Productivity Evaluation Through American Productivity Center Approach at PT Sejahtera Furnindo

by A A S Manik Mahachandra J M

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Ahmudi[1], M Mahachandra[1] and N U Handayani[1]

Industrial Engineering Department, Faculty of Engineering, Diponegoro University, Tembalang, Semarang, Indonesia

ahmudi.80@gmail.com

Abstract. PT Sejahtera Furnindo, a well-established export furniture company in Central Java, currently only considering the profit level to study its performance. With this approach, company usually pays only a little attention to its resources usage efficiency, that makes it requires a large cost to carry out company activities. For finding a more comprehensive approach, this research offers an evaluation of company productivity measurement using American Productivity Approach (APC). Results of this study showed that total factor productivity during the measurement periods indicate a positive growth level. This illustrates its success in managing labor input and collective capital owned. However, the total productivity revealed a changing level of growth, which illustrated that company had not been able to manage the overall input successfully during the measurement periods. Efforts are needed to increase the profitability for the coming period, along with efforts to increase productivity that focus on increasing material productivity and capital productivity as input factors that were also significantly influenced its profitability.

1. Introduction

The success of company in carrying out its business can be seen from how the company uses and processes all of its resources[1]. The more efficient a company processes existing resources, the greater the company will get a profit which is a must for a company to face competition among similar industries [1]. One measure that can connect the input and output sides of a company is productivity [1]. Increased productivity in a performance measurement system is very necessary [3].

Increasing profit is the main goal for every company, including PT Sejahtera Furnindo. In a company performance measurement system, there are seven benchmarks that are considered, namely effectiveness, efficiency, quality, profitability, productivity, quality of work life, and innovation[5].

Basically, from year to year this company always makes improvements in all its production lines but no measurements are taken to determine the overall productivity index. From this background, the main problem faced in this study is that the company urgently need to determine its productivity index and evaluates its productivity.

2. Productivity

Productivity and production are two different meanings, where an increase in productivity means the use of efficiency from resources in producing goods and services. Many definitions of productivity have been made by international experts and agencies. Productivity includes two basic concepts, namely usability (efficiency) and use result (effectiveness), where power is used to describe the level of human resources, funds, and nature needed to produce certain results, while effectiveness to describe effect and

quality of the results sought. Total productivity is a formulation of a comparison of tangible output with tangible inputs [5].

2.1. Productivity Cycle

The formal concept called productivity cycle firstly introduced by [5] to be used in continuous productivity improvement. The program consists of four stages, i.e. Productivity Measurement, Productivity Evaluation, Productivity Planning and Productivity Improvement.

The Four elements are a cycle that must be carried out continuously and sustainably in order to obtain optimal benefits. The concept shows that productivity improvement programs must be preceded by productivity measurements. After the level of productivity is known, then the next step is to evaluate or compare the results that are now with the plans that have been previously set. Based on the results of this evaluation planned targets for productivity levels in both the short and long term. To achieve these targets, productivity improvements must be done formally.

2.2. Productivity Measurement Model of American Productivity Center (APC)

The APC model has put forward a measure of productivity that is defined as follows [6]:

$$\text{Productivity} = \frac{Sales\ Results}{Costs} = \frac{(Number\ of\ Outputs\ x\ per\ unit\ price)}{Number\ of\ inputs\ x\ cost\ per\ unit} \tag{1}$$

$$\text{Productivity} = \frac{(Number\ of\ outputs)}{Number\ of\ Inputs}\ x\ \frac{Price}{Cost} \tag{2}$$

$$Profitability = Productivity\ x\ Price\ improvement\ factors \tag{3}$$

The output prices and costs per unit of input every year are multiplied by the quantity of output produced and the quantity of inputs used in a certain period to obtain a price improvement index, the profitability index can be determined using the following formula:

$$IPH = IP\ X\ IPH\ or\ IP = IPF\ /\ IPH \tag{4}$$

Where: IPF: Profitability Index
              IP: Productivity Index
              IPH: Price Improvement Index

APC advantage can cover the shortcomings of other productivity, measurement methods, like OMAX which only assesses the level of productivity weighting [9]. APC is able to calculate productivity index, profitability index, and price improvement index [10]. Following table is previous study that examined productivity measurements.

