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APPLICATION OF GREEN SUPPLY CHAIN IN IMPROVING PERFORMANCE ON SOLID PRODUCTS (CAPLET) USING GREEN SCOR ANALYSIS

(Case Study of a Pharmaceutical Company in Jakarta)

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Abstract

In improving the performance of supply chain activities in pharmaceutical companies while implementing green supply chain management using the Supply Chain Operation References (SCOR) analysis. The performance constraints of KPI achievement such as Supplier deviation, Documentation Error, Complaint, Energy CO2, Water-H2O, and Non-Hazardous Waste, for 3 years 2016-2018 did not consistently reach the target. With the implementation of green supply chain in improving performance, especially in Solid products by using the Supply Chain Operation References - (SCOR) analysis. Green manufacturing is the first thing developed in the pharmaceutical industry in Jakarta. Green manufacturing is therefore a production process that uses inputs with relatively low environmental impact, which are very efficient, and which produce little or no waste or pollution. This study aims to determine the performance of Green Supply Chain Operations Reference Model (SCOR) on PT. XYZ Indonesia and to determine the proposed improvements to increase the performance of Green Supply Chain Operations Reference Model (SCOR). Type of this research is quantitative with focus to measure the performance of green manufacturing, the object of the research is a pharmaceutical company diPulogadung East Jakarta, province of Jakarta, Indonesia. The subjects that will be used as research are Commercial Manager, Logistic Manager, Planner Manager, Material Management Manager, Warehouse Manager, Quality Control Manager, Quality Assurance Manager, Head of Operation, Value Stream Solid-Semi Solid Manager, Procurement Manager, Engineering Manager , Manager of Environment Health and Safety and Site Director in charge of green supply chain management . The population in this study are manufacturing process activities related to Sales and Operating Planning - SNOP, Supply Review - SRm, Master Production Planning - MPS, Material Requirement Plan - MRP Solid Caplet products and Samples in this researchare manufacturing activities the Commercial, Logistics, Production, Quality, Procurement, Engineering and Environment Health and Safety, and the samples in this research are manufacturing activities the Commercial, Logistics, Production, Quality, Procurement, Engineering and Environment Health and Safety Departments . Collecting and analyzing data using primary and secondary data with data analysis kualtitatif. The results showed that the value of green manufacturing performance (green SCOR) was 96.506 (excellent) and a new way of monitoring daily and weekly performance by using technology that is currently developing in the form of excel files and power business interaction programs.

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Keywords: Green Supply Chain, Analytical Hierarchy Process, Supply Chain Operation References, Improving Performance, Pharmaceutical Industry.

INTRODUCTION

PT. XYZ has performance constraints on achieving KPIs such as Supplier deviation, Documentation Error, Complaint, Energy CO2 (energy use), Water-H2O (water use), and Non-Hazardous Waste , for 3 years, 2016 - 2018, it has not consistently reached target, the KPI Supplier deviation in 2017 and 2018 did not reach the target, KPI Documentation error in 2016, 2017 and 2018 did not reach the target, KPI Complaints in 2016 and 2018 did not reach the target, KPI Energy CO2 (energy use) in 207 and 2018 did not reach the target, Water H2O KPI in 2016, 2017 and 2018 did not reach the target, Non-Hazardous Waste KPI in 2016 did not reach the target and Landfill Waste KPI in 2016, 2017 and 2018 did not reach the target. Therefore it is necessary to measure the performance of the supply chain to determine its performance. To measure the performance of the Indonesian supply chain, we can use the Supply Chain Operation References (SCOR) hierarchy model (Irfan, 2008; Wayyun, 2010; Jamehshooran, 2015). Model Analysis of Supply Chain Operation Reference (SCOR) aims to find out supply chain performance towards management (Sutawijaya, 2016). The application of the SCOR model can identify supply chain performance indicators by showing the company's supply chain process, so that it can be used as an evaluation in improving performance (Kurien, 2012; Ambe, 2014; Susanty, 2017). The application of the concept of green supply chain management needs to be done in order to improve the performance of PT. XYZ Indonesia by using the Green Model Supply Chain Operations Reference (SCOR) in line with the company's goals.

