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Analysis of Productivity using The Marvin E. Mundel Method

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Abstract

This study addressed the measurement of total productivity and the measurement of productivity for every input with the use of the method of Marvin E. Mundel. Then give the proposal on how the method enhancement productivity. The case study chosen involved a company in bread production in the urban area in the City of Padang, West Sumatera, Indonesia. These results prove the total productivity of the company tends abnormal, with the highest total production in March of 3.28% and the lowest total productivity in May was -6,07%. For results measurement productivity on input, the value is on income employee highest productivity in December was 15, 56%, and the lowest productivity in March amounted to -3,78%. Energy's highest productivity in April was 11.48%, and the lowest productivity in May amounted to -13,08%. Raw ingredients' highest productivity in April was 11.23%, and the lowest productivity in May amounted to -7,28%. Depreciation cost's highest productivity in August was 29.96%, and otherwise, the lowest productivity in May amounted to -79,46%. Transportation's highest productivity in December is by 15,56% as well as otherwise the lowest productivity in April amounted to -3,78%. And for enhancement of productivity with method give a proposal on each input. The conclusion from the productivity measurement on the company tends to be not stable. Productivity on value energy, raw materials, and costs depreciation experience a very significant decrease so that the need enhancement productivity with a suggestion for each input.

Keywords: Analysis, Productivity, Marvin E. Mundel Method, Salaries, Cost.

1. Introduction

In the industrial world, productivity measurement is fundamental for a company to maintain business competition very tight annually. Thus, every company is always required to improve performance in effectiveness and efficiency. Therefore, they can face competition in the industrial world from other companies and how the industry uses and processes all of its resources. It will continue to be effective in digesting energy sources so that the industry's opportunity to earn profits will continue to be huge. The interpretation of productivity involves a broad aspect, namely capital (including land), costs, labour, energy, equipment, and technology. Universally, productivity is the ratio between the output (output) achieved with the input (input) given. Productivity is also the result of effective input management and the effectiveness of achieving goals. Effectivity and efficiency will create great productivity [1, 2].

The company business is one of the companies engaged in bread production. So far, this company has never measured productivity. This company has a problem with production costs that creates instability in the value of output (income) and input (production costs).

This research aims to measure productivity using the Marvin E. Mundel method carried out at the Thai Tea HausQ business in Makassar. This study aims to measure partial productivity and total productivity. The results obtained from the analysis of the productivity measurement show that partial productivity and total productivity have increased [3].

Productivity research using the Marvin E. Mundel method has also been carried out on oil palm processing at PTPN V Sungai Pagar, Kampar district. The analysis shows that the highest productivity index was in February 2017, and the lowest productivity index was in February 2016 [4].

Similar research was conducted on a CV. Gavra Parkas. The results show that not all inputs have decreased, so the cause of the company's total productivity is 98.18% impact the company [5].

Another research was also conducted at PT. Megayaku Prime Packaging. The result shows that data processing carried out by partial productivity calculations resulted in the productivity index for 2018 and 2019 increasing in April 2019. The highest productivity index value was 297.72% in May 2019. For several periods, the maintenance productivity index decreased. The lowest decline in the productivity index was 14.82% in December 2018. This was due to the large number of maintenance costs that were not matched by the high number of production and the limited number of machines that made the machines work continuously, so they frequently needed machine maintenance [6].

Similar research has also been conducted at CV. Nipson Industrial Coatings. This industry had no time to carry

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out productivity measurements, so this research is useful to identify aspects that cause productivity decline. The results prove that there is a decrease in productivity [7].

Similar research has also been done before. This research used the procedure of Marvin E. Mundel and the American Productivity Center (APC). This research aimed to identify efficiency and productivity as determinants of creative industry performance in the Semarang area. The results proved that industrial craft creativity in the research area is not yet efficient, either technically, allocated, or productive, and lies in a declining productivity level [8].

Other research has also been conducted at PT. Nusantara II plantations, Palm Oil Mill, Palm Oil Seberang Langkat. It proved that if the productivity index is applied, the total productivity index is 161.97%. Industrial productivity can increase by 50% after a maintenance design is carried out [9].