Table 1. Some previous studies of productivity measurement

No	Title	Researcher	Objective	Methods
1	A review of literature on manufacturing systems productivity measurement and improvement	Huang (2006)	propose a productivity measurement methodology based on productivity level metrics	performance-based matrix method
2	Multifactor Productivity Measurements Model (MFPMM) as Effectual Performance Measures in Manufacturing	Wazed and Shahadat (2008)	to compare productivity measures that are usually used in industry with productivity measurement theories currently available	MFPMM

No	Title	Researcher	Objective	Methods
3	Productivity Measurement of Hi-tech Industry of China Malmquist Productivity Index – DEA Approach	Qazi and Yulin (2012)	to measure changes in productivity of the Chinese hi-tech industry using the Malmquist productivity index.	Malmquist productivity index.
4	Review of Productivity Measurement and Improvement procedures in Small and Medium Scale Manufacturing Industries	Deshmukh (2014)	productivity measurement and improvement procedures in small and medium scale manufacturing industries in the field of management at the business unit level	partial and total productivity measurement method
5	Partial and Total Productivity Measurement Models for Garment Manufacturing Firms	Shibabaw (2015)	developing a model of productivity measurement for garment manufacturing companies in Ethiopia	partial and total productivity measurement
6	Development of Productivity Measurement and Analysis Framework for Manufacturing Companies	Goshu and Matebu (2017)	Propose alternative methodologies for measuring productivity in Ethiopian leather shoe companies.	qualitative and quantitative approaches

3. Methodology
This study was conducted using observational research method, where primary and secondary data were observed and calculated from PT Sejahtera Furnindo as the case study.

3.1. Data Collection
Primary data collected were all input data relevant with labor, material, energy, and capital, as well as all output data that related to quantity and product price. Data of year 2013 and 2017 were able to accessed and used in the study.

3.2. APC Calculation.
Evaluating company productivity via APC approach can be carried out based on constant prices and prevailing prices [6].

3.2.1. Calculation based on constant prices.
Output index based on constant prices is calculated from the following equations:

$$\text{Basic year output} \quad O_0 = \sum_i^N QoxHOo \tag{5}$$

$$\text{Measured year output} \quad O_t = \sum_i^N QOtxHOt \tag{6}$$

$$\text{Output Index} \quad IO = \frac{Ot}{Oo} \tag{7}$$

Where: QO_0 : Base year output quantity
   QO_t : Measured year output quantity
   HO_0 : Base year output quantity

Labor input index based on constant prices is calculated from the following equations:

$$\text{Basic year labor input } L_o = \sum_i^N QLoxHLo \tag{8}$$

$$\text{Measured year labor input } L_t = \sum_i^N QL\,txHLt \tag{9}$$

$$\text{Labor input index } IL = \frac{Lt}{L0} \tag{10}$$

Total input index based on constant price is calculated from the following equations:

$$\text{Base year total input } I_0 = L_0 + M_0 + E_0 + K_0 \tag{11}$$

$$\text{Measured year total input } terukurI_t = L_t + M_t + E_t + K_t \tag{12}$$

$$\text{Total input index } IIT = \frac{It}{Io} \tag{13}$$

3.2.2. Calculation of input index uses prevailing price. Labor input with prevailing prices is calculated from the following equation:

$$\text{Base year labor input } L_0 = \sum_i^N QL0xHL0 \tag{14}$$

$$\text{Measured year labor input } L_t = \sum_i^N QLtxHLt \tag{15}$$

$$\text{Labor input index } IL = \frac{Lt}{L0} \tag{16}$$

Total input with prevailing price

$$\text{Base year total input} = L_0 + M_0 + E_0 + K_0 \tag{17}$$

$$\text{Measured year total input } I_t = L_t + M_t + E_t + K_t \tag{18}$$

$$\text{Total Input Index } IIT = \frac{It}{L0} \tag{19}$$

3.2.3. Calculation of profitability index uses prevailing price. Profitability index based on prevailing price is calculated from the following equations:

