ISSN 2347 - 3983

Volume 11. No.12, December 2023

International Journal of Emerging Trends in Engineering Research

Available Online at http://www.warse.org/IJETER/static/pdf/file/ijeter0511122023.pdf

https://doi.org/10.30534/ijeter/2023/0511122023

Productivity Measurement to Monitor the Performance of Shrimp Cracker Companies

Siti Mundari[1], Herlina[2], Roziq Firmansyah [3]

[1] Fakultas Teknik, Universitas 17 Agustus 1945 Surabaya, Indonesia, mundari@untag-sby.ac.id

[2] Fakultas Teknik, Universitas 17 Agustus 1945 Surabaya, Indonesia, herlina@untag-sby.ac.id

[3] Fakultas Teknik, Universitas 17 Agustus 1945 Surabaya, Indonesia, roziqfirmansyah123@gmail.com

Received Date: October 22, 2023 Accepted Date: November 24, 2023 Published Date : December 07, 2023

ABSTRACT

High productivity over time for a company is important, but not enough. Ensuring that the company has a productivity index that gets better over time is more important. A better productivity index means that the company's productivity performance is getting better. That way the productivity index can be used as an indicator of success in making improvements to the Company's production process. This research will measure and analyze the productivity index of PT X in order to evaluate and improve the company's performance. By using the OMAX method, the results show that the productivity index in April 2023 was 106.7%. Furthermore, the month of May was -16.7%, June was 70.0%, July was 36.7%, August was 13.3% and September was 6.7%. And it was not in good condition. From the results of the analysis it turns out that the cause is the low production capacity of many defective products. Various improvements must be made by the Company, especially related to improving employee skills, improving the work environment, planned machine maintenance, and procuring standardized raw materials.

Key words : Company performance, OMAX method, productivity index, shrimp crackers.

1. INTRODUCTION

Crackers are one of Indonesia's most popular cash snacks. There are many kinds of crackers, one of which is shrimp crackers. Because it tastes good and nutritious, shrimp crackers are favoured by many people, so shrimp crackers have become one of the promising commodities.

Not only is the domestic market share growing, it turns out that the value of exports abroad also continues to increase. export destination markets are also increasing. East Java Sidoarjo shrimp crackers, for example, have now penetrated 30 countries and generated foreign exchange worth Rp 200 billion per month [1]. Some of the main export destinations for shrimp crackers are the Netherlands (US$ 8.7 million), the United Kingdom (US$ 4.1 million), South Korea (US$ 2.6 million), the People's Republic of China (US$ 1 million) and Germany (US$ 826 thousand). The value of exports continued to increase year on year by 6.9%.

Based on a report from the Central Statistics Agency, the export volume of crackers in January-November 2021 amounted to 20.47 million kg. This volume increased by 53.34% compared to exports in the same period in 2020 which amounted to 13.35 million kg. Meanwhile, the export value of crackers and chips for the January-November 2021 period was reported at US$52.02 million, an increase of 57.7% compared to the same period the previous year of US$32.98 million [2]. This fact stimulates the growth of many cracker companies, which in turn sharpens the level of competition.

PT X is one of the shrimp cracker companies located in Sidoarjo Regency, East Java-Indonesia, which also has to face the harsh reality of competition. So it requires managers to always monitor the company's performance in order to remain in a superior position among similar companies.

The company's performance in a certain time can be shown by high productivity. High productivity reflects how efficient the production process is [3]. But for the company's performance over time, the company's performance is not sufficiently indicated by high productivity, but must be indicated by an increasing productivity index. Because the higher this index will be an indicator of the company's success in empowering the resources owned better [4]. Finally, the increasing level of productivity can be used as a basis for the company's future planning [5].

In order to provide more objective information, the level of productivity is measured in detail to the components that support productivity. For this reason, this study will analyze the company's partial productivity level in order to provide input to managers as a basis for the company's future planning. By using the Objective Matrix (OMAX) method, the partial productivity measurement of PT X is carried out to monitor the productivity of the elements contained in the company based on the productivity criteria in accordance with the level of importance of the element [6]. The OMAX method allows companies to conduct a more detailed analysis related to the use of raw materials, labor, production equipment and others [7].

