

MODEL DESIGN OF SUPPLY CHAIN PERFORMANCE MEASUREMENT BASED ON LEAN AND GREEN USING THE BALANCE SCORE CARD AT PT TOBA PULP LESTARI

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ABSTRAK

Perkembangan teknologi yang semakin pesat ikut membawa peningkatan padat tingkat persaingan bisnis. Strategi bisnis yang kompetitif diperlukan untuk menjawab tantangan persaingan bisnis. PT Toba Pulp Lestari merupakan perusahaan yang bergerak di bidang perkebunan dan industri pengolahan pulp. Daerah pemasaran yang tersebar didalam dan luar negeri menyebabkan kinerja rantai pasok menjadi salah satu isu penting dalam perusahaan tersebut. Penggunaan konsep Lean dan Green pada sistem rantai pasok dapat menjadi suatu keunggulan kompetitif bagi PT. Toba Pulp Lestari guna menciptakan sebuah strategi rantai pasok yang lebih efektif dan efisien dari segi biaya dan dampak lingkungan. Pengukuran kinerja diperlukan untuk mengetahui efektivitas dan efisiensi dari implementasi kedua konsep tersebut dalam rantai pasok perusahaan. Sistem pengukuran kinerja dikembangkan berdasarkan empat perspektif Balanced Scorecard (BSC) : keuangan, pelanggan, proses bisnis internal serta pertumbuhan dan pembelajaran. Key Performance Indicator (KPI) yang digunakan sebagai basis pengukuran diformulasikan melalui konsep lean dan green. Nilai bobot masing-masing KPI ditentukan menggunakan metode Analytical Hierarchy Process (AHP) dengan pakar yang terkait sebagai responden. Pemilihan pakar yang akan menjadi responden dilakukan berdasarkan pengalaman dan pengetahuan pakar tersebut, terutama yang relevan dengan topik penelitian ini. Nilai bobot menentukan urutan prioritas KPI. Metode face validity digunakan untuk memvalidasi model pengukuran kinerja yang dihasilkan. Pengolahan dan analisis data

menghasilkan 25 KPI berbasis lean dan green yang relevan dengan rantai pasok rayon PT.Toba Pulp Lestari dengan rincian: 3 KPI untuk perspektif keuangan,

ABSTRACT

Rapid technological developments helped bring an increase in the level of business competition. Competitive business strategies required to address the challenges of business competition. PT.Toba Pulp Lestari a company engaged in the plantation and rayon processing industry. Marketing area are scattered inside and outside the country led to the supply chain performance become one of the important issues in the company. The use of Lean and Green concept in the supply chain system can become a competitive advantage for PT. Toba Pulp Lestari to create a more effective and efficient supply chain strategy in terms of expenditure and environmental impact. Performance measurement is required to determine the effectiveness and efficiency of these two concepts implementation in the supply chain companies. Performance measurement system was developed based on four perspectives of the Balanced Scorecard (BSC): financial, customer, internal business processes, learning and growth. Key Performance Indicator (KPI) which is used as a measurement basis is formulated through the concept of lean and green. Weight value of each KPI is determined using Analytical Hierarchy Process (AHP) with relevant experts as respondents. Respondents selected based on the experience and knowledge, especially experience and knowledge that relevant with the topic of this research. The weight value determined the order of KPI priority. Face validity is used to validate the performance measurement model. Data

processing and analysis yielded 25 lean and green-based KPIs that are relevant to pulp supply chain at PT. Toba Pulp Lestari with 3 KPI for financial perspective, 4 KPI for customer perspective, 11 KPI for internal business process perspective and 7 KPI for learning and growth perspective. Structure of designed models showed that customer perspective is the most priority aspects.