$$\text{Profitability index of labor input } IPF_L = \left(\frac{Io}{Io}\right) x\ 100 \tag{20}$$

$$\text{Profitability index of material input } IPF_M = \left(\frac{Io}{Im}\right) x\ 100 \tag{21}$$

$$\text{Profitability index of energy input } IPF_E = \left(\frac{Io}{IE}\right) x\ 100 \tag{22}$$

$$\text{Profitability index of capital input } IPF_k = \left(\frac{Io}{IK}\right) x\ 100 \tag{23}$$

$$\text{Profitability index of total input } IPF_T = \left(\frac{Io}{IIT}\right) x\ 100 \tag{24}$$

3.2.4. Calculation of price improvement index. Price improvement index is calculated from the following equations:

$$\text{Price improvement index for labor input } IPH_L = \frac{IPFL}{IPL} \tag{25}$$

$$\text{Price improvement index for material input } IPH_M = \frac{IPFM}{IPM} \tag{26}$$

$$\text{Price improvement index for energy input } IPH_E = \frac{IPFE}{IPE} \tag{27}$$

$$\text{Price improvement index for capital input } IPH_k = \frac{IPHK}{IPK} \tag{28}$$

$$\text{Price improvement index for total input } IPH_T = \frac{IPFT}{IPT} \tag{29}$$

4. Results and Discussion

4.1. Data Collection

Data of production output sales and input data (labor, material, energy and capital) were calculated based on constant prices in **Table 2** and based on prevailing prices **Table 3**.

Table 2. Output and input data based on constant prices

NO	Description	Constant Prices				
		Based Period 2013	Period 2 2014	Period 3 2015	Period 4 2016	Period 5 2017
(1)	(2)	(3)	(4)	(5)	(6)	(7)
		OUTPUT:				
1	Output Total	5,778,000,000	6,872,000,000	7,000,000,000	7,896,000,000	8,618,000,000
		INPUT:				
2	Labor	2,502,000,000	2,658,000,000	2,814,000,000	2,874,000,000	2,994,000,000
3	Material	313,250,000	348,575,000	404,175,000	434,700,000	460,700,000
4	Energy	13,837,161	14,523,261	15,690,126	16,503,787	16,956,431
5	Capital	2,420,778,800	1,902,000,700	1,570,142,650	1,429,017,625	1,247,407,600
6	Input Total	5,249,865,961	4,923,098,961	4,804,007,776	4,754,221,412	4,719,064,031

Table 3. Output and input data based on prevailing prices

NO	Description	Based on Prevailing Prices				
		Based Period 2013	Period 2 2014	Period 3 2015	Period 4 2016	Period 5 2017
(1)	(2)	(3)	(4)	(5)	(6)	(7)
		OUTPUT:				
1	Output Total	5,778,000,000	5,986,000,000	6,700,000,000	7,502,000,000	8,429,000,000
		INPUT:				
2	Labor	2,502,000,000	3,252,000,000	4,074,000,000	4,809,000,000	5,694,000,000
3	Material	313,250,000	404,765,000	569,825,000	695,975,000	771,875,000
4	Energy	13,837,161	14,523,261	15,690,126	16,503,787	17,047,001
5	Capital	2,420,778,800	1,891,473,700	1,564,977,150	1,411,670,125	1,235,042,600
6	Input Total	5,249,865,961	5,562,761,961	6,224,492,276	6,933,148,912	7,717,964,601

4.2. Data Processing

4.2.1. Calculation of partial productivity. Partial productivity ratio is calculated from the following equation:

$$\text{Partial productivity ratio} = \frac{Output\ Total}{Input\ Partial} \qquad (30)$$

4.2.2. Calculation of total factor productivity. Total productivity is calculated from the following equation:

$$\text{Total factor productivity ratio} = \frac{Net\ Output}{Input\ (Labour+Capital)} \qquad (31)$$

4.2.3. Productivity level measurement with APC Model. In processing this data several calculations were carried out in constant and prevailing price. Calculation of productivity index numbers using constant price in shown in Table 4, while calculation of profitability index numbers using prevailing prices is shown in Table 5. Moreover, calculation of price improvement index is then shown in Table 6.