1.1 Objective Matrix (OMAX) Model

Objective Matrix (OMAX) was developed by James L. Riggs (Department of Industrial Engineering at Oregon State University). OMAX was introduced in the United States in the 80s [8]. Productivity measurement with OMAX is done on an objective matrix. The form of the matrix shows in Figure 1 is as follows [9]:

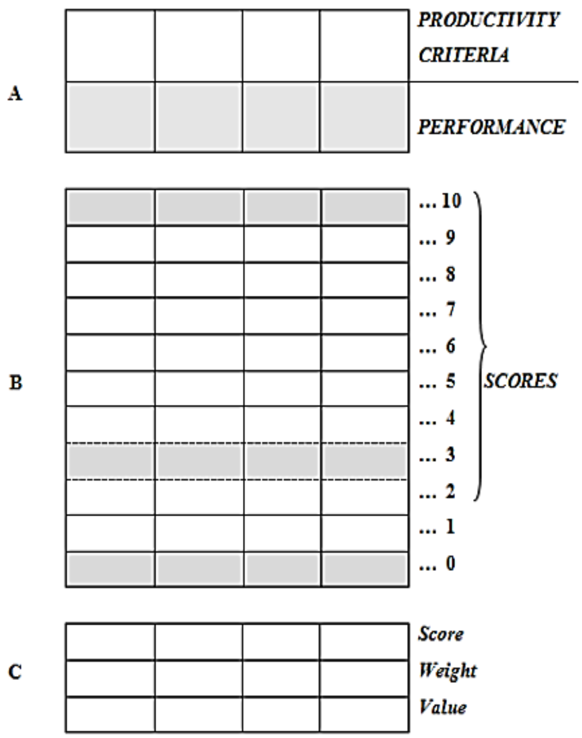

Figure 1: OMAX Matrix

Description:

A. Definition Block

Productivity Criteria, which are the criteria that measure productivity in the department where productivity will be measured.

Current performance, which is the current achievement value of each productivity based on the last measurement.

B. Quantification Block

It is a matrix body consisting of a scale that shows the performance level of the measurement of each productivity criterion. The scale has eleven levels from 0 to 10. The larger the scale, the better the productivity.

C. Productivity Assessment Block

The productivity assessment block consists of:

Score, which is the level value where the productivity measurement level is located.

Weight, which is the amount of weight from each productivity criterion to the total productivity.

Score, which is the result of multiplying each score with its weight.

Productivity Indicator is the sum of each criterion value. Based on the Productivity Indicator, the Productivity Index (IP) can be calculated based on the formula:

$$IP = \frac{Productivity\ Indicator - 300}{300}\ x\ 100\%$$

2. METHODOLOGY

Data was taken for 6 months from April 2023 to September 2023. The stages of problem solving use the concept of the productivity cycle to be used in improving productivity continuously [10]. This productivity cycle consists of four main activity stages, namely:

1. Productivity measurement
2. Productivity evaluation
3. Productivity planning
4. Productivity improvement.

Based on the concept of the productivity cycle, formally the productivity improvement program starts from measurement, then proceeds to evaluation, planning and finally productivity improvement.

2.1 Operational Definition of Variables.

The variables used in this study are shown in Table 1 below.

Table 1: Variables used.

Variable	Description
Number of Product Defects	Production results that are not in accordance with established standards/specification
Actual Production Result	Production results achieved
Production Capacity	Maximum ability to produce products
Production Plan	Scheduled production quantities
Raw materials Quantity	The main raw materials for making shrimp crackers

2.2. Criteria Determination

The criteria to be measured on the production floor are as follows:

Criterion 1 is the minimization of defective products (Ratio 1).
Criterion 2 is maximization of production capacity (Ratio 2).
Criterion 3 is optimization of production plan (Ratio 3).
Criterion 4 is the efficient use of shrimp raw materials (Ratio 4).

3.RESULTS AND DISCUSSION

Data collection was conducted for six months from April 2023 to September 2023. The data consists of the number of defective products, production capacity, production plan, and quantity of raw materials and the results are shown in Table 2.