Keywords: Performance measurement, supply chain system, lean, green, balanced score card

INTRODUCTION

Every company needs a competitive advantage to maintain its business continuity. Competitive advantage can be achieved through proper strategic planning. The essence of the success of the strategy lies in the selecting activities that are able to provide added value that is different from the competitors. The compatibility between strategy and activity can not only provide competitive advantage but also ensure the sustainability of the strategy [1]. Supply chain management is one aspect that can be used to generate the competitive advantage. The supply chain is all stages that are involved directly or indirectly in fulfilling the consumer demand. The intended consumers in this case include producers, suppliers, transporters, warehouses, retailers and the final users [2]. Supply Chain Management is a method, tool or approach to supply chain management [3]. Competitive advantage in the supply chain is achieved by increasing the added value of various activities related to the process of delivering products to the hands of the final users. Some of the important issues in supply chain management are Lean Supply Chain Management (LSCM) and Green Supply Chain Management (GSCM). According to the reference [4], these two issues have a central role in minimizing costs and environmental impacts generated by the companies. The LSCM concept was developed based on the philosophy of minimizing costs and supply chain process time holistically to increase the effectiveness. A different approach is provided by the concept of

GSCM. The concept of GSCM is rooted in an environmental perspective, which is more focused on efforts to reduce waste and environmental impacts which are caused by various supply chain activities. Integration between the concepts of LSCM and GSCM can create a supply chain strategy that is more effective and efficient in minimizing costs and environmental impacts. Companies can obtain wider and more holistic benefits in managing performance at the strategic level through the integration of these two concepts. PT. Toba Pulp Lestari is a company engaged in the plantation and pulp processing industry. The company is one of the national private companies which in its activities uses the Domestic Investment facility. RAYON Industry of PT. TOBA PULP Lestari has been operating since 1980 with the aim of fulfilling the needs of national and international industrial markets and serving the processing of smallholder rubber plantation products. The integration of the concepts of LSCM and GSCM can be used to provide the competitive advantage for PT. Toba Pulp Lestari. A performance measurement mechanism that includes both concepts is needed to ensure that their implementation can run in a sustainable manner. Things to note are that the integration between the concepts of LSCM and GSCM concepts must not forget the principles of effectiveness and efficiency. The Balanced Score Card (BSC) can be a foundation that can accommodate these needs. BSC includes four perspectives, namely: financial perspective, customers, internal business processes and the growth and learning. These four perspectives are able to accommodate the important aspects in performance measurement, especially those related to effectiveness and efficiency. Reference [4] integrates the concepts of LSCM and GSCM with the BSC perspective to produce an effective and efficient supply chain. Another example of application is reference [5] which also integrates the BSC and SCOR to evaluate the supply chain performance of soft drink products at PT. Coca Cola Padang. The research conducted aims to develop the supply chain performance model of PT Toba Pulp Lestari. The performance measurement model is

arranged based on a series of indicators that lead to the achievement of certain standards. The standard used is the achievement of the implementation of the concepts of LSCM and GSCM. The weight value of each indicator is also determined so that the developed model can be used to determine the company policies more precisely in an effort to increase the effectiveness and efficiency of the supply chain.

LITERATURE REVIEW

1. Supply Chain Management

Rapid technological developments in the information age have increased the intensity of the competition in the business world. Shorter product life cycles have made the global market more consumer oriented [6]. The competitive strategy is an important step in running a business. The manufacturing business environment is rapidly evolving towards a longer supply chain and is dependent on suppliers [7]. The fast response rate has become an important benchmark for the companies, causing the occurrences of reconfiguration and strategy changes to gain supply chain flexibility [6]. These conditions cause the supply chain becomes one aspect of the business that requires a competitive strategy in its implementation. Aspects of the supply chain business are related to the efforts to fulfill the needs and deliver the products to the final consumers. The supply chain is all stages that are involved directly or indirectly in fulfilling the demands of producers, suppliers, transporters, warehouses, retailers and final consumers [2]. Producers, suppliers, transporters, warehouses and retailers work together and are coordinated in a series of activities that aim to ensure that products reach the final consumers to fulfill their needs. Supply Chain Management (SCM) is a method, tool or approach to supply chain management [3]. The series of SCM activities involve various actors such as suppliers, manufacturers, distributors, retailers and customers, who are directly or indirectly involved in the efforts to fulfill the consumer demands. The role of SCM is becoming increasingly important because at present the business competition has shifted from competition between companies to the competition