Based on this background, the value of the Green Model Supply Chain Operation Reference (SCOR) performance at PT. XYZ Indonesia and to find out the proposed improvements that should be done to improve the Green Model Supply Chain Operation Reference (SCOR) performance value

LITERATURE REVIEW

According to Finch (2006) supply chain is all activities related to the flow and transportation of goods from raw materials (inbound logistics) to finished products into the hands of consumers (outbound logistics) and also the flow of information. Supply chain is a network of facilities and distribution channels which includes the procurement of raw materials, production, assembly and delivery of products or services to customers (Borade and Bansod, 2007). Dedicate the supply chain according to Pujawan and Mahendrawathi (2017), is a network consisting of many companies jointly working to produce and send products to the hands of consumers. The network of many companies are suppliers, manufacturers, distributors, retailers, and supporting companies such as logistics (third pastry logistics) services.

Green Supply Chain Management as a process of using environmentally friendly inputs and turning those inputs into outputs that can be reused at the end of its life cycle thereby creating a sustainable Supply Chain (Penfield, 2007). Green supply chain management is also

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defined as the integration of environmental thinking into Supply Chain Management, including product design, material purchasing and supplier selection, manufacturing processes, delivery of final products to consumers (Srivastava, 2007). Green Supply Chain Management involves traditional Supply Chain management practices, which integrate environmental criteria, or the problem of purchasing decisions for goods or services and long-term relationships with suppliers (Gilbert, 2000). In recent years, Green Supply Chain Management (GSCM) has become one of the important strategies for achieving sustainable development for the company (Kurien et al., 2012). The GSCM concept is a supply chain management that deals with environmental aspects. Green -based supply chain management is important to implement because so far the size of supply chain performance usually does not pay attention to impacts on the environment. The pressure on environmental care causes companies to feel the need for improvement in the existing supply chain concept to consider the environmental impact on all products and processes, starting from raw materials, finished products, to the end use of these products (Lamming and Hampson, 1996).

A. Huang, F. Badurdeen, 2016, said the basis of this framework is green manufacturing. Product life cycle and 6R are concrete pillars for green manufacturing.

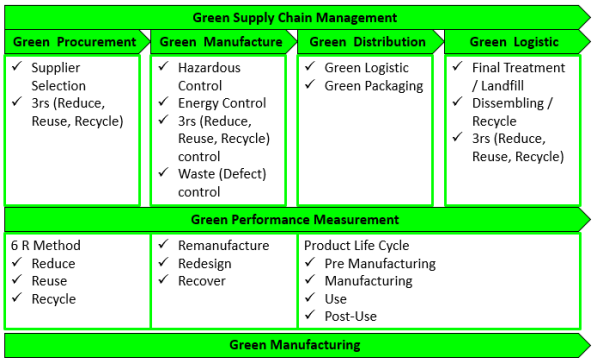

Figure 1. Green Manufacturing Framework (Aihua Huang, 2016)

According to Pujawan (2010), SCOR divides supply chain processes into five processes including Plan (planning process), Source (Procurement process), Make (production process), Deliver (delivery process), and Return (return process). The SCOR framework provides a variety of performance measures for evaluating supply chains arranged in several levels of metric measurements associated with one of the performance attributes: Reliability, Responsiveness, Flexibility, Cost, and Asset (Natalia and Astuario, 2015). That way this model is used as a tool to manage the environmental impact of a supply chain. The goal is to create an analysis that will later provide an overview of the relationship of supply chain functions with environmental aspects in order to create improved management performance between the two (Taylor, 2003).

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Figure 2. Structure of the SCOR model (Taylor 2003)

Then in this Green SCOR model there are performance attributes that are used to evaluate supply chains, including:

a) Reliability aspects

The ability to provide products that can reduce the negative impact on the environment in the manufacturing process of its products. For example the ability to reduce air emissions, fuel from transportation used. Proper documentation in running the business process. And also the ability in proper storage, handling and disposal on a mission to reduce negative impacts on the environment.

b) Aspects of Reaction Ability (Responsiveness)

The level of speed in responding or responding in reducing negative impacts on the environment.

c) Aspects of Flexibility (Flexibility / Agility)

The extent to which a company can meet the environmental demands of customers. As an example of complaints from customers about products from the company can also be related to transportation, recycling and others.

d) Cost aspects

Costs related to supply chains, cleaning costs as well as energy costs.

e) Aspects of Assets

Organizational effectiveness in managing assets that can reduce environmental impact and can reduce internal costs.

