Supply Chain Performance Measurement at PT. Perkebunan Nusantara XIV Camming Sugar Factory in Bone District

Anis Saleh, Arfandi Ahmad*, Yan Herdianzah, Dirgahayu Lantara, Nur Ihwan Saputra, and Muhammad Dahlan

Department of Industrial Engineering, Universitas Muslim Indonesia, Makassar, Indonesia

Email: anis.saleh@umi.ac.id, arfandi.ahmad@umi.ac.id, yan.herdianzah@umi.ac.id, dirgahayu.lantara@umi.ac.id, nurihwansaputra@umi.ac.id, muhammad.dahlan@umi.ac.id

*Corresponding author

ABSTRACT

PTPN XIV (PERSERO) of Camming Sugar Factory in Bone Regency Measuring work results in the company is one of the company's performance evaluation tasks, namely to find out if the results achieved are good enough or still need improvement. The characteristic of a weak result is the fact that the company's goal is not achieved in the desired way. The objective of this study is to identify the KPIs and measure the performance indicators at the Bone Regency of PTPN Camming Sugar Factory. Key Performance Indicator (KPI), Lean Supply Chain Management (LSCM), and Analytic Hierarchy Process (AHP) methods are used in this study. The results of this study provide 11 Lean metrics that align with business conditions. Once the indicators are obtained, the KPI weighting is carried out using the Analytical Hierarchy Process (AHP), prioritizing the performance criteria of the production and supply departments. KPIs that have a significant impact on a company's supply chain performance. This is reflected in the highest order of weight in three KPIs, namely production department performance criteria, employee productivity attributes (0.573) and delivery department criteria, on-time loading (0. 85), and delivery (0.372) attributes. with a weight percentage of 19.1, 16.20% and 12. 2%. The KPIs in the lowest weight category are collection (0.120) and delivery (0.116) with a weight percentage of .01% and 3.87%.

DOI: https://doi.org/10.24002/ijieem.v5i2.6861

Keywords: performance measurement, supply chain, key performance indicator (KPI), lean supply chain management (LSCM), analytical hierarchy process (AHP)

Research Type: Research Paper

Article History: Received January 24, 2023; Revised May 30, 2023; Accepted October 30, 2023

How to cite: Saleh, A., Ahmad, A., Herdianzah, Y., Lantara, D., Safutra, N.I., & Dahlan, M. (2023). Supply chain performance measurement at PT. Perkebunan Nusantara XIV camming sugar factory in Bone district. *International Journal of Industrial Engineering and Engineering Management, 5*(2), 61-66.

1. INTRODUCTION

Performance measurement in a company is one of the company evaluation activities that must be done. The purpose of measuring and evaluating the company's performance is to find out if the results achieved are good enough or if they can be improved. (Nurdin, 2019). According to Nordiawan & Hertianti (2010), performance measurement is a systematic process to assess whether a planned program/activity has been implemented according to plan and most importantly whether it has achieved the intended success during planning. Performance success is influenced by structured planning in managing each activity to be carried out in several future time periods (Priatna, 2016). According to Dewi (2013), effectiveness is a condition that must be known and communicated to certain parties to determine the level of achievement of the agency results related to the vision being implemented by the organization and to know the positive and negative effects related to it. Politics assumed the vision implemented by the organization.

According to Mardiasmo (2004), public sector performance measurement systems are systems that aim to help public sector managers evaluate strategy implementation through financial and non-financial metrics. The results of measuring the company's

performance can be used as input or learning so that the company itself can improve its existing weaknesses and continue to develop its full potential to continue its development in the future (Nurdin, 2019).

According to Leppe & Karuntu (2019), a supply chain involves a continuous relationship of purchasing goods, money, and information. Goods generally flow upstream to downstream, money flows downstream to upstream. Viewed horizontally, the supply chain has five main components or actors, which are suppliers, manufacturers, distributors, retailers, and customers. Vertically, the supply chain consists of five main components namely buyers, transporters, warehouses, and sellers. SCM (Supply Chain Management) is the overarching process of creating and delivering products to consumers from a structural perspective. Supply chain refers to the complex network of relationships that an organization maintains with its business partners to obtain production resources for delivery to consumers (Kalakota & Robinson, 2001). Supply chain management is an attempt to integrate parties involved in supply chain activities into product production to improve operational efficiency, quality, and customer service (Maddeppungeng, 2017).