Similar research was also conducted on the Textile and Textile Product Industry in Central Java. This study uses the American Productivity Center (APC) and Marvin E. Mundel methods. This research aimed to examine the importance of productivity and effectiveness further of product development in the textile and textile product industry in Central Java. In the analysis, productivity decreased except for the capital input variable whose productivity level did not decrease [10].

Research with the same problem on productivity has also been carried out at PT. Sejahtera Furmindo. It is a well-established export furniture company in Central Java. The results of this research proved that PT. Sejahtera Furmindo was able to increase the productivity index, profitability index, and price increases from 2013 to 2017. On the contrary, the average profitability index increased 1.6% per year, and the average price increase index increased by 0.77% per year [11].

Research with the same problem in productivity has also been tried at the Plate Factory. The industry is facing a decrease in the level of production in December 2018, which requires an assessment in calculating industrial performance by measuring productivity using OMAX. Based on the results, industrial productivity in December 2018 in week 3 had the highest production value, whereas week 4 had the lowest productivity value [12].

Research in measuring productivity using the Marvin E. Mundel procedure was also carried out at PT. Abadi Water Pandaan, Pasuruan, East Java. This research aims to increase productivity and minimize waste. The Marvin E. Mundel and Lean Manufacturing models are perfectly suitable for solving this problem because they are related to maximizing the creation process. This research creates a productivity index on 5 inputs, in the form of labour, depreciation, materials, and maintenance. From data processing, the lowest input index in June 2020 was 83.49%, and the highest was in July 2020, which was 126.93%. To reduce waste, 3 pieces of equipment were selected in the form of PAM, SCRM, and QFM [13].

Similar research was also conducted at PT Raffsya Media. This research aims to increase productivity so that it is expected to increase profits. The results of this research are the average value of the productivity index which is less than 100%, the value of the productivity index which has reached less than 50%, and the value of the largest difference between the achievement of the productivity index target. The input of the average value of the productivity index, which is less than 100% is material (98, 85%) and labour (95, 11%). The input value of the productivity index, which is less than 50% is capital (46, 19%). The inputs with the highest productivity index difference between the industry's achievements and targets are: combed cotton fabrics (- 359, 18%), Lacoste fabrics (- 274, 19%), baby terry fabrics (- 266, 01%), labor (- 298, 72%), as well as capital (- 486, 27%). The inputs that became the focus of the revision were then analysed, and eight alternative proposals were proposed [14].

Research with the same problem was also tried at PT XYZ. The industry faces cases where resources are not optimal, so a productivity measurement is to increase the resources in the industry. The results of the research-tested productivity analysis in the period March 2015 s. d. March 2016 shows a shrinking performance as indicated by some of the undervalued ratios. The grouping of the types of evaluation of the ratio values uses the Traffic Light System procedure. The use of the OMAX method was tried as an analysis of PT XYZ's productivity increase in increasing the productivity of long-term adrift energy sources [15].

Research to measure productivity has also been tried in the UD teak industry. Easy Sido Lamongan. This research uses the procedures of the American Productivity Center (APC) and Marvin E. Mundel. The results of this research prove that in the APC procedure, the labour productivity index is 99,815, the labour productivity is 100,105, then the capital productivity is 99,421 and the raw material productivity is 103,482. Next for the Marvin E. Mundel procedure. Distributing the results of labour productivity of 100,73 labour productivity of 101.02, capital productivity of 100,33 [16].

Similar research was also conducted at PT X, which produces components for 2-wheeled and 4-wheeled vehicles. This research used the American Productivity Center (APC) and Marvin E. Mundel procedures. From the calculation results, the productivity value with the Mundel model of the total industrial production index in May was 104, 90% (+4, 90), in June was 101, 09% (+1, 09), in July was 106.08%(+6, 08), in August was

104, 97%(+4, 97), and in September was 106, 84%(+6, 84). Meanwhile, using the APC model, the total industrial production index in May was 101, 46%(+1, 46), in June was 98, 11%(- 1, 84), and in July was 99, 83%(- 0, 17).), in August was 99, 78%(- 0, 22), and in September was 101, 52%(+1, 52). Based on the results of the comparison of the two models, the industry can sort out the Mundel model because it shares calculation results that are more specific than the APC model [17].