Furthermore, based on the data in Table 2, the OMAX matrices are created for each period which is used to calculate the company's performance indicators and productivity index and the results are as shown in Table 3 through Table 8.

Table 2: Number of defective products, production capacity, production plan, quantity of raw materials

Month	Number of Defective Products (kg)	Production Capacity (kg)	Production Planning (kg)	Raw Material Quantity (kg)
April	3,740	35,000	31,250	525
May	2,218	35,000	25,062	425
June	2,437	35,000	31,750	405
July	2,317	35,000	28,500	410
August	2,228	35,000	24,000	339
September	2,349	35,000	21,500	385

Table 3: Performance indicators and productivity index April

Defect Product Minimization	Productin Capacity Optimality	Production Planning Optimality	Material Efficiency	Productivity Criteria
0.128	0.833	0.933	55.495	Performance
0.136	0.938	0.962	77.814	10
0.131	0.907	0.958	74.625	9
0.127	0.876	0.954	71.437	8
0.122	**0.845**	0.950	68.249	7
0.117	0.814	0.945	65.060	6
0.112	0.783	0.941	61.872	5
0.107	0.751	0.937	58.683	4
0.102	0.720	**0.933**	**55.495**	3
0.090	0.648	0.922	51.820	2
0.079	0.575	0.912	48.146	1
0.067	0.502	0.901	44.471	0
8	7	3	3	Score
40	30	20	10	Weight
320	**210**	**60**	**30**	Value

(SCORE)

Performance Indicator	Current	Previous	Index
	620	300	106.7%

Table 4: Performance indicators and productivity index May

Defect Product Minimization	Productin Capacity Optimality	Production Planning Optimality	Material Efficiency	Productivity Criteria
0.100	0.660	0.920	54.380	Performance
0.136	0.938	0.962	77.814	10
0.131	0.907	0.958	74.625	9
0.127	0.876	0.954	71.437	8
0.122	0.845	0.950	68.249	7
0.117	0.814	0.945	65.060	6
0.112	0.783	0.941	61.872	5
0.107	0.751	0.937	58.683	4
0.102	0.720	0.933	**55.495**	3
0.090	**0.648**	**0.922**	51.820	2
0.079	0.575	0.912	48.146	1
0.067	0.502	0.901	44.471	0
3	2	2	3	Score
40	30	20	10	Weight
120	**60**	**40**	**30**	Value

(SCORE)

Performance Indicator	Current	Previous	Index
	250	300	-16.7%

Table 5: Performance indicators and productivity index June

Defect Product Minimization	Productin Capacity Optimality	Production Planning Optimality	Material Efficiency	Productivity Criteria
0.080	0.860	0.950	74.390	Performance
0.136	0.938	0.962	77.814	10
0.131	0.907	0.958	**74.625**	9
0.127	**0.876**	0.954	71.437	8
0.122	0.845	**0.950**	68.249	7
0.117	0.814	0.945	65.060	6
0.112	0.783	0.941	61.872	5
0.107	0.751	0.937	58.683	4
0.102	0.720	0.933	55.495	3
0.090	0.648	0.922	51.820	2
0.079	0.575	0.912	48.146	1
0.067	0.502	0.901	44.471	0
1	8	7	9	Score
40	30	20	10	Weight
40	**240**	**140**	**90**	Value

(SCORE)

Performance Indicator	Current	Previous	Index
	510	300	70.0%

Table 6: Performance indicators and productivity index July

Defect Product Minimization	Producin Capacity Optimality	Production Planning Optimality	Material Efficiency	Productivity Criteria	
0.090	0.770	0.940	65.580	Performance	
0.136	0.938	0.962	77.814	10	SCORE
0.131	0.907	0.958	74.625	9	
0.127	0.876	0.954	71.437	8	
0.122	0.845	0.950	68.249	7	
0.117	0.814	**0.945**	**65.060**	6	
0.112	**0.783**	0.941	61.872	5	
0.107	0.751	0.937	58.683	4	
0.102	0.720	0.933	55.495	3	
0.090	0.648	0.922	51.820	2	
0.079	0.575	0.912	48.146	1	
0.067	0.502	0.901	44.471	0	
2	5	6	6	Score	
40	30	20	10	Weight	
80	**150**	**120**	**60**	Value	
Performance Indicator		Current 410	Previous 300	Index 36.7%	