Supply Chain Management is a concept of product distribution models that can optimally replace product distribution models. Supply chain management is an integrated approach that encompasses all material management processes and provides an orientation to the processes by which products are offered, manufactured, and distributed to consumers. The material context of supply chain management certainly does not only include raw materials and production (finished products) but also includes auxiliary materials, components, spare parts, work-in-progress (semi-finished products), and various equipment (accessories) that are used to support the operational activities of the entire company (Vistasusiyanti, et al., 2017).

The potential for Indonesia's sugar industry development is increasing. The process of taking raw materials from Camming sugar factory is that sugarcane plantations that are ready to harvest are then checked for eligibility, when it is fit for harvest, the sugar factory will issue a cutting order (SPT–*surat perintah tebang*). After the SPT is issued, the sugar cane-cutting process is immediately carried out. There are two process of cutting sugarcane in the factory. The first one is TPG (*tebang pabrik gula*), where the logging activity is done by workers or tools provided by the factory. The other one is TS (*tebang sendiri*) or own logging, where the logging activity is done by workers who provide what the sugarcane farmers themselves own. Logging activities carried out by the sugar factory. Camming uses several alternative methods, namely manual logging, grab loaders, and tractors. The process of transporting sugarcane from the plantation to the factory is by truck, after the truck transporting the sugar cane to the factory then unloads the sugarcane and puts it into the container that has been provided and queues to enter the milling station. The queued sugarcane will be milled the next day for milling process continuity.

Production flow at Camming sugar factory through five stations, namely a milling station, purification station, evaporation station, cooking or crystallization station, and spinning station. The purification system is carried out in the Camming sugar factory. Sulfite camming. In addition, the crystallization system used by the sugar factory is ACD where sugar A is consumption sugar while sugars C and D are partly used as seeds with further processing.

Camming's production in 2021 is 15,000 tons of granulated sugar, but the target of the factory wants to achieve is 27,000 tons of granulated sugar. Signs of poor performance are characterized by a decrease in desired output. Of the above several processes, the sugar cane cultivation process takes place in January, and the harvesting takes place in August, so we have to wait for the new harvest time until the sugar production process takes place in the factory. Problems with sugarcane harvesting and the process of transporting sugar cane to the factory are still manual so it takes quite a long time, problems with milling machines and boilers cause the production process to stop for an undetermined period of time, and there is still sugar packaging that is damaged due to the process of packaging and transporting sugar to storage so that it affects the quality of the sugar.

One of the most important aspects of business development and sustainability for sugar producers is improved supply chain management. The supply chain that is developing and important to implement is the Lean concept (Khair, et al, 2019). Therefore, this research aims to identify KPIs and measure the performance indicators of PTPN Camming Sugar Factory, Bone Regency. Key Performance Indicator (KPI) methods, Lean Supply Chain Management (LSCM), and Analytic Hierarchy Process (AHP) are used in this study. This method assists in determining the priority of several criteria by conducting a pairwise comparison analysis of each performance criterion.

2. LITERATURE REVIEW

According to Bolstroff in Leppe & Karuntu (2019), he introduced the components included in the application of supply chain management, i.e. plan, source, manufacturing, delivery, and return. Plan is a strategic part of supply chain management. This step regulates everything that can satisfy consumer demand. Source is an entrepreneur must be able to choose suppliers who can send the necessary products to increase the production volume offered to consumers. Manufacturing is a step for entrepreneurs from the point of view of labor productivity and business. Delivery refers to the logistics part, where there must be clear coordination between the level of requirements and inventory of the products to be purchased and those needed by consumers. Return must be considered and formalized as a part. of both. and entrepreneurs and collectors, which supports the level of consumer service.

KPI or Key Performance Indicator is a parameter that functions as a medium for measuring a company's performance by using a range of numbers, values, or percentages. The use of KPIs can determine the success or failure of an agency in achieving the set targets (Warganegara et al., 2021). KPI is a measurement tool

used in companies to measure the success rate of employee performance. Each KPI that is owned by each company must have standards set by company management according to their capabilities (Warganegara et al., 2021).

The Analytical Hierarchy Process (AHP) provides subjective values for the relative importance of each variable, and by determining which variables have the highest priority in influencing the outcome of this situation, It is a way to solve complex, unstructured situations into multiple components in a hierarchical arrangement (Parhusip, 2019). AHP (analytic hierarchy process) is a method that can solve decision-making problems based on many categories. Hard skills and soft skills can be collaborated using AHP (analytic hierarchy process) so that the linkages between categories make the recruitment process optimal (Suryadi & Nurdiana, 2015). The AHP method was developed by mathematician Thomas L. Saaty. This method simplifies and speeds up the decision-making process by decomposing the problem into parts and hierarchically arranging those parts or variables, resulting in effective decision-making for complex problems. A framework for doing, assigning numerical values to subjective judgments about the importance of each variable and combining these considerations to determine which variables have the highest priority and act to influence the outcome in that situation (Darmawan, 2014).