Based on the theoretical base of support obtained from the exploration of existing theory, it can be arranged k erangka idea as follows:

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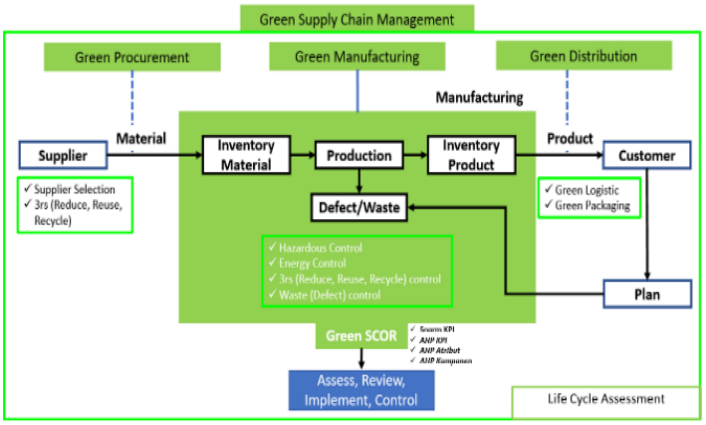

Figure 3. Framework (Nirlawan 2010)

RESEARCH METHODS

This type of research is a qualitative study using a descriptive exploratory approach with the object of research is the measurement of the performance of green manufacturing, the intended object is a pharmaceutical company in Pulogadung, East Jakarta, DKI Jakarta, Indonesia. In the manufacturing process of a Solid productCaplet.

Data collection methods used in this study include:

1) Primary Data.

Primary data is data taken directly from the research object. The following are primary data conducted by researchers:

a) Interview, conducted by Focus Group Discussion (FGD), which is a discussion and question and answer directly to get data. Interviews were conducted with trusted sources of interest and had direct contact with supply chain movements, Commercial Managers, Logistic Managers, Planner Managers, Material Management Managers, Warehouse Managers, Quality Control Managers, Quality Assurance Managers, Head of Operations, Managers of Solid-Semi Value Streams Solid, Procurement Manager, Engineering Manager, Environment Health and Safety Manager and Site Director. Interviews related to the production process, supply chain flow mechanism, operational activities, supplier selection, and assessment of the company regarding the products produced.

b) Direct observation, this data collection method is done through careful observation or direct observation at the research location, PT. XYZ This is done with the aim of being able to get a clear picture of the problems that occur and allow getting answers to these problems.

2) Secondary Data

Secondary data is data obtained through literature related to green supply chain management and other previous research related to research. Secondary data is obtained indirectly where the data will be useful as a support in the preparation of this study.

This research was conducted in several stages:

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The first step taken was the design of a performance measurement model. Literature and field studies are carried out in this first stage. Literature study focuses on the Green SCOR model, while field studies are conducted by collecting data in a manufacturing company. Data collected are: the company's supply chain process, identification of stakeholders contained in the supply chain, identification of the green requirements and green objectives of each stakeholder, and the process of management and waste management. The results of the literature study and field study form the basis of the design of the KPI (Key Performance Indicator). The design of KPI for this performance measurement model is carried out in several steps: First is the identification of the company's supply chain model. Second is supply chain mapping using the green SCOR model, to find out the correlation between stakeholders and the performance attributes contained in the green SCOR model, a green objective was identified after all objectives for each stakeholder are known, the KPI design process is carried out.

The second stage of this research is focus group discussion - FDG, this is done to test the validation with stakeholders by conducting interviews with stakeholders Commericial, Logistic, Planner, Material Management, Warehouse, Quality Control, Quality Assurance, Production, Solid Value Stream, Procurement, Engineering and Environment Health and Saferty at the company to find out which KPIs can be used to measure work at the company.

