between what we produce and we use as a resource to produce them, *i.e.*, arithmetic ratio of amount produced (output) to the amount of resources (input). Productivity may then be defined as the ratio of earned to actual hours and In general, productivity signifies the measurement of how well an individual entity uses its resources to produce outputs from inputs (Attar *et al n.d*). European Productivity Agency (EPA) cited in Kumar and Suresh (2008) defined

productivity as, as it is an attitude of mind. It is the mentality of progress, of the constant improvements of that which exists. It is the certainty of being able to do better today than yesterday and continuously. It is the constant adaptation of economic and social life to changing conditions. It is the continual effort to apply new techniques and methods. It is the faith in progress."

3.2. Productivity measures

It is a common measure of how a country, company, or a business unit is using its resources (factors of production)

Measuring productivity is one of the most common ways to measure the competitiveness for any company.

The use of just one resource input to measure productivity is known as **single factor productivity**.

However, a broader view of productivity is multifactor productivity, which includes all inputs (e.g., labor, material, energy, capital).

Multifactor productivity is also known as **total factor productivity**.

The following formulas are taken form (Stevenson 1996, Kumar and Suresh,2008) and Virtual University of Pakistan, (2009)

Partial productivity measure=   Total output ÷ individual input

$$\frac{output}{Labor} \quad or \quad \frac{output}{capital} \quad or \quad \frac{output}{machine}$$

Multifactor productivity measure= $\dfrac{out\ put}{Labor+\ capital+\ machine\ +energy}$

Total Productivity Measure= $\dfrac{Total\ out\ put}{Total\ inputs}$

Productivity Growth = $\dfrac{\textbf{Current}\ Period\ Productivity - Previous\ Period\ Productivity}{Previous\ Period\ Productivity}$

Productivity Growth = Unit less Quantity

3.3 Factors affecting productivity

Economists tried to put variety of reasons for changes in productivity and tried to identify the principle factors influencing productivity rate.

Olomolaiye et al. (1998) classified the productivity factors as external factors which are outside the control of the organization management and internal factors related to the productivity factors originating within the organization. Lack of suitable knowledge, health and safety regulations, and codes of practices are external factors influencing task operations and productivity. In the internal category, management inadequacies could result in a waste of resources with consequent losses in productivity; adoption of modern technology and training for the laborer would increase productivity.

Adrian, (1987) Classified the factors affecting productivity in the construction industry as industry related factors, labor-related factors, and management-related factors. Industry-related factors are related with characteristics of the construction industry, such as the uniqueness of construction projects, varied locations, adverse and unpredictable weather, and seasonality. Labor-related factors include the union's influence, little potential for learning, and lack of motivation. Management-related factors usually refer to a lack of management for tools or techniques.

The following are factors which will determent productivity identified by (Attar *et al* n.d) and Kumar and Suresh (2008).

Capital/labor ratio: It is a measure of whether enough investment is being made in plant, machinery, and tools to make effective use of labor hours.

Scarcity of some resources: Resources such as energy, water and number of metals will create productivity problems.

Work-force changes: Change in work-force effect productivity to a larger extent, because of the labor turnover.

Innovations and technology: This is the major cause of increasing productivity.

Regulatory effects: These impose substantial constraints on some firms, which lead to change in productivity.

Bargaining power: Bargaining power of organized labor to command wage increases excess of output increases has had a detrimental effect on productivity.

Managerial factors: Managerial factors are the ways an organization benefits from the unique planning and

managerial skills of its manager.

Quality of work life: It is a term that describes the organizational culture, and the extent to which it motivates and satisfies employees.

3.4 Productivity Analysis

For the purposes of studies of productivity for improvement purposes, following types of analysis can be carried out (Kumar and Suresh (2008) :

Trend analysis: Studying productivity changes for the firm over a period of time.

Horizontal analysis: Studying productivity in comparison with other firms of same size and engaged in similar business.

Vertical analysis: Studying productivity in comparison with other industries and other firms of different sizes in the same industry.

Budgetary analysis: Setting up a norm for productivity for a future period as budget, based on studies as above, and planning strategies to achieve it.

4.   Methodology

This study tried to assess assessment of partial and multi factor productivity on Messebo Cement factory (Ethiopia). The study used primary and secondary data as input. The primary data was collected observation and through interview conducted with the production department of the factory. The most important data for the study was gained from secondary sources like annual production report of the organization. The data was presented through table and analyzed by using a descriptive statistics.