Table 7: Performance indicators and productivity index August

Defect Product Minimization	Producin Capacity Optimality	Production Planning Optimality	Material Efficiency	Productivity Criteria	
0.100	0.640	0.940	66.580	Performance	
0.136	0.938	0.962	77.814	10	SCORE
0.131	0.907	0.958	74.625	9	
0.127	0.876	0.954	71.437	8	
0.122	0.845	0.950	68.249	7	
0.117	0.814	0.945	**65.060**	6	
0.112	0.783	**0.941**	61.872	5	
0.107	0.751	0.937	58.683	4	
0.102	0.720	0.933	55.495	3	
0.090	**0.648**	0.922	51.820	2	
0.079	0.575	0.912	48.146	1	
0.067	0.502	0.901	44.471	0	
3	2	5	6	Score	
40	30	20	10	Weight	
120	**60**	**100**	**60**	Value	
Performance Indicator		Current 340	Previous 300	Index 13.3%	

Table 8: Performance indicators and productivity index September

Defect Product Minimization	Producin Capacity Optimality	Production Planning Optimality	Material Efficiency	Productivity Criteria	
0.120	0.550	0.900	50.440	Performance	
0.136	0.938	0.962	77.814	10	SCORE
0.131	0.907	0.958	74.625	9	
0.127	0.876	0.954	71.437	8	
0.122	0.845	0.950	68.249	7	
0.117	0.814	0.945	65.060	6	
0.112	0.783	0.941	61.872	5	
0.107	0.751	0.937	58.683	4	
0.102	0.720	0.933	55.495	3	
0.090	0.648	0.922	**51.820**	2	
0.079	**0.575**	0.912	48.146	1	
0.067	0.502	**0.901**	44.471	0	
7	1	0	1	Score	
40	30	20	10	Weight	
280	**30**	**0**	**10**	Value	
Performance Indicator		Current 320	Previous 300	Index 6.7%	

The progress of month-to-month productivity index changes over six months can be seen in the Figure 2

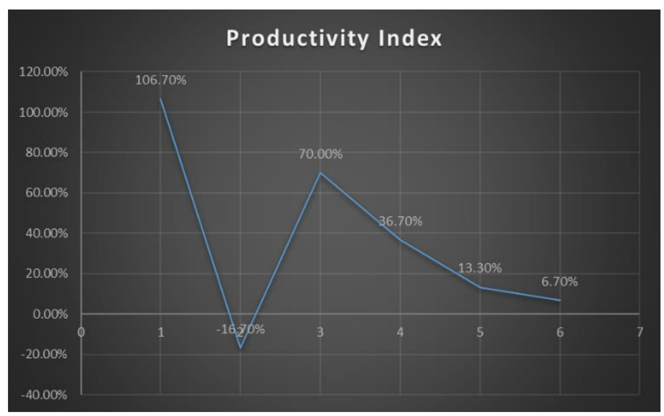

Figure 2: Month-on-month productivity index.

Figure 2 shows that the company's productivity index is not in good condition. This means that the company's productivity from month to month does not show an increasing trend, fluctuating with the lowest value occurring in May. This shows that not all productivity components have good performance.

3.1 Root Cause Analysis of Problems

From the results of the ratio calculation, then look for the number of scores below 3. It turns out that there are three criteria whose scores are below 3. First, the defective product minimization criteria occurred in June with a weight of 40.

Second, the production plan optimization criteria occurred in July with a weight of 20. And third, the raw material efficiency criteria with a weight of 10 as shown in Table 9:

Table 9: Total score productivity criteria

Productivity Criteria	Total score	Weight	Cumulative Value	Accumulative %
Defect Product Minimization	2	40	80	36.36%
Production Capacity Optimality	3	30	90	77.27%
Production Planning Optimality	2	20	40	95.45%
Material Efficiency	1	10	10	100.00 %

From the Pareto diagram, the accumulated weight of the criteria for optimizing production capacity and the criteria for minimizing defective products has almost touched the 80% mark as shown in Figure 3. Therefore, these two criteria are the main focus of the analysis to find the cause of the declining productivity index.