The third stage of this research is the measurement of green supply chain performance based on selected KPIs. The weighting of the green supply chain process is done by pairwise comparisons on all aspects contained at this level, Plan, Source, Make, Delivery and Return along with its attributes and indicators. Data management using the AHP (Analytical Hierarchy Process) method to help the calculation of the score where the weight is given to each business process and each indicator of the business process. The results obtained in the form of green supply chain performance values based on the weight of all aspects related to the green SCOR model. Furthermore, this value is analyzed and compared with company targets related to the performance of the green supply chain.

The following is a flow chart that is used as a reference in conducting research:

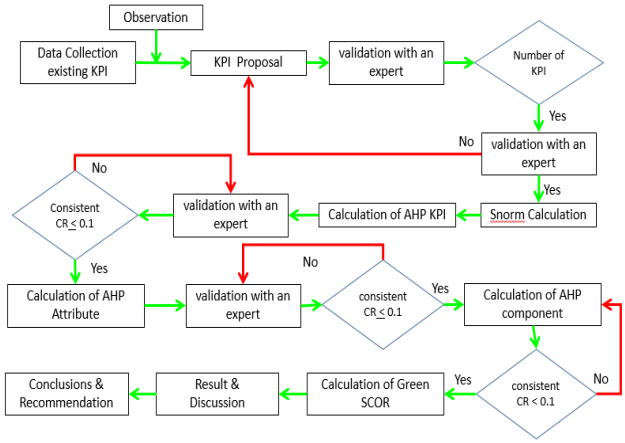

Figure 4. Digram of research (Author 2020)

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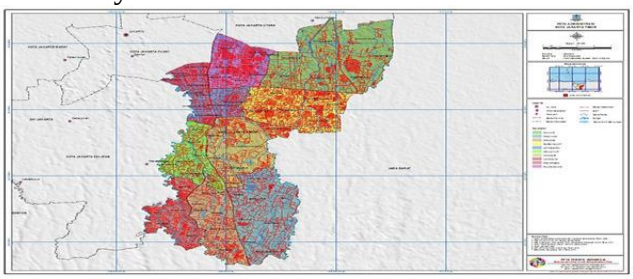
RESULT AND DISCUSSION

1. Company Overview of PT XYZ

In Indonesia, PT. XYZ was first established in 1973 Warung Bandrek Street No.31, RT.05/RW.05, Bondongan, Distric Bogor Selatan, Bogor with an area of 36,500m^2 and the second in 1994 at Pulobuaran Raya Street, RT.3/RW.9, Jatinegara, DistricCakung, City of East Jakarta with an area of 19,050 m^2. At the end of 2017 all PT XYZ activities were drilled and moved to a new facility in the city of east Jakarta.



Figurer 5. Administration – City of East Jakarta (Bakosurtanal 2016)

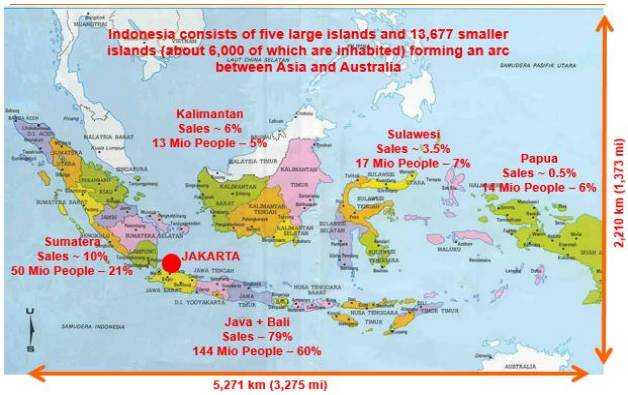


Figure 6. Supply Chain Market of PT XYZ (Induction PT XYZ 2018)

Figure 6 shows the market map of PT XYZ:

Tabel 1 Map of PT XYZ Market, Induction PT XYZ 2018

Island	Population	Sales
Jawa Bali	144 juta	79%
Sumatra	50 juta	10%
Kalimantan	13 Juta	6%
Sulawesi	17 Juta	3.5
Papua	14 juta	0.5

The morphology XYZ is divided into three value stream processes, the value stream of liquid, the value stream Semi Solid-solid and the value stream repack.