5.   Discussion

The discussion of the term paper is based on the following information provided in the table below which is taken from the annual report of Messebo cement factory starting from year 2009-10 to 2011-12.

5.1. Summary of production performance of Messebo cement factory

TABLE 1. Summarized production performance of year 2009-10

Unit	Plan	Actual	Performance Vs. Plan (%)
Raw material grinding	907740	757068	83.4
Clinker production	593467	494006	83.24
Cement production			
OPC	169431	134862	79.6
PPC	651938	522049	80.08
Total OPC and PPC	821369	656911	79.98

TABLE 2. Summarized production performance of year 2010-11

Unit	Plan	Actual	Performance Vs. Plan (%)
Raw meal grinding	1162195	1061749	91.36
Clinker production	740250	680933	91.99
Cement production			
OPC	202200	189254	93.6
PPC	808800	726154	89.78
Total OPC and PPC	1011000	915408	90.54

TABLE 3. Summarized production performance of year 2011-12

Unit	Plan	Actual	Performance Vs. Plan (%)
Raw meal grinding	1083300	291564	28.91
Clinker production	690000	190697	27.67
Cement production			
OPC	184920	40033	21.65
PPC	734680	229542	31.03
Total OPC and PPC	924600	269575	29.16

This term paper uses the trend analysis type of productivity analysis to show the productivity changes for the factory over a period of time.

5.2. Changes on the production of raw meal grinding and clinker
The following two tables (table4 and table 5) shows the changes occurred in the production of raw meal grinding and clinker
TABLE 4.Changes from 2009-10 to 2010-11 on raw meal grinding and clinker production

Unit	Actual		Change	Percentage
	2009-10	2010-11		
Raw meal grinding	757068	1061749	304681(increase)	40.24%
Clinker production	494006	680933	186927(increase)	37.84%

TABLE5.Changes from 2010-11 to 2011-12 on raw meal grinding and clinker production

	Actual		Change	Percentage
	2010-11	2011-12		
Raw meal grinding	1061749	291564	(decrease)	72.54%
Clinker production	680933	190697	(decrease)	72%

  The decrease and increase in the production of raw meal and clinker results from the increase and decrease in the demand of the OPC and PPC in the market.

5.3. Changes in the production of OPC and PPC
Table 6.Changes from 2009-10 to 2010-11 on OPC and PPC

Unit	Actual		Change	Percentage
Cement production	2010-11	2011-12		
OPC	134862	189254	54392 (increase)	40.3%
PPC	522049	726154	204105(increase)	39.1%
Total	656911	915408	258497(increase)	39.35%

  As we can see in the above table the amount of both production of OPC and PPC is increased when we go from 2010-to 2011-12.i.e OPC increased by 54392 tones (40.3%), PPC by 204105 tones (39.1%) and the total production by258497 tones (39.35%). The increase in the productivity results from the Using of technology intelligently, investing in human capital to ensure that staff are skilled and motivated, an increase in the production of raw meal and clean clinker, an increase in the market price of cement and an increase in construction which leads to a high demand in cement.
Table 7.Changes from 2010-11 to 2011-12 on OPC and PPC

Unit	Actual		Change	Percentage
Cement production	2010-11	2011-12		
OPC	189254	440033	149221(decrease)	78.85%
PPC	726154	229542	496612(decrease)	68.39%
Total	915408	269575	645833(decrease)	70.22%

  As we can see in the above table the amount of both production of OPC and PPC is decreased when we go from 2010-to 2011-12.i.e OPC decreased by 149221 tones (78.85%), PPC by 496612 tones (68.39%) and the total production by 645833 tones (39.35%).The major reason for the declining in production is the emergence of Derba cement factory which sales at 170 birr while Messebo sales at 250 birr. The less price of Derbas' cements leades to the decrease in the demand of Messebos' cement.
  The prices being offered by Derba, although the product is yet to enter the market in any significant manner, is a primary reason behind the reduced demand for their product according to a manager of Messebo Cement. Because Messebo cement cannot able to create artificial demand by simulating scarcity through hoarding it loses its' market share which leads to reduction in its' production.