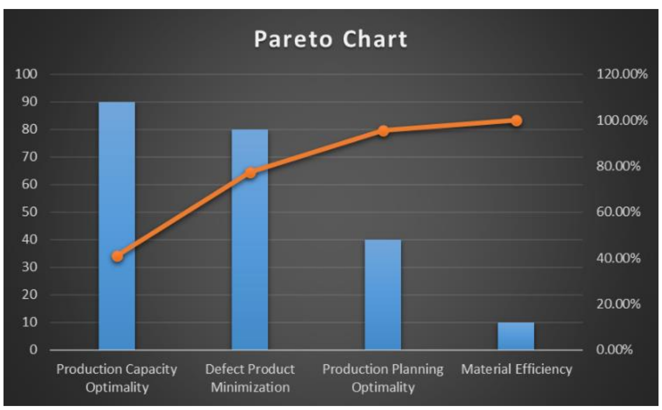

Figure 3: Pareto diagram of each criterion.

For production capacity optimality criteria. From the results of the cause-and-effect analysis of the human, material, machine, environment and method factors, several causes were obtained that made the production capacity low. Each cause can be seen in Figure 4 below:

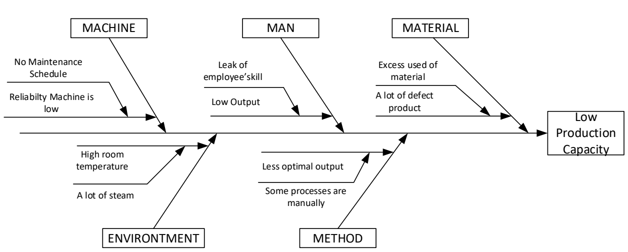

Figure 4: Cause-and-effect diagram of low production capacity

Explanation:

a. Human Factors
   Low employee skills lead to low production output
b. Material Factors
   Many raw materials are of poor quality, resulting in many defective products.
c. Machine Factors
   There is no planned maintenance schedule causing machine erring downtime.
d. Method Factor
   Part of the production process is still done manually so that the end result is not optimal.
e. Environmental Factors
   The hot steam of the steamer and boiler machines makes the temperature of the production room hot.

Mean while, for defect product minimization criteria. From the results of the cause-and-effect analysis of the human, material, machine, environment and method factors, several causes were obtained that made the defect product high. Each cause can be seen in Figure 5 below:

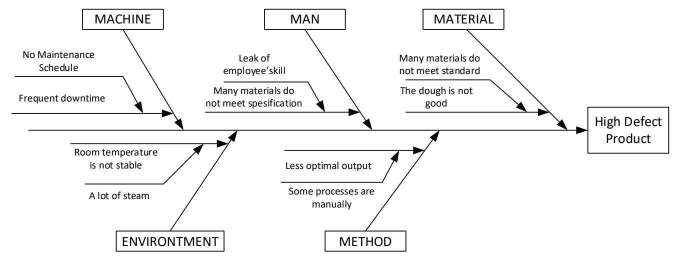

Figure 5: Cause-and-effect diagram of high rate of defect product

Explanation:

1. Human Factors
   Many products do not meet specifications due to low employee skills.
2. Material Factors
   Flour dough does not meet the standard, this is due to the quality of raw materials not in accordance with standard specifications.
3. Machine Factors
   Frequent machine stops due to lack of machine maintenance.
4. Method Factor
   The final result is less ma because it still uses a manual process.
5. Environmental Factors
   Unstable room temperature due to the influence of hot steam from production machines.

3.2. Improvement Plan and Action

1. Improvement of employee skills
   a. Provide appropriate training as required.
   b. Monitoring and evaluating the level of skill progress
2. Controlling the use of raw materials
   a. Improve communication with suppliers to ensure standardized quality of raw materials.

b. Provide training to employees on how to use raw materials efficiently and how to use the right quality measurement methods.