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1. Value Stream Liquid

The manufacturing process starts from Dispensing, Mixing, Primary packaging and Secondary packaging of all liquid products ranging from suspension, emultion and solution formulas. Suspension preparations are liquid preparations in the form of solids dissolved in liquid, emultion preparations are liquid preparations in the form of water that is dissolved in oil or oil dissolved in water, and solution is liquid preparations in the form of solids that are completely dissolved in water. The number of operators in this process consists of:
- Dispensing: 2 operators
- Mixing : 2 operators
- Primay packaging: 4 operators
- Secondary packaging: 5 operators

2. Solid-Semi solid value stream

The manufacturing process starts from Dispensing, Granulation, Mixing, Compressing, Primary packaging and Secondary packaging for solid products. The solid product is divided into 2 formula preparations, direct compress and non direct compress, the difference is that the preparation of this formula is in the granulation process where the direct compress formula is prepared without going through the granulation process. Whereas Dispensing, Mixing, Primary packaging and Secondary packaging for semi-solid or cream products. The number of operators of solid direct compress and non direct compress products consists of:
- Dispensing: 2 operators
- Granulation: 2 operators
- Mixing: 2 operators
- Compressing: 2 operators
- Primary packaging: 2 operators
- Secondari packaging: 6 packers

And the number of operators of semi-solid products consists of:
- Dispensing: 2 operators
- Mixing: 2 operators
- Primary packaging: 2 operators
- Secondari packaging: 6 packers

3. Repack value stream

The process of this product is divided into two, the manual repack process and the automatic repack process. The manual repack process is carried out for imported products such as vaccines, the number of packers in this process consists of:
- Open secondary packing: 2 packers
- Printing: 1 operator
- Labeling: 1 operator
- Repacking: 6 packers

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While the automatic repacking process is carried out for inhalation products consisting of:
- Dispensing : 1 operator
- IPC (volume, leak): 1 operator
- Labeling:1 operator
- Assambling: 1 operator
- Cartoning: 1 operator
- Shipper: 1 operator
- Helper: 1 packer

2. Rantai Pasok PT XYZ

Figure 7. E2E supply chain of PT. XYZ (Induction PT XYZ)

Figure 7 shows the end-to-end supply chain which is divided into 3 business areas PT XYZ external, which is a supplier that supplies all of the packaging material needs, both primary packaging material and secondary packaging material, and PT XYZ internal manufacturing , Manufacturing, which is all production processes, starting from Dispensing or preparation raw material and packaging material, Mixing or mixing raw materials between active substances and fillers with coloring agents and flavorings , granulation or the process of forming drug particles according to predetermined sizes , compressing or molding the particle shape into tablet or caplet form, filling or the process of packaging the primary packaging in which the tablet or caplet is inserted into the packaging blister, packing or packaging process secodary packaging where each blister included in the carton and then inserted into the carton shipper or box and Commercial the ordering of products and distribute the finished product. The supplier sends packaging materials, primary packaging and secondary packaging materials to help PT XYZ make products which are then distributed by PT XYZ's commercial products to customers.

1. Supplier of packaging material

The process of supply packaging material begins with consumer information on product needs mapped in the forecast within 12 months (224 days) which is then mapped on a quarterly basis and then mapped on a monthly basis. The estimated demand for this product is communicated to the logistic head through the SNOP - Sales and Operation Planning meeting , then the logistic head communicates to his team planner and material management through SRM - Supply Review Meeting, then the planner communicates to the quality (QC & QA) and production team

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through MPS – Master Production Schedule meeting regarding the number of products to be made, the amount of raw material, packaging material, finish good that must be checked and the amount of raw material, packaging material and finish goods that must be released or ready to send, while the material management communicates to the warehouse to ensure that the warehouse capacity is sufficient to store raw materials, packaging materials and finish goods, and procurement to purchase materials needed through the MRP - Material Requirement Planning meeting.