5.4. Discussion of productivity per labor and machine
Information about number of employees in production department with total Labor and Machine hour

Journal of Resources Development and Management
www.iiste.org
ISSN 2422-8397   An International Peer-reviewed Journal
Vol.36, 2017

Table 8. Employees, Machine and Labor hour of production department

Labor productivity =   Output/Labor hour
Machine productivity=   Output/Machine hour

Year	No. of employees in Quarry Team	Quarry Team Labor Hour	Used Machine Hour for Quarry	No. of employees in Cement Production Team	Cement Production Team Labor Hour	Used Machine Hour for Cement production	Total employees in Production Department	Total Machine hour	Total Labor Hour
2009/10	137	222560 hr.	9630 hr.	211	342400 hr.	6848 hr.	348	16478hr.	564960hr.
2010/11	173	294464 hr.	10593 hr.	271	453680 hr.	7704 hr.	444	18297hr.	758144hr.
2011/12	251	407456 hr.	8988 hr.	373	607760 hr.	5992 hr.	624	14980hr.	1015216hr.

There are two teams in MOSSOBO cement production and process department:
➤ Quarry
➤ Cement production

A. Quarry Team

This team is responsible for raw material Grinding and Clinker Production. Its productivity for the past three years, according to Labor and Machine, has been calculated as follows;

Table 9. Machine and Labor Productivity of the Quarry team

Year	Output	Labor Hour	Machine Hour	Labor Productivity	Machine Productivity
2009-10	1251074	222560 hr.	9630 hr.	5.6 u/hr.	129.9 T/Hr.
2010-11	1742682	294464 hr.	10593 hr.	5.9 u/hr.	164.5 T/Hr.
2011-12	482261	407456 hr.	8988 hr.	1.2 u/hr.	53.7 T/Hr.

Table 9 has illustrated the Labor and Machine productivity of the Quarry Team. As shown in the table, in 2009/10 the productivity of labor and machine was 5.6u/hr. and 129.9t/hr., respectively. This is done by calculating the ratio of the Quarry team output to input (Labor and Machine).

For Labor   = 1251074 / 222560hr.   , and For Machine = 1251074 / 9630hr.
                = 5.6u/hr.   = 129.9t/hr.

In 2010/11 the productivity of the Quarry Team had been increased, both in Labor and Machine, from 5.6u/hr to 5.9u/hr and from 129.9t/hr. to 164.5t/hr, respectively.

For Labor   = 1742682 / 294464hr.   , and For Machine = 1742682 / 10593hr
                = 5.9u/hr.   = 164.5t/hr.

Dramatically in2011/12, the productivity of the Quarry Team had been declined from 5.9u/hr. to 1.2u/hr. and from 164.5t/hr. to 53.7t/hr. for Labor and Machine, correspondingly.

For Labor   = 482261 / 407456hr.   , and For Machine = 482261 / 8988hr.
                = 1.2u/hr.   = 53.7t/hr.

B. Cement Production Team

This group is responsible for producing both PPC and OPC. . Its productivity for the past three years, according to Labor and Machine, has been calculated as follows;

Table10. Machine and Labor Productivity of the Cement Production team

Year	Output	Labor Hour	Machine Hour	Labor Productivity	Machine Productivity
2009-10	656911 Quintal	342400 hr.	6848 hr.	1.9 u/hr.	95.9 quintals/hr.
2010-11	915408 Quintal	453680 hr.	7704 hr.	2 u/hr.	118.8 quintals/hr.
2011-12	269575 Quintal	607760 hr.	5992 hr.	0.4 u/hr.	45 quintals/hr.

Table 10 has portrayed the Labor and Machine productivity of the Cement Production Team. As depicted in the table, in 2009/10 the productivity of labor and machine had been 1.9qu/hr. and 95.9qu/hr., respectively. The determinants for this result are both Labor and Machine.

For Labor   = 656911q / 342400hr.   , and For Machine = 656911q / 6848hr
                = 1.9q/hr.   = 95.9q/hr.

In 2010/11 the productivity of the Cement Production Team had been increased, both in Labor and Machine, from 1.9q/hr. to 2q/hr. and from 95.9q/hr. to 118.8q/hr., correspondingly.

For Labor   = 915408q / 453680hr.   , and For Machine = 915408qu / 7704hr
                = 2q/hr.   = 118.8q/hr.

In2011/12 an astonished reduction had been occurred in production, and by this the productivity of the Cement Production Team was diminished from 2q/hr to o.4 q/hr. and from 118.8q/hr. to 45q/hr. for Labor and Machine, respectively.