Table 4. Output and input index of productivity during 2014 period against 2013 (base)

NO	Description	Constant Prices		Index		Change
		2013	2014	2013	2014	
(1)	(2)	(3)	(4)	(5)	(6=4/3)	(7= 6-5) %
		Output:				
1	Output Total	5,778,000,000	6,872,000,000	1	1.19	0.19
		Input:				
2	1. Labor	2,502,000,000	2,658,000,000	1	1.06	0.06
3	2. Material	313,250,000	348,575,000	1	1.11	0.11
4	3. Energy	13,837,161	14,523,261	1	1.05	0.05
5	4. Capital	2,420,778,800	1,902,000,700	1	0.79	-0.21
6	Input Total	5,249,865,961	4,923,098,961	1	0.94	-0.06
		Productivity(IP):				
7	1. Labor	2.309	2.585	100	111.95	11.95
8	2. Material	18.445	19.715	100	106.88	6.88
9	3. Energy	417.571	473.172	100	113.32	13.32
10	4. Capital	2.387	3.613	100	151.37	51.37
11	Productivity Total	1.101	1.396	100	126.83	26.83

Table 5. Output and input index of profitability during 2014 against 2013 (base)

NO	Description	Prevailing Prices		Index		Change
		2013	2014	2013	2014	
(1)	(2)	(3)	(4)	(5)	(6=4/3)	(7= 6-5) %
		Output:				
1	Output Total	5,778,000,000	5,986,000,000	1	1.04	0.04
		Input:				
2	1. Labor	2,502,000,000	3,252,000,000	1	1.30	0.30
3	2. Material	313,250,000	404,765,000	1	1.29	0.29
4	3. Energy	13,837,161	14,523,261	1	1.05	0.05
5	4. capital	2,420,778,800	1,891,473,700	1	0.78	-0.22
6	Input Total	5,249,865,961	5,562,761,961	1	1.06	0.06
		Profitability (IPF):				
7	1. Labor	-	-	100	79.71	-20.29
8	2. Material	-	-	100	80.18	-19.82
9	3. Energy	-	-	100	98.71	-1.29
10	4. capital	-	-	100	132.59	32.59
11	Profitability Total	-	-	100	97.77	-2.23

Table 6. Price improvement during 2014 period against 2013 (base)

NO	Input Factor	Profitability Index (PFI)	Productivity Index (PI)	Prices Improvement Index (PIH)
(1)	(2)	(3)	(4)	(5) = (3)/(4)
1	Labor	79.71	111.95	0.71
2	Material	80.18	106.88	0.75
3	Energy	98.71	113.32	0.87
4	Capital	132.59	151.37	0.88
5	Input Total	97.77	126.83	0.77

4.3. Analysis of Data Processing Results

4.3.1. Calculation Analysis of Partial Productivity. Analysis with this method is quite simple and easy to implement by a company to find out the ratio of output to one type of input.

4.3.2. Calculation Analysis of Total Factor Productivity. The ratio of total factor productivity is calculated as in Table 7.

Table 7. Ratio calculation of total factor productivity

Years	Output (Rp)	Labor (Rp)	Capital (Rp)	Productivity Ratio Total Factor	Index	Change (%)
2013	5,778,000,000	2,502,000,000	2,420,778,800	1.174	1.000	0
2014	6,872,000,000	2,658,000,000	1,902,000,700	1.507	1.284	0.284
2015	7,000,000,000	2,814,000,000	1,570,142,650	1.597	1.360	0.360
2016	7,896,000,000	2,874,000,000	1,429,017,625	1.835	1.563	0.563
2017	8,618,000,000	2,994,000,000	1,247,407,600	2.032	1.731	0.731

Based on the table the highest value ratio is in 2017, which is 2.032 or interpreted 2.32% of the product produced from the costs incurred by the company for capital and paying for its workforce.

4.3.3. Calculation Analysis of Total Productivity with American Productivity Center. The productivity index, profitability index, and prices improvement index calculation is shown in Table 8.