2. Solid product manufacturing process

The process of making solid products begins with the receipt of material from the packaging material supplier, before packaging material is quarantined to check whether the packaging material meets specified specifications such as color, redaction, gramatur, thickness, folding, direction of paper fiber , pharmacode, i -mark, printing.
The dispensing process can be carried out if all materials, raw materials, packaging materials, meet specified specifications, in this case PT. XYZ has 2 types, direct compress and non direct compress:
2.1. *Direct Compress*. This solid product after the dispensing process is immediately known as the compresing process, which is forming a tablet accompanied by an IPC process - In process control every 1 hour, the IPC process includes individual weight of each tablet, tablet hardness, tablet disintegration time, tablet form, if in the IPC process tablet is found that does not meet the specifications, the process is stopped and an investigation is carried out, if the compressing process meets the specified specifications, the next stage is filling or primary packaging, the process of packing the tablet into aluminum foil-PVC which has formed a tablet pouch . During the filling or primary packaging process, the IPC process is carried out - In process control every 1 hour, the IPC process involves leakage of tablet pockets. If a leak is found then the filling or primary packaging process is stopped and an investigation is carried out, if the filling or primary packaging process meets the specified specifications then the next stage is the packing or secondary packaging process, the end result is a blister or strip where in 1 blister or strip there are 10 tablets. The next process is secondary packaging that is packing each blister into an individual carton using a cartoning machine and each individual carton is put into a carton that is each carton containing 20-50 individual carton, followed by an IPC-In process control process using a weiger check machine that is ensuring in a carton there is no loss of 1 tablet, then each carton is put into a carton shipper, in a carton shipper there are 50 cartons.

2.2. *Non Direct Compress*. This solid product after the dispensing process goes through the stages of the mixing process that is mixing active substances with fillers accompanied by the IPC process - In process control every 30 minutes, The IPC process includes homogeneity, if the IPC process does not meet the specified specifications then the process is stopped and carried out investigation and if it meets the specified specifications proceed to the next process, granulation , this process aims to control the shape and moisture content of the granules before the next stage, compressing. The process of graulation is accompanied by IPC - In process control every 30 minutes, the IPC process includes particle shape and water content in granules,

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if in the IPC process found granules that do not meet specifications, the granulation process is stopped and an investigation is carried out, and if it meets the specifications then the next stage i.e. a compresing process, which is forming a tablet accompanied by an IPC process - In process control every 1 hour, the IPC process includes individual weight of each tablet, tablet hardness, tablet disintegration time, tablet form, if in the IPC process found a tablet that does not meet specifications then the process is stopped and carried out an investigation, if the compressing process meets specified specifications, the next stage is filling or primary packaging, which is the process of packing the tablet into aluminum foil-PVC which has formed a tablet bag. During the filling or primary packaging process, the IPC process is carried out - In process control every 1 hour, the IPC process involves leakage of tablet pockets. If a leak is found then the filling or primary packaging process is stopped and an investigation is carried out, if the filling or primary packaging process meets the specified specifications then the next stage is the packing or secondary packaging process, the end result is a blister or strip where in 1 blister or strip there are 10 tablets. The next process is secondary packaging that is packing each blister into an individual carton using a cartoning machine and each individual carton is put into a carton that is each carton containing 20-50 individual carton, followed by an IPC-In process control process using a weiger check machine that is ensuring in a carton there is no loss of 1 tablet, then each carton is put into a carton shipper, in a carton shipper there are 50 cartons.

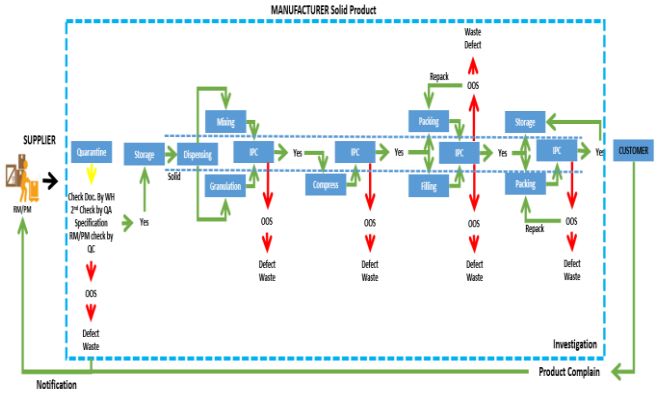

Figure 8. The flow of solid product manufacturing PT.XYZ

3. Distribution.

Distribution of PT. XYZ is carried out by PT. XYZ namely as a customer. PT. Commercial Team XYZ in collaboration with PT. APL in the distribution of PT. XYZ, in the distribution of PT. XYZ is divided into 2 namely solid pharmacy products which are solid products that must use a doctor's prescription and solid healthcare products, which are products that do not use a doctor's prescription.