between supply chains. Effective management of all actors is essential to achieve the supply chain effectiveness[8]. Materials, information and money are three important flows in the supply chain [2]. Material means product, information is data that has been processed, and money is the resources expended for ensuring the smooth flow of material and information. The goal of SCM is to manage and improve the flow of materials from the point of origin to the point of delivery as well as the information feedback from the final customers at minimum cost. Good integrated and transparent flow of information from the suppliers to final consumers. Integration and transparency will make it easier to control the SCM implementation process. Research in the field of SCM is relatively open to the integration of theories from other disciplines and the use of non-conventional knowledge methods and paradigms. This encourages theoretical developments to explain various phenomena that cannot be explained or can only be partially explained from the basic theory of SCM [9]. Lean and Green are examples of two concepts that can be integrated into SCM theory. The concept of lean can be used to minimize waste from the supply chain, while the concept of green is useful for minimizing the environmental impact of the supply chain.

2. Lean Supply Chain Management

New issues that arise along with the development of modern supply chains open up new areas of thought in supply chain improvement efforts. Supply chain strategy is a collection of activities and strategic actions along the supply chain that creates a reconciliation between what the final customers need and the capabilities of the resources in the supply chain [3]. Selection of the proper supply chain strategy is important for a company in realizing its competitive advantage to fulfill the customer needs according to their expectations and needs. One strategy that can be used to increase the company's competitive advantage is to apply a lean approach in supply chain management. Lean is a continuous action to eliminate waste and increase the value-added products (goods/services) in order to provide value to the customers [10]. The lean approach aims to increase the

value to the customers (customer value) by continuously increasing the ratio of the value added to waste. Lean Supply Chain Management (LSCM) is a supply chain strategy based on minimizing the cost and time of the supply chain as a whole to increase the effectiveness. The concept of LSCM focuses on optimizing supply chain processes, simplifying and reducing waste and activities that do not provide added value [11]. The main objective of implementing LSCM is to reduce the production costs through minimizing any activities that do not provide added value. Supply chain productivity can still be increased while maintaining the quality of the product in this way.

3. Green Supply Chain Management

Another issue that is developing in modern supply chain systems is the application of the green concept. The tendency of the companies to apply the green concept is very dependent on the company's position in the supply chain. Downstream industries and the companies in downstream positions place more emphasis on green design practices, purchasing and internal management. Companies that are in the mid stream such as Original Design Manufacturers (ODM)/ Original Equipment Manufacturer (OEM) are more focused on green manufacturing and logistics practices [12]. Regardless of the company's position, the application of the green concept is based on the growing environmental awareness. As stated by [13], the increasing awareness of the environment has supported the emergence of Green Supply Chain Management (GSCM). GSCM is a supply chain paradigm related to the environmental and ecological efficiency issues of the company's business processes [14]. The main objective of GSCM is to integrate the environmental values into the supply chain concept [15]. The GSCM concept was developed based on the environmental perspective, namely minimizing waste and environmental impact caused by the supply chain activities of the industrial companies. The environmental perspective is one of the long-term non-financial aspects that must be considered by the companies in maintaining the sustainability of their supply chain activities. The results of the

reference research [16] show that the efforts to reduce the environmental impacts will be more effective if it was carried out through the internal activity management. A performance measurement system is needed to ensure the successful management of internal activities. Therefore, GSCM implementation requires a reliable performance measurement system. Fundamentally, GSCM performance measurement is used to determine the efficiency and effectiveness of the existing systems, compare the competing alternative systems or to design proposed systems by determining the values of the decision variables that produce the most desired level of performance [14].

4. Supply Chain Performance Measurement

It is a common understanding that performance measurement provides an opportunity for businesses to identify the ways to improve the supply chain sustainability [17]. The process of measuring supply chain performance includes all activities related to the efforts to fulfill the customer demands. Supply chain performance measurement aims to improve the smooth flow of goods and information from each link in the supply chain activities and to reduce the inventory. There are several dimensions that need to be considered in measuring the supply chain performance, including: 1. Cost, related to the funds spent to finance supply chain operations. 2. Time, related to the length of time which is needed to carry out an activity. 3. Capacity, related to the size of the amount of work that can be done in the supply chain within a certain period. 4. Capability, related to the aggregate ability of the supply chain to carry out the activities. Measurement of supply chain performance focuses on the cost efficiency and the supply chain operating time. This measurement is carried out by first determining the relevant indicators.