3. METHODS

Primary data obtained directly from the instrument (data acquisition instrument). The primary data for this study consisted of interviews and questionnaires.

The research location which is the object of research in data collection is carried out at PT. Perkebunan Nusantara XIV Camming Sugar Factory, Wanuawaru Village, Libureng District, Bone Regency, South Sulawesi Province with a research period of one month, namely June 2021-August 2021.

The data collected in this final project research are supply chain process data for the Camming Bone Sugar Factory, data relating to Supply, Production Process, the Warehouse Storage Process, company profile data which includes a general description of the company, organizational structure, and line of business of the Factory. Gula Camming, data from various literature related to research, such as Lean concepts for formulating Key Performance Indicators (KPI).

The stages carried out in the implementation of this research are as follows:

1. Identify key performance indicators (KPI) from a lean perspective.
2. Classification of Key Performance Indicators (KPI) into performance criteria.
3. Weighting and prioritization of Key Performance Indicators (KPI).
4. Verification and validation of performance measurements made.

The data analysis technique used in analyzing the data in this study is as follows (Rahmayanti & Putri, 2011):

1. Analytical Hierarchy Process (AHP)
   AHP is used in the weighting of each KPI to get the KPI that has the greatest weight. The KPI that has the greatest weight is the KPI that is a priority over the other KPI.
2. Verification
   Verification is carried out on KPIs and the design results of supply chain performance measurement systems. Verification is carried out by interviewing the production manager, operational manager, and warehouse manager directly to ensure that the results of measuring the performance of the supply chain system are carried out correctly. Verification can be done by analyzing whether the identified KPIs cover everything needed in this study.
3. Validation
   Validation is performed to demonstrate that the results of the supply chain performance measurement system design can be implemented within the enterprise. The validation technique used in this study is a content validation technique where the aim is to test the suitability between the concept and the real system, while the parties involved in conducting this validation are production managers, operational managers, and warehouse managers who are considered capable of providing assessments related to theory. underlying the conceptual design of a supply chain performance measurement system is correct and acceptable.

4. RESULTS AND DISCUSSIONS

The results of the analysis provide data by looking at key performance indicators from a lean perspective. First, the collected data is validated by Camming Bone Sugar Factory's Assistant Managers to determine compatibility indicators with the supply chain system. Camming Bone Sugar Factory. The results of the verification show that there are eleven Key Performance Indicators from a lean perspective that You can measure performance according to your existing supply chain system. Key Performance Indicator is an important indicator that can answer all requirements of all processes involved in Camming Bone Sugar Factory.

The novelty of this research is to measure performance at each workstation at PT. Camming Sugar Factory, by determining each Key Performance Indicator (KPI) that has been set at each company workstation, then determines priority indicators that must be given immediate action for improvement.

Key Performance Indicator Lean verification results are:

1. On-time loading
2. On-time delivery
3. Tractor performance
4. Employee productivity
5. Machine productivity
6. Materials productivity
7. Receiving
8. Put-away
9. Storage
10. Order-picking
11. Shipping

Based on the validation performed, there are eleven KPIs from a lean perspective, whose performance is measurable and consistent with the supply chain system used by Camming Bone Sugar Factory. Following are the results of the LSCM KPI verification which are grouped into three performance criteria including the performance criteria for the Supply section, the performance criteria for the Production section, and the performance criteria for the Warehouse section which can be seen in Table 1.

Table 1. Eleven KPIs used by Camming Bone Sugar Factory

No.	Lean Supply Chain	References	Performance Criteria
1.	On-time loading	Haris & Sovia (2018)	Supply
2.	On-time delivery	Haris & Sovia (2018)	
3.	Tractor performance	Haris & Sovia (2018)	
4.	Employee productivity	Akbar & Suliantoro (2014)	Production
5.	Machine productivity	Akbar & Suliantoro (2014)	
6.	Materials productivity	Akbar & Suliantoro (2014)	
7.	Receiving	Jalal & Safitri (2018)	Warehouse
8.	Put-away	Jalal & Safitri (2018)	
9.	Storage	Jalal & Safitri (2018)	
10.	Order-picking	Jalal & Safitri (2018)	
11.	Shipping	Jalal & Safitri (2018)	

Table 2. Calculation of total weight between performance criteria

Criteria	Weight	Ranking
Supply	0.418	1
Production	0.343	2
Warehouse	0.167	3

Level 2 weighting is based on attributes of supply performance criteria, production criteria, and Warehouse criteria.