The Marvin E. Mundel method can be compared to determine the level of productivity for each input. The purpose of the research is to know the total and to know the measurement results on the input value, which includes employee salaries, energy, raw materials for depreciation, and transportation costs, and increase productivity from the measurement results that have been carried out. The test results will find out whether the company experienced a decrease or increase in productivity during the measurement period, find out what factors caused a production decrease, and then provide a proposal for improvement for each input that has decreased.

2. Research Method

The method used is Marvin E. Mundel for productivity measurement. Place of research conducted in the bread company in West Sumatra, Indonesia. The research was carried out from December 21, 2021, to January 22, 2022. The data used in this study are output data, namely the amount of income in January-December 2021 obtained from bread production, and input data, namely labour, energy, raw material costs, depreciation costs, and transportation costs in January-December 2021. Below is a data recapitulation of output and input data in Table 1.

Table 1. Recapitulation of Output and Input Data

Month	Salaries (Rp)	Energy (Rp)	Raw Materials (Rp)	Depreciation Cost (Rp)	Transportation (Rp)	Income (Rp)
January	18.000.000	8.400.000	8.150.000	520.000	1.500.000	61.607.500
February	18.000.000	8.250.000	7.950.000	400.000	1.500.000	61.197.500
March	18.000.000	7.500.000	7.300.000	380.000	1.500.000	60.340.000
April	18.000.000	7.250.000	7.050.000	450.000	1.500.000	59.277.500
May	18.000.000	10.500.000	9.550.000	2.750.000	1.500.000	66.935.000
June	18.000.000	9.250.000	8.600.000	420.000	1.500.000	61.305.000
July	18.000.000	9.800.000	9.100.000	600.000	1.500.000	64.365.000
August	18.000.000	9.100.000	8.450.000	400.000	1.500.000	61.587.500
September	18.000.000	9.800.000	9.100.000	1.750.000	1.500.000	65.272.000
October	18.000.000	10.450.000	9.550.000	630.000	1.500.000	67.920.000
November	18.000.000	10.650.000	9.850.000	590.000	1.500.000	69.647.500
December	18.000.000	10.700.000	9.700.000	1.200.000	1.500.000	71.195.500

This study uses quantitative data because the data in this study are in the form of numbers and use statistical analysis. This research begins by conducting a literature study related to research or theory on productivity measurement using the Marvin E. Mundel method.

After data collection is complete, the next steps after obtaining data, are:

a. Measurement of total productivity and measurement of productivity on input values include employee salaries, energy, raw materials, depreciation, and transportation costs.

In measuring total productivity, productivity on input values includes employee salaries, energy, raw materials, depreciation, and transportation costs using Equation (1).

$$\text{IP Total} = \frac{\text{AOMP/AOBP}}{\text{RIMP/RIBP}} \times 100\ \% \qquad (1)$$

Where IP is the productivity index, AOMP is aggregate output for the period measured, AOBP is aggregate output for the base period, RIMP is input for the measured period, and RIBP is input for the base period.

b. How to increase productivity at the company. To increase productivity from the results obtained is to know and analyse the causes of factors that affect productivity and then make improvements in each part that has decreased productivity by providing suggestions for improvements to each input.

3. Result and Discussion

The first stage is to measure total productivity which compares the output (output) with the sum of all input factors (input). In measuring total productivity from January to December 2021, the highest value was found in March, which was 3.28%, and the lowest total productivity was in May, which was -6.07%. The following Table 2 calculates the total productivity from January-December 2021.

Table 2. Measurement of Total Productivity

Month	Income (Rp)	Production Cost (Rp)	Productivity (%)	Productivity Gaps (%)	Description
January	61.607.500	36.570.000	100,00	0	Constant
February	61.197.500	36.100.000	100,63	0,63	Increase
March	60.340.000	34.680.000	103,28	3,28	Increase
April	59.277.500	34.250.000	102,74	2,74	Increase
May	66.935.000	42.300.000	93,93	-6,07	Decrease
June	61.305.000	37.770.000	96,35	-3,65	Decrease
July	64.365.000	39.000.000	97,97	-2,03	Decrease
August	61.587.500	37.450.000	97,62	-2,38	Decrease
September	65.272.000	40.150.000	96,50	-3,50	Decrease
October	67.920.000	40.130.000	100,47	0,47	Increase
November	69.647.500	40.590.000	101,85	1,85	Increase
December	71.195.500	41.100.000	102,83	2,83	Increase

Measurement of productivity on input values which include employee salaries, energy, raw materials, depreciation costs, and transportation.