5. Balanced Scorecard

Balanced Scorecard (BSC) is a company performance measurement method by considering four interrelated perspectives. These four perspectives function as the translators along with the ways to communicate the strategy and the

goals to be achieved by the company in the long term, to be measured and controlled then on an ongoing basis. The four perspectives considered in the BSC are [18]: 1. A financial perspective, related to how to serve shareholders. Measuring cash flow, returning on capital, sales and income growth is usually used for a financial perspective specifically uses. 2. Customer perspective, related to the level of customer satisfaction. In general, the measurement of this perspective includes the matters relating to the level of damage, timely delivery, warranty support, product development and other matters that originate from direct input from the customers and are linked to the company's specific activities. 3. Internal business process perspective, which is the perspective related to the main competencies and operational areas. Internal business processes are generally measured through productivity, cycle time, quality, various cost measurements and other related indicators. 4. Learning and growth perspective, which is the perspective related to continuous improvement and value creation. Measurements are usually emphasized on the aspects related to organizational innovation and learning, such as: technology leadership, product development cycle time, operational process improvement, and others.

RESEARCH METHODOLOGY

The object of the research is PT. Toba Pulp Lestari which is located in Porsea, North Sumatra Province. The focus of the research is the product supply chain from suppliers to paper distributors. Literature studies are conducted to support the implementation of the research by studying and understanding various relevant theories and concepts. These theories and concepts are compiled from various references such as books, internet and other related sources. The types of data collected in this study are various data related to: business processes, types of products produced, raw materials used and areas of raw material suppliers. Production processes, transportation, distribution and marketing areas, parties involved (stakeholders), company profiles (including a general description of the

company, vision and mission, organizational structure and line of business of PT. Toba Pulp Lestari as well as the data from various literature related to the research, such as the concepts of lean and green to formulate Key Performance Indicators (KPI). Data collection was carried out using several methods, namely observation, literature study, interviews, KPI weighting questionnaires and the expert opinion. The stages carried out in the implementation of this research are as follows:

1. Studying the preliminary study to observe the condition of the pulp supply chain system at PT. Toba Pulp Lestari.
2. Formulating KPI from each of the concepts of LSCM and GSCM.
3. Grouping KPI of LSCM and GSCM into the BSC perspective.
4. Weighting and determinating the KPI priority. The KPI weighting process is carried out using the Analytical Hierarchy Process (AHP) method. The weight value of KPI determines the priority level of that KPI.
5. Designing LSCM and GSCM performance measurement models in the BSC perspective.
6. Doing verification of the performance measurement model. Verification is carried out using the interview method, namely direct discussion to ensure that the results of the supply chain performance measurement system design can be implemented correctly.
7. Doing validation of the performance measurement model. Validation is carried out to prove that the resulting supply chain performance measurement model is feasible to be implemented in the company. The validation technique used is face validity, which is asking for the opinions of the relevant experts to assess the resulting model.

RESULTS AND DISCUSSION

1. Formulation of Key Performance Indicators (KPI)

KPI are formulated based on the concepts of LSCM and GSCM. The formulation was carried out through an in-depth study of the LSCM and GSCM literatures. The list of KPI obtained is

verified by PT. Toba Pulp Lestari to determine the suitability of these indicators with the existing supply chain system. Verification produces 25 KPI whose performance can be measured and are in accordance with the real supply chain system used by PT. Toba Pulp

Lestari. These KPI are also important indicators that can answer the needs of all stakeholders of PT. Toba Pulp Lestari. The verification results and their grouping into KPI of LSCM and GSCM can be seen in Table 1.

Table 1. KPI Verification Results

No	Key performance indicators (KPI)	
	Lean supply Chain	Green Supply Chain
1	Total supply chain costs (L1)	
2	Quality Enhancement (L2)	
3		
4		
5		
6		
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11		
12		
13		
14		
15		

Types of data required for the measurement process for each KPI can be seen in Table 2.