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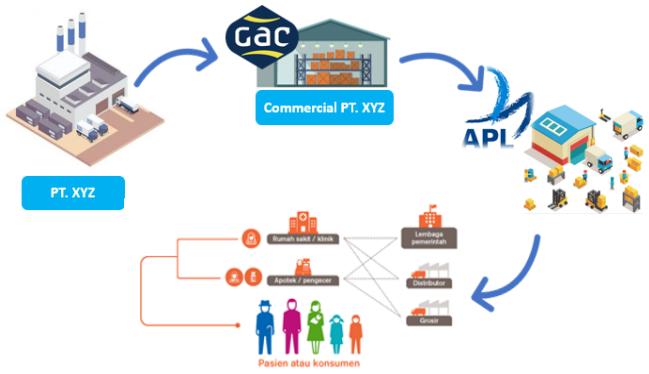

Figure 9. Flow distribution of product solid pharmacy PT. XYZ

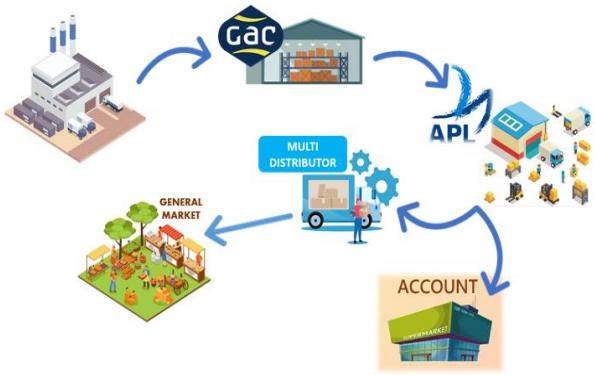

Figure 10. Flow distribution of product solid healthcare PT. XYZ

Figure 11. Distribution Time product solid PT. XYZ

3. Research Result

Measurement of Green Supply Chain performance indicators at PT. XYZ is done using the SCOR model at level 1. Level 1 SCOR models include 5 main activities namely plan, source, make, deliver, and return. At level 1 there are 5 attributes namely reliability, responsiveness, agility, cost and assets. Level 2 key performance indicators (KPI) are used to measure the level

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of achievement of objectives. KPI identified from the metric of green supply chain operations reference (SCOR green) based on objective expected by each stakeholder.

1. Determination of KPIs

An interview and question and answer discussion process was held with senior managers (department heads), and managers namely the Head of Commercial, Head of Procurement, Head of Logistics, Manager Planner, Material Management Manager, Warehouse Manager, Quality Control Manager, Quality Assurance Manager, Head of Operation, Value Stream Solid-Semi Solid Manager, Head of Engineering, Head of Environment Health and Safety as well as direct observation through observation or direct observation in the logistics department of PT. XYZ From the results of Focus Group Discussion - FGD in which there are interviews and question and answer discussions obtained the communication process manufacturing flow and Key Performance Indicator (KPI) which is the basis for the calculation to determine the value of Green SCOR. KPI verification process is carried out by experts and has a direct involvement in the manufacturing performance process itself