3. Effective maintenance schedule planning
   a. Conduct machine failure analysis to identify the causes of high downtime frequency.
   b. Create a routine maintenance schedule for all production machines.
   c. Monitor machine conditions in real-time and enforce predictive analysis (risk management) to prevent unexpected failures and downtime.
4. Optimal temperature and ventilation settings
   a. Ensure sufficient and efficient ventilation to reduce vapor concentration from machines and maintain a stable room temperature.
   b. Monitor the room temperature in real-time by using an automatic temperature regulation system

4. CONCLUSION

Productivity measurement with the OMAX method provides a comprehensive approach in monitoring company performance, especially in the production department with the criteria of minimizing defective products, optimal production capacity, optimal production plan, and efficiency of raw materials in the production process. From the

calculation results show that the productivity index in April was 106.7%, in May -16.7%, in June 70.0%, in July 36.7%, in August 13.3% and in September 6.7%. The lowest productivity index occurred in May 2023. Productivity improvement can be focused on optimizing production capacity and minimizing defective products. So it is necessary to plan and take corrective actions that focus on these 2 criteria. It is expected that by making these improvements the company can increase the productivity of each predetermined criterion.

REFERENCES

1. Amilia, W. **Perancangaan Tools Pengukuran Kinerja Perusahaan dan Karyawan dengan menggunakan Objective Matrix**. *AGROINTEK: Jurnal Teknologi Industri* Balkan D. **Enterprise Productivity Measuremnet in Services by OMAX (Objective Matrix) Method and An Application with Turkish Emergency Services**. Conference Paper, September 2011. Hamburg (pp. 1-13), 2011. *Pertanian*, *7*(1), 29–37, 2013.
2. Balkan D. **Enterprise Productivity Measuremnet in Services by OMAX (Objective Matrix) Method and An Application with Turkish Emergency Services**. Conference Paper · September 2011. Hamburg (pp. 1-13), 2011.
3. Gasperz, V. Manajemen Produktivitas Total, Jakarta: Gramedia Pustaka Utama, 2000.Kementerian Perdagangan Republik Indonesia, Re-nyahnya Ekspor Kerupuk Indonesia, 2017.
4. Hardi, J., Supardi, D., Angelo, C., Farhan, N., CND, F., Ahmad, A., Rijanto, A. **Human Resource Scorecard (HRSC) and Objective Matrix as Performance and Performance Booster Method to Optimize Measurement Production Performance.**Rizaty M. A. **Lima Negara Tujuan Ekspor Kerupuk RI, Thailand Terbesar**, 2022.
5. Kementerian Perdagangan Republik Indonesia, **Renyahnya Ekspor Kerupuk Indonesia**, 2017.
6. Rizaty M A. **Lima Negara Tujuan Ekspor Kerupuk RI, Thailand Terbesar**. 2022.
7. *Satria, Wahyu.* ***Pengukuran Produktivitas Berbasis Metode Objective Matrix (OMAX) dan Analytical Hieirarchy Proceiss (AHP) (studi kasus Divisi Cold Rolling Mill (CRM) PT Krakataui Steieil (Peirseiro) Tbk****, Universitas Andalas, Padang, 2015.*
8. Setiowati, R. **Pengukuran produktivitas departemen produksi dengan metode Objective Matrix (OMAX) pada CV. Jaya Mandiri**. Vol, 10, 199–209, 2017.
9. *Silalahi, Risdianto, Yuniar.* ***Usulan Strategi Pening-katan Produktivitas berdasarkan Hasil analisis Pengukuran Objektive Matrik (Omax) Pada Departemen Produksi Transformer****. Reka Integra, Vol 2 No3. Jurnal Teknik Industri ITENAS Bandung, 2014.*
10. Zanuar, R. A., Suharno. **Pengukuran Produktivitas pada Lini Produksi di PTPN IX (PERSERO) Kopi Banaran Menggunakan Metode Objective Matrix (OMAX).** Universitas Gadjah Mada, 2014.