4.1. Interattribute Weighting Analysis on Supply Performance Criteria

The weighting between the attributes on the supply performance criteria consists of three attributes. The attributes on the weighting of supply performance criteria consist of On Time Loading, On Time Delivery, and Tractor Performance. Based on the weighting results, the highest ranked weighting is from the attribute "loaded on time" with a total weighting of 0.485. It can be seen in the table 3.

Table 3. Calculation of total weight between supply attributes

Supply	Weight	Ranking
On-time loading	0.485	1
On-time delivery	0.372	2
On-time performance	0.142	3

4.2. Weighting Analysis Between Attributes on Production Performance Criteria

Weighting between attributes on production performance criteria consists of three attributes. The attributes on the weighting of Production performance criteria consist of Employee Productivity, Machine Productivity, and Material Productivity. Based on the weighting results, the employee's productivity attribute determines the highest-ranked weighting, and the total weighting is 0.573. It can be seen in the table 4.

Table 4. Calculation of total weight between production attributes

Production	Weight	Ranking
Employee Productivity	0.573	1
Machine Productivity	0.264	2
Materials Productivity	0.162	3

4.3. Weighting Analysis Between Attributes on Warehouse Performance Criteria

The weighting between the attributes on the warehouse performance criteria consists of five attributes. The attributes on the weighting of the warehouse performance criteria consist of Receiving, Putting away, Storage, Order Picking, and Shipping. Based on the weight results, the highest-ranking part is obtained by the acceptance attribute with a total weight of 0.304. It can be seen in the table 5.

Table 5. Calculating the total weight between warehouse attributes

Warehouse	Weight	Ranking
Receiving	0.304	1
Storage	0.263	2
Put-away	0.193	3
Order-picking	0.120	4
Shipping	0.116	5

4.4. Analysis of KPI priorities based on total weight results

You can see the priority of all KPIs based on the action taken. Starting with the KPI with the highest weight on the supply chain performance criteria and ending with the KPI with the lowest weight. The KPIs with the highest importance are those that contribute significantly to the performance of the entire supply chain. Based on this,

companies can set appropriate policies to achieve supply chain effectiveness and efficiency.

Based on research that has been done using supply chain performance criteria, production and supply performance criteria get the highest weight. The three KPIs with the highest weights are production performance criteria, employee productivity attributes (0.573) and supply performance criteria, on-time loading attributes (0.485), and on-time delivery (0.372). In this case, there is a significant positive relationship between job satisfaction and work productivity. This shows that the higher the job satisfaction received by employees, the higher their work productivity. On-time loading and on-time delivery the time needed from the tractor to leave, and return does not take a long time and loading sugar cane into the tractor already uses a grab loader to save time. The following is a summary of the percentage of supply chain performance measurement weights can be seen in Table 6.

Table 6. Percentage of supply chain performance measurement weight

No.	KPI	Weight	Percentage
1.	On-time loading	0.485	16.21%
2.	On-time delivery	0.372	12.42%
3.	Tractor performance	0.142	4.74%
4.	Employee productivity	0.573	19.14%
5.	Machine productivity	0.264	8.82%
6.	Materials productivity	0.162	5.41%
7.	Receiving	0.304	10.15%
8.	Put-away	0.193	6.45%
9.	Storage	0.263	8.78%
10.	Order-picking	0.120	4.01%
11.	Shipping	0.116	3.87%

5. CONCLUSION

Based on the collection, processing, and analysis of data that has been done. So, it can be concluded into three things.

From the research results, obtained eleven indicators in terms of lean that are in accordance with the conditions of the company.

After KPI weighting was carried out using the Analytical Hierarchy Process (AHP), the performance criteria for the production and supply department were the priorities. KPIs that have a significant impact on the performance of a company's supply chain. We can see this from his top three KPIs in weighting, namely performance criteria for the production section, employee productivity attributes (0.573) and criteria for the supply section, On Time Loading (0.485) and On Time Delivery (0.372) attributes with a respective weight percentage of 19.14%. 16.20%, and 12.42%. The KPIs with the lowest order of weight are Order Picking (0.120) and Shipping (0.116) with respective weight percentages of 4.01% and 3.87%.

The limitation of this research is that the researchers did not come up with a strategy that could be applied to PT. Camming Sugar Factory to be able to improve employee performance so that company goals can be achieved in accordance with the mission set by the company. The suggestion for further research is to create a strategy to improve company performance by referring to the KPIs that have been found previously in this research.