Partial productivity (single-factor productivity) is the ratio of output to one type of input. The following is the productivity measurement at the output value which includes employee salaries, energy, raw materials, depreciation costs, and transportation.

a. Employee salaries

The results of productivity on the input value of employee salaries were where the highest productivity was in December at 15.56%, and the lowest productivity was in March at -3.78%. Table 3 of productivity calculations on the input value of employee salaries.

Table 3. Employee Salaries

Month	Output (Rp)	Salaries (Rp)	Productivity (%)	Productivity Gaps (%)	Description
January	61.607.500	18.000.000	100,00	0,00	Constant
February	61.197.500	18.000.000	99,33	-0,67	Decrease
March	60.340.000	18.000.000	97,94	-2,06	Decrease
April	59.277.500	18.000.000	96,22	-3,78	Decrease
May	66.935.000	18.000.000	108,65	8,65	Increase
June	61.305.000	18.000.000	99,51	-0,49	Decrease
July	64.365.000	18.000.000	104,48	4,48	Increase
August	61.587.500	18.000.000	99,97	-0,03	Decrease
September	65.272.000	18.000.000	105,95	5,95	Increase
October	67.920.000	18.000.000	110,25	10,25	Increase
November	69.647.500	18.000.000	113,05	13,05	Increase
December	71.195.500	18.000.000	115,56	15,56	Increase

b. Energy

The results of productivity on the value of energy inputs experienced a decrease in productivity from May-December. The highest productivity in April is 11.48%, and the lowest productivity in May is -13.08%. Table 4 for calculating productivity at the energy input value.

Table 4. Energy

Month	Output (Rp)	Energy Input (Rp)	Productivity (%)	Productivity Gaps (%)	Description
January	61.607.500	8.400.000	100,00	0,00	Constant
February	61.197.500	8.250.000	101,14	1,14	Increase
March	60.340.000	7.500.000	109,70	9,70	Increase
April	59.277.500	7.250.000	111,48	11,48	Increase
May	66.935.000	10.500.000	86,92	-13,08	Decrease
June	61.305.000	9.250.000	90,36	-9,64	Decrease
July	64.365.000	9.800.000	89,55	-10,45	Decrease
August	61.587.500	9.100.000	92,28	-7,72	Decrease
September	65.272.000	9.800.000	90,81	-9,19	Decrease
October	67.920.000	10.450.000	88,62	-11,38	Decrease
November	69.647.500	10.650.000	89,17	-10,83	Decrease
December	71.195.500	10.700.000	90,72	-9,28	Decrease

c. Raw materials

The results of productivity on the value of input raw materials decreased productivity from May-December. The highest productivity in April was 11.23%, and the

lowest productivity was in May, which was -7.28%. Table 5 is a calculation of productivity at the input value of raw materials.

Table 5. Raw Materials

Month	Output (Rp)	Energy Input (Rp)	Productivity (%)	Productivity Gaps (%)	Description
January	61.607.500	8.150.000	100,00	0,00	Constant
February	61.197.500	7.950.000	101,83	1,83	Increase
March	60.340.000	7.300.000	109,35	9,35	Increase
April	59.277.500	7.050.000	111,23	11,23	Increase
May	66.935.000	9.550.000	92,72	-7,28	Decrease
June	61.305.000	8.600.000	94,30	-5,70	Decrease
July	64.365.000	9.100.000	93,57	-6,43	Decrease
August	61.587.500	8.450.000	96,42	-3,58	Decrease
September	65.272.000	9.100.000	94,89	-5,11	Decrease
October	67.920.000	9.550.000	94,08	-5,92	Decrease
November	69.647.500	9.850.000	93,54	-6,46	Decrease
December	71.195.500	9.700.000	97,10	-2,90	Decrease

d. Depreciation cost

The results of productivity on the input value of depreciation costs were where the highest productivity in August was 29.96%, and the lowest productivity in May was -79.46%. Table 6 of productivity calculations at the input value of depreciation costs.