For Labor   = 269575q / 607760hr.   , and For Machine = 269575q / 5992hr.
                   = o.4q/hr.   = 45q/hr.

Multifactor Productivity

Multifactor Productivity =	$\dfrac{\text{Output}}{\text{Labor Hour + Machine Hour}}$

Table11. Multi factor productivity

Year	Total Output of Quarry and Cement production team in production Department	Total Hour of Machine and Labor	Multifactor Productivity
2009-10	1907985	581438 hr.	3.28q/hr.
2010-11	2658090	776441 hr.	3.42q/ hr.
2011-12	751836	1030196 hr.	0.7q/hr.

Labor and machine hour were used while conducting Multifactor productivity.
Table 11 illustrated the Multifactor productivity of the production department. In 2009/10 the productivity of the production department had become 3.28q/hr. labor and machine hour were used while conducting Multifactor productivity.

          = 1907985 / 581438hr
                   = 3.28q/hr.

In 2010/11 the Multifactor productivity of the production department was improved in a pleasant manner. It increased from 3.28q/hr to 3.42q/hr within a year. This is because the commitment of production department to increase productivity by hiring more labor.

          = 2658090 / 776441hr.
                   = 3.42q/hr.

Unfortunately, in 2011/12, Multifactor productivity of the department was reduced from 3.42q/hr. to 0.7q/hr.

          = 751836 / 1030196hr.
                   = o.7q/hr.

Productivity Growth

Productivity Growth =   Current Period Productivity – Previous Period Productivity
                          Previous Period Productivity

At 2010/11 the productivity of Messebo Cement Factory had been slightly grown as follows:

Productivity Growth = $\dfrac{3.42 - 3.28}{3.28}$
                         = 0.04

At 2011/12 the productivity of Messebo Cement Factory was substantially declined:

Productivity Growth = $\dfrac{0.7 - 3.42}{3.42}$
                         = -0.8

Reasons for Productivity Growth in 2010/11

Comparing with the late previous year, 2009/10, Messebo's productivity had been tended to grow. This comes because of the following main factors:

➢ **Adequate work-Force;** the factory hired skilled and adequate work-force in the production department.
➢ **Technology;** installation of the main computer network in central control room and in the department control stations.

Reasons for Productivity Decline in 2010/11

In 2011/12 **the productivity of the factory decreased profoundly. The followings are the factors that have led the factory to lower productivity:**

➢ **Poor anticipation of Labor and Demand;** The launching of Dereba cement factory nullifies the forecasts of the personnel department as well as the sales department of Messebo cement Factory.
➢ **Intense Competition;** currently Ethiopia has had above ten cement factories.
➢ **High price;** the price of Messebo cement factory product is releatively high when it is compared with its rivals. And this played a major role in Shift in demand. The decrease in demand results the decrease in production, which leads to the decrease on productivity in labor and machine.

6. Conclusion and recommendation

6.1. Conclusion

Based on the above analysis the following conclusion was given.

- ➢ Messebo Cement is facing with the reduction in its productivity while we are comparing the trends of its productivity
- ➢ The emergence of Derba cements factory leads to the decrease in demand of Messebo's cement.
- ➢ Using of technology intelligently, the increase in the demand of cement, market price and investing in human capital are important factors of productivity in Messebo cement.
- ➢ Having appropriate work-force leads Messebo to raise its productivity in 2010/11.

6.2. Recommendation

Based on the analysis and the discussion provided above we recommend the following points to Messebo cement factory.

- ❖ It is advisable to reduce the price of its products without affecting the quality which leads to increase in the demand of its products.
- ❖ Exporting is a good way to earn foreign currency which is vital for the company as well as the country of which the company is running its business. Since the competition in the national market is going intense it is better to engage in to the international market with increase in the quality of its products and packaging by considering cost of production.
- ❖ It is logical if the production department of Messebo Cement factory adopt layoff for the idle work-force by providing appropriate compensation.
- ❖ It is advisable if the factory uses promotional strategies to promote its products and return to the market.
- ❖ It will profoundly help, if the factory attentively follows its competitor's strategies and activities to give virtuous response to changes.
- ❖ It is better if the personnel and sales department of the factory forecast the future by considering different factors that affect both production and productivity.
- ❖ It is fruitful if the production department works together than ever with other functions in the factory.

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