ACKNOWLEDGEMENT

The author would like to thank the Institute for Research and Service and Thanks also to the Lecturers and Staff of Industrial Engineering, Faculty of Industrial Technology, Universitas Muslim Indonesia.

REFERENCES

Akbar, M. R, & Suliantoro, H. (2014). Analisis pengukuran kinerja produksi menggunakan metode sink's seven performance criteria pada depertemen produksi mesin PS60 PT. General Electric Indonesia. *Industrial Engineering Online Journal*, *6*(9), 1-10.

Darmawan, A. (2014). Pemilihan sistem *Learning Management System* (LMS) metode AHP menggunakan *Criterium Decision Plus* 3.0. *Faktor Exacta*, *7*(3), 260-270.

Dewi, I. (2013). Pengaruh penerapan TQM, sistem pengukuran kinerja dan sistem penghargaan (reward) terhadap kinerja manajerial (studi empiris pada hotel di Kota Padang dan Bukittinggi), Universitas Negeri Padang. *Jurnal Akuntansi*, *1*(1), 1-17.

Haris, R. F., & Sovia, A. (2018). Pendekatan difotai (studi kasus: PT Wira Logitama Saksama). *Jurnal Logistik Bisnis*, *10*(2), 37-49.

Jalal, Q.A., & Safitri, W. (2018). Analisis kinerja gudang dengan pendekatan *key performance indicator* (KPI) dan *analitycal hierarchy process* (AHP). *Jurnal Ilmiah Teknik Industri*, *6*(2), 71–78.

Kalakota, R., & Robinson, M. (2001). *E-Business 2.0. roadmap for success*. USA: Addison-Wesley.

Khair, F., Dendhy, D., & Wijaya, I. (2019). Perancangan pengukuran kinerja sistem rantai pasok perusahaan injeksi plastik menggunakan *lean & green supply chain management* (LGSCM). *Jurnal Penelitian dan Aplikasi Sistem & Teknik Industri*, *8*(1), 48–60.

Leppe, E. P., & Karuntu, M. (2019). Analisis manajemen rantai pasokan industri rumahan tahu di kelurahan Bahu Manado. *Jurnal Emba*, *7*(1), 201–210.

Maddeppungeng, A. (2017). Pengaruh manajemen rantai pasok (MRP) pada daya saing dan kinerja perusahaan jasa konstruksi di DKI-Jakarta. *Jurnal Konstruksia*, *8*(2), 23-36.

Mardiasmo. (2004). *Akuntansi sektor publik*. Yogyakarta: ANDI.

Nordiawan, D., & Hertianti, A. 2010. *Akuntansi sektor publik* (ed. 2). Jakarta: Salemba Empat.

Nurdin, R. H. (2019). Pengukuran kinerja perusahaan pada PT. Yyy dengan menggunakan metode *balanced scorecard*. *Jurnal Manajemen Bisnis dan Kewirausahaan*, *3*(3), 32-38.

Parhusip, J. (2019). Penerapan metode analytical hierarchy process (AHP) pada desain sistem pendukung keputusan pemilihan calon penerima bantuan pangan non tunai (BPNT) di Kota Palangka Raya. *Jurnal Teknologi Informasi*, *13*(2), 18-29.

Priatna, H. (2016). Pengukuran kinerja perusahaan

dengan rasio profitabilitas. *Jurnal Ilmiah Akuntansi*, *7*(2), 44-53.

Rahmayanti, D., & Putri, U. (2011). Perancangan model pengukuran kinerja lean dan green rantai pasok semen secara terintegritas. *Jurnal Optimasi Sistem Industri*, *10*(2), 135-144.

Suryadi, A. & Nurdiana, D. (2015). Sistem pengambilan keputusan untuk pemilihan teknisi lab dengan multi kriteria menggunakan metode AHP (*analytic hierarchy process*). *Jurnal Pendidikan Matematika*, *5*(1), 11-21.

Vistasusiyanti, Kindangen, P., & Palandeng, I. D. (2017). Analisis manajemen rantai pasokan spring bed pada PT. Massindo Sinar Pratama Kota Manado. *Jurnal EMBA*, *5*(2), 901-908.

Warganegara, T.L.P., Wahyuningsih, F., & Narundana, V. T. (2021). Analisis kinerja karyawan berdasarkan *key performance indicator* dengan menggunakan metode *human resources scorecard* (HRSC) pada PT PLN (Persero) UP3 Tanjung Karang. *Maneggio*, *4*(1), 73-81.