Table 6. Depreciation Costs

Month	Output (Rp)	Energy Input (Rp)	Productivity (%)	Productivity Gaps (%)	Description
January	61.607.500	520.000	100,00	0,00	Constant
February	61.197.500	400.000	129,13	29,13	Increase
March	60.340.000	380.000	134,03	34,03	Increase
April	59.277.500	450.000	111,19	11,19	Increase
May	66.935.000	2.750.000	20,54	-79,46	Decrease
June	61.305.000	420.000	123,20	23,20	Increase
July	64.365.000	600.000	90,55	-9,45	Decrease
August	61.587.500	400.000	129,96	29,96	Increase
September	65.272.000	1.750.000	31,48	-68,52	Decrease
October	67.920.000	630.000	91,00	-9,00	Decrease
November	69.647.500	590.000	99,64	-0,36	Decrease
December	71.195.500	1.200.000	50,08	-49,92	Decrease

e. Transportation

The results of productivity on the value of transportation inputs where the highest productivity in December is 15.56%, and the lowest productivity in April is -3.78%. Table 7 of productivity calculations on the value of transportation inputs .

Table 7. Transportation

Month	Output (Rp)	Energy Input (Rp)	Productivity (%)	Productivity Gaps (%)	Description
January	61.607.500	1.500.000	100,00	0,00	Constant
February	61.197.500	1.500.000	99,33	-0,67	Decrease
March	60.340.000	1.500.000	97,94	-2,06	Decrease
April	59.277.500	1.500.000	96,22	-3,78	Decrease
May	66.935.000	1.500.000	108,65	8,65	Increase
June	61.305.000	1.500.000	99,51	-0,49	Decrease
July	64.365.000	1.500.000	104,48	4,48	Increase
August	61.587.500	1.500.000	99,97	-0,03	Decrease
September	65.272.000	1.500.000	105,95	5,95	Increase
October	67.920.000	1.500.000	110,25	10,25	Increase
November	69.647.500	1.500.000	113,05	13,05	Increase
December	71.195.500	1.500.000	115,56	15,56	Increase

Based on the calculation results, efforts and suggestions will be made for the company to increase productivity. Before taking steps to increase a firm's productivity, first determine the cause of the decline in productivity for each input. The following recommendations for increasing productivity can be seen in the Table 8.

Table 8. Proposed Productivity Improvement

Item	Main Factors/Causes	Efforts to Increase Productivity
Salaries	Decreased income caused by low bread production	Reduce labour or increase the amount of bread production
Energy	High cost of energy	Reducing energy costs as low as possible by saving energy, such as using lights and using temporary electricity-related tools
Raw Materials	Number of defective products	Make target and percentage of defective products
	Inventory of raw materials that are not as expected	Carry out safety stock of raw materials
Depreciation Cost	The number of costs for maintenance on vehicles or machines	The need for routine maintenance on the car or engine and perform regular checks every month
Transportation	Decreased income caused by the low amount of bread production so that transportation costs become noticeably large	If the amount of bread production decreases, it is better if the expenditure on transportation costs is reduced from the usual amount

4. Conclusion

The conclusions obtained on the productivity measurement using the Marvin E. Mundel method are the total production value tends to be unstable, with the highest total productivity in March of 3.28% and the lowest total productivity in May of -6.07%. Measure the productivity of each input, such as employee salaries. The highest productivity occurred in December at 15.56%, and the lowest productivity occurred in March at -3.78%, while productivity for energy input decreased from May-December. The highest productivity was in April at 11.48%, and the lowest productivity was in May at -13.08%. Raw material input productivity decreased from May-December. The highest productivity was in April at 11.23%, and the lowest productivity was in May at -7.28%. Input depreciation costs, where the highest productivity was in August at 29.96% and the lowest productivity was in May at -79.46%, and transportation facilities, where the highest productivity was in December at 15.56%, and the lowest productivity was in April at -3.78%.

In increasing productivity at the company, it is necessary to find out the cause of the significant decrease in productivity in energy inputs, raw materials, and depreciation costs, then provide suggestions for inputs that have decreased productivity. The proposed energy input is to reduce energy costs as low as possible by saving energy, such as the use of lamps and temporary electricity-related equipment. For the raw materials, the suggestions given are to make targets and the percentage of defective products. Thus, the next effort is to carry out safety stock of raw materials and input depreciation costs. The advice given is the need for car or engine maintenance and periodic checks every month.

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