Table 8. Productivity, profitability index and prices improvement period 2013 to 2017

Index	Period					Average
	2013	2014	2015	2016	2017	
Productivity index	100	126.83	132.39	150.90	165.93	135.21
Profitability index	100	97.77	112.68	98.31	99.23	101.60
Prices improvement index	1	0.77	0.85	0.65	0.60	0.77

From **Table 8**, we can analyze the performance of PT Sejahtera Furnindo each year as follows:
- In 2014, the productivity increased by 26.83%, compared to labor productivity in base period. Similarly, the price improvement index increased by 0.77, which caused a decrease in profitability of 2.23%.
- In 2015, productivity increased by 32.39%, compared to productivity in the base period. The increment in productivity demonstrated by an 0.85% increment in the price improvement index, which was caused by an increase in the profitability index of 12.68%.
- In 2016, there was an increase in productivity 50.90%, compared to the productivity of the base period. Similarly, the price improvement index increased by 0.65%, which caused a decrease in the profitability index by 1.69%.
- In 2017, productivity was increased by 65.93%, compared to the base period. The price improvement index also increased 0.60%. However, the profitability index decreased by 0.77%.

4.4. Evaluation of Productivity

The next step is to evaluate decrease causes in company productivity during measurement period. To find out more details the problem causes in company productivity used to with formation of causal diagram. The following is an analysis for each input productivity, which graphed in **Figure 1**:
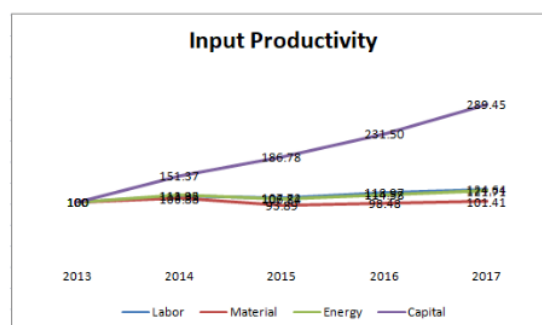
Figure 1. Input productivity

- Material Input
  2015 has the lowest material productivity level compared to other periods. The low material productivity in the 2015 period can be identified as: (1) Quality of raw materials received from supplier under standard; (2) Availability of raw materials in supplier is limited; (3) Operators are less careful in cutting raw materials so that much material is wasted.
- Labor Input
  In 2015 there was a decrease compared to the previous period. There are several things that must be evaluated for labor input including: (1) The length of time the machine is set up; (2) lack of motivation of the workforce due to the low system of rewards; and (3) Lack of workforce knowledge about techniques to improve company quality and productivity.
- Energy Input
  In 2015 there was a decline in productivity compared to the previous period, 2014. This was caused by several things including: (1) Overtime increases so that energy used also increase; and (2) the machine often breaks down or stalled in a standstill due to lack of raw materials.
- Capital Input
  The capital input increased every year. Increased capital productivity has not been followed by an increase in the profitability index. Evidently in 2014 there was a decrease in profitability of 2.23%, 2016 fell 1.69% and 2017 fell by 0.77%.

4.5. Planning Strategy of Corporate Productivity Improvement
The first step that can be done in improving productivity is to prioritize problems that are very influential in increasing productivity in accordance with the input factors of company.
- To maintain the quality of raw materials, additional quality control personnel to incoming materials is needed. Company also ought to tighten inspection of raw materials received from suppliers.
- To minimize the machine set up time, they must improve the operator skills by conducting regular training machine.
- To increase the workers' motivation, rewards system achieving target can be applied.

5. Conclusion
This observational study had revealed that PT Sejahtera Furnindo was able to increase the productivity index, profitability index, and price improvement from 2013 to 2017. This is something important that they do not realize before. The average productivity index has increased 35.2% per year, while the average profitability index made 1.6% increment per year, and the average price improvement index improved by 0.77% per year. Factors that can provide improvements in increasing the company

productivity was cost savings policy for workers, optimizing the use of raw materials, also energy saving by minimizing overtime working hours.

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