Table 2. Data Grouping Related to KPI

Data classification	No	Data
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2. KPI Grouping in the Perspective of the Balanced Scorecard (BSC)

KPI that have been formulated are then grouped into a Balanced Scorecard (BSC) perspective consisting of financial, customer, internal process business and learning & growth perspectives. This is done to make it easier to carry out pairwise comparisons of each indicator where this pairwise comparison is carried out for each KPI that is in the same group in the perspective of BSC. This grouping of KPI is done by matching the meaning of each KPI to the meaning and scope of each BSC perspective. In addition, the grouping also refers to several existing references related to the grouping of supply chain KPI to the perspective of BSC. This grouping can be done by structuring the lean and green supply chain performance assessment model in an integrated manner in the perspective of BSC. by making pairwise comparisons between KPI using a weighting questionnaire assessed by the experts at PT. Toba Pulp Lestari. The pairwise

comparison values are processed with the help of Expert Choice software to determine the weight value of each KPI.

3. KPI Weighting

KPI weighting is carried out to determine the level of priority and the importance of each KPI to other KPI. This weighting is carried out. The higher the weighted value of KPI, the higher its level of importance compared to other KPI. The weight of each KPI is acceptable if the inconsistent ratio value obtained is less than 0.1. The inconsistency ratio value shows the level of consistency of the experts in providing the values from pairwise comparisons for each KPI. The results of this weighting are obtained from pairwise comparisons between the four perspectives, namely the financial, customer, internal process business and learning & growth perspectives using expert choice software. The results of KPI weighting can be seen in Table 3 up to Table 7.

Table 3. Indicator Weight in the Scope of the BSC

Kode KPI	Definisi	Bobot
F	Financial	0,162
C	Customer	0,487
IP	Internal Business Process	0,223
LG	Learning and Growth	0,127

Table 4. Indicator Weights in Financial Perspective

Kode KPI	Definisi	Bobot
L1	Total Biaya Rantai Pasok	0,333
L13	Revenue Perusahaan	0,333
G5	Biaya Lingkungan	0,333

Table 5. Indicator Weight in Customer Perspective

Kode KPI	Definisi	Bobot
L2	Peningkatan Kualitas	0,365
L7	Akurasi Peramalan	0,076
L15	Tingkat Kepuasan konsumen	0,302
G9	Tingkat Ketertarikan Konsumen Terhadap produk ramah lingkungan	0,257

Table 6. Indicator Weight In the perspective of Internal Process Business

Kode KPI	Definisi	Bobot
L3	Lead time Pemesanan	0,121
L4	Total siklus waktu rantai pasok	0,069
L6	Utilisasi Kapasitas	0,169
L9	Level Persediaan Material dan Produk	0,074
L11	Jumlah produk cacat yang dihasilkan	0,064
L12	Jumlah truk yang dialokasikan ke distributor	0,037
G1	Operasi Hemat energi	0,078
G2	Disposisi Limbah	0,088
G3	Penggunaan material yang bisa didaur ulang	0,099
G6	Emisi udara dan air	0,106
G7	Penggunaan zat-zat yang tidak berbahaya	0,094

Table 7. Indicator Weights in the perspective of Learning and Growth

Kode KPI	Definisi	Bobot
L5	Pengembangan produk	0,154
L8	Layanan Pasca penjualan	0,175
L10	Leakuratan dokumen tasi surat jalan	0,077
L14	Biaya pelatihan dan pengembangan karyawan	0,096
G4	Lerjasama dengan pemasok bersertifikat	0,082
G8	Penurunan frekwensi kecelakaan lingkungan	0,262
G10	Efisiensi daur ulang	0,154

4. KPI Priority Based on Weighting Results

The overall KPI weighting is carried out by multiplying the weight of each KPI with the perspective weight in which the KPI is grouped. The results of the overall

KPI weighting can be seen in Table 8. Based on the overall weight of each KPI, then KPI priorities are determined starting from the KPI that has the highest weight to the KPI that has the lowest weight. KPI priorities can be seen in Table 9.

Table 8. KPI Overall Weight

Kode KPI	Bobot KPI	Bobot Perspektif KPI	Bobot Keseluruhan
L1	0,333	0,162	0,054
L13	0,333		0,054
G5	0,333		0,054
L2	0,365	0,487	0,178
L7	0,076		0,037
L15	0,302		0,147
G9	0,257		0,125
L3	0,121	0,078	0,009
L4	0,069		0,005
L6	0,169		0,013
L9	0,074		0,006
L11	0,064		0,005
L12	0,037		0,003
G1	0,078		0,005
G2	0,088		0,007
G3	0,099		0,008
G6	0,106		0,008
G7	0,094		0,007
L5	0,154	0,088	0,014
L8	0,175		0,015
L10	0,077		0,007
L14	0,096		0,008
G4	0,082		0,007
G8	0,262		0,023
G10	0,154		0,014

5. Supply Chain Performance Measurement Model Structure

The Lean and Green supply chain performance measurement model with the perspective of BSC is designed in the form of metrics. This performance measurement metric can be seen in Table 10.

6. Model Validation

Validation is a step that needs to be done to explain that the supply chain performance measurement model designed is feasible to be applied to the real systems. The aspects considered in the model validation process are as follows:

1. KPI is in accordance with the real conditions of PT. Toba pulp Lestari and representative in nature, meaning that KPI can represent the needs of the stakeholders involved in supply chain activities.
2. KPI contained in the model can be measured for their performance in the pulp supply chain activities of PT. Toba Pulp Lestari.

3. The priority sequence of KPI contained in the model is KPI that is truly a critical indicator for the supply chain performance of PT. Toba Pulp Lestari.

4. The designed supply chain performance measurement model can be implemented at PT. Toba Pulp Lestari to measure the effectiveness and efficiency of the pulp supply chain.

The validation technique applied is face validity, namely asking people who have adequate knowledge and experience about the concept of lean and green. Respondents will provide an assessment of the components of the designed model. Validation is carried out by the Management Representative of PT. Toba Pulp Lestari. The results of the validation show that the designed supply chain performance measurement model is valid and acceptable by PT. Toba Pulp Lestari. This model can be implemented for measuring the company's supply chain performance. Performance measurement is carried out to see the effectiveness and efficiency of the supply chain. The prioritized aspect is the consumer aspect to increase the value in order to achieve

the satisfaction of crumbrubber consumers. This is in accordance with the results of prioritization which is carried out for all KPI. The three highest priority weight values of all KPI indicate that the quality improvement and customer satisfaction levels for environmentally friendly products must be a priority for the company's targets. It is also recognized by the company that creating the quality pulp with minimal environmental impact is

an important demand from today's consumers. Therefore, companies need to know the level of the effectiveness and efficiency of the supply chain in order to produce the quality and environmentally friendly crumb rubber to increase the consumers' satisfaction. If the company is able to know the level of the achievement of its current performance, the company can determine the proper and appropriate policies in the future

Table 9. Indicator Weight in Customer Perspective

Kode KPI	Definisi	Bobot
L2	Peningkatan Kualitas	0,178
L15	Tingkat Kepuasan Konsumen	0,147
L9	Tingkat Ketertarikan konsumen terhadap produk ramah lingkungan	0,125
L1	Total biaya rantai pasok	0,054
L13	Revenue perusahaan	0,054
G5	Biaya lingkungan	0,054
L7	Akurasi Peramalan	0,037
G8	Penurunan frekwensi kecelakaan lingkungan	0,023
L8	Layanan pasca penjualan	0,015
L5	Pengembangan produk	0,014
G10	Efisiensi Daur Ulang	0,014
L6	Utilisasi kapasitas	0,013
L3	Leadtime pemesanan	0,009
G3	Penggunaan material yang bias didaur ulang	0,008
G6	Emisi udara dan air	0,008
L14	Biaya pelatihan dan pengembangan karyawan	0,008
G2	Disposisi limbah	0,007
G7	Penggunaan zat-zat yang tidak berbahaya	0,007
L10	Keakuratan dokumentasi surat jalan	0,007
G4	Kerjasama dengan pemasok bersertifikat	0,007
L9	Level persediaan material dan produk	0,006
G1	Operasi hemat energy	0,006
L4	Total waktu siklus rantai pasok	0,005
L11	Jumlah produk cacat yang dihasilkan	0,005
L12	Jumlah truk yang dialokasikan utk pengiriman	0,003

Table 10. Supply Chain Performance Measurement Model Structure

Kode KPI	Definisi	Financial		Consumer		Internal Business Process		Learning and Growth		Bobot
		L	G	L	G	L	G	L	G	
L2	Peningkatan Kualitas			X						0,178
L15	Tingkat Kepuasan Konsumen			X						0,147
G9	Tingkat Ketertarikan konsumen terhadap produk ramah				X					0,125

	lingkungan									
L1	Total biaya rantai pasok	X								0,054
L13	Revenue perusahaan	X								0,054
G5	Biaya lingkungan		X							0,054
L7	Akurasi Peramalan			X						0,037
G8	Penurunan frekwensi kecelakaan lingkungan								X	0,023
L8	Layanan pasca penjualan							X		0,015
L5	Pengembangan produk							X		0,014
G.10	Efisiensi daur ulang								X	0,014
L6	Utilisasi kapasitas								X	0,013
L3	Leadtime pemesanan						X			0,009
G3	Penggunaan material yang bias didaur ulang						X			0,008
G6	Emisi udara dan air							X		0,008
L14	Biaya pelatihan dan pengembangan karyawan							X		0,008
G2	Disposisi limbah								X	0,007
G7	Penggunaan zat-zat yang							X		0,007
L10	Keakuratan dikumentasi surat jalan									0,007
G4	Kerjasama dengan pemasok bersertifikat								X	0,007
L9	Level persediaan material dan produk					X				0,006
G1	Operasi hemat energy						X			0.006
L4	Total waktu siklus rantai pasok					X				0,005
L11	Jumlah produk cacat yang dihasilkan					X				0,005
L12	Jumlah truk yang dialokasikan utk pengiriman					X				0.003

7. Model Implementation

Implementation of this supply chain performance measurement model can be done through the following stages:

1. Collecting data related to KPIs according to the planned supply chain performance measurement model.
2. Creating Standard Operational Procedure (SOP) to measure the performance of the crumb rubber supply chain and the forms required for measurement and documentation of performance measurement results.
3. Measuring the performance of the crumb rubber supply chain at PT. P&P Lembah Karet and documenting the results of these performance measurements.
4. Determining the proper policy on the supply chain performance of PT. P&P Lembah Karet based on the results of performance measurements that have been carried out for each KPI.

CONCLUSIONS AND SUGGESTION

This research has produced a set of KPI which is obtained from the integration of the concepts of lean and green in the crumb rubber supply chain at PT. P&P Lembah Karet. The results of the integration are as follows:

1. The formulation of KPI is 25 KPI consisting of 15 Lean supply chain KPI and 10 Green supply chain KPI. This KPI is an important indicator that can answer the needs of all stakeholders involved in the crumb rubber supply chain at PT. P&P Lembah Karet from the aspect of cost reduction and environmental impact.
2. Grouping KPI into four BSC perspectives, namely financial, customer, internal process business and learning & growth perspectives. The total of 25 KPI can be grouped into 3 KPI for the financial perspective, 4 KPI for the customer perspective, 11 KPI for the internal process business perspective and 7 KPI for the learning & growth perspective.
3. The overall KPI priority is determined by sorting KPI from those with the highest weight to the lowest weight. KPI that has the highest priority means that this KPI is a KPI that has a major

influence on the company's supply chain performance. In this study, the customer perspective is a priority as evidenced by the 3 KPI at the highest order of weight in the designed supply chain performance assessment model. The weights for the three KPI are 0.178 respectively; 0.147 and 0.125.

Suggestions related to the results of this study are as follows:

1. Coordination in the ease of access to information between departments and the involvement of all employees of PT. P&P Lembah Karet is urgently needed so that the implementation of this model can be carried out properly.
2. Further research can measure the performance of lean and green supply chains in an integrated manner at PT. P&P Lembah Karet to determine the effectiveness and efficiency of PT. P&P Lembah Karet currently based on the model that has been designed in this study.
3. The research aspect can be expanded for further research, not only within the scope of the lean and green supply chain system, but the supply chain system as a whole.

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