1. Head of Commercial and Head of Logistics discuss KPI Service, namely the number of finished products made to meet consumer needs through CTP - Confirm to Product.
2. Head of Procurement, Head of Logistics, Planner Manager, Material Management Manager discuss Sales and Operating Planing , which also discussed the Master Production Schedule and Material Requirement Plan to be communicated and discussed with the Warehouse Manager, Quality Control Manager, Quality Assurance Manager, Head of Quality Assurance, Head of Operation, Manager of Solid-Semi Solid Value Stream, Head of Engineering, Head of Environment Health and Safety determines Service KPI, Defect KPI and Waste KPI, that is the amount of material ready for use for production and finished products ready to be sent via CTR - Confirm to Release , ZD - Zero Defect that inside him there Process Deviation, Deviation Supplier, Documentation Error, Complain , and Reject, then ZW - Zero Waste which there are Energy CO_2 , Water H_2O, non-Hazerdous Waste and LanfillWast e. this is done to find out whether the performance indicators designed are correct and in accordance with company needs, namely by checking which indicators have not been included or do not need to be included because of the possibility of similarities with other indicators.

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Table 2. SCOR Model Key Performance Indicator (KPI)

Component	*Atribut*	*Key Performance Indicator*	*KPI Section*
Plan	Reability	Sales and Operation Planning - Commercial demand forecast information	Commercial
		Supply Review Meeting - Ensure the forecast received is in accorddance with SNOP-Sales and Opreation Planning	Logisic
		Master Production Schedule - Creating production schedule base on production capacity	Planner
		MPS - Creating testing inspection schedule for raw material and packaging material	QC
		MPS - Creating release schedule for raw material and packaging material	QA
		Material Requirement Planning - Creating procurement schedule and material allocation for production needs	Material Management
		Material Requirement Planning - Creating ofn material purchase schedule	Procurement
		Creating PM - Preventive Maintanance schedule Creating waste hadling schedule for Non Hazardous waste	ENG EHS
	Responsiveness	The time period for making the production schedule	Planner
		The time period for revising the production schedule	Planner
		The period of receipt of RM / PM	Warehouse
		The period of inspection is RM / PM	QC
		Release period is RM / PM	QA
		Time period of production	Production
		The duration of the FG Solid release	QA
Source	Reability	RM / PM documentation in accordance with compliance requirements	QA
		RM / PM packaging according to RM / PM requirements specifications	QA
		The amount of RM / PM received is in accordance with PO	Warehouse
		RM meet specification	QC
		PM meet specification	QC
	Responsiveness	Lead time RM testing 10 days	QC
		Lead time PM testing 8 days	QC
		Lead time release RM testing 3 days	QA
		Lead time release PM testing 3 days	QA
		Lead time Production 10 days	QC
		Lead time FG testing 5 days	QC
		Lead time release FG 7 days	QA
	Flaxibility	Campaign testing material process	QC
		Campaign production process	Production
	Cost	Kemasan RM/PM	Procurement
	Aset	5 bacth RM stock	Material Management
		2 bacth PM stock	Material Management
Make	Reability	Adjustment production schedule	Planner
		Granulasi process	Production
		Compressing prosess	Production
		Primary packaging process	Production
		Secondary packaging process	Production
		Jumlah primary packaging material yang cacat	Production
		Jumlahsecondary packaging material yang cacat	Production

Table 2. SCOR Model Key Performance Indicator (KPI(, (cont'd)

Component	*Atribut*	*Key Performance Indicator*	*KPI Section*
Make	Responsiveness	Lead time manufacturing process for finish goods	Production
		Production responsiveness with a variety of products	Production
		Responsiveness of production with changes in production schedules	Production
	Flaxibility	Campaign production process	Production
		Campaign testing FG	QC
	Cost	Product cost	Production
	Aset	Average length of life of a production machine	ENG
Deliver	Reability	RM/PM readiness	Planner
		FG readiness	Planner
	Responsiveness	Laadtime FG	Production
Return	Reability	Customer complain	QA
	Responsiveness	OOS product replacement time	QA

1. Determination of Normalization

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The next step is to normalize each KPI. This is done because each KPI has different weights with different size scales. For this reason, the parameter equalization process is needed, namely by means of the normalization. Here normalization plays an important role in achieving the final value of performance measurement. The normalization process is carried out with the Snorm De Boer normalization formula. Determination of Snorm De Boer normalization begins with the determination of the value of the achievement of the performance or the worst performance of the performance indicator (Smin), Determination of the value of the achievement of the best performance or performance of the performance indicator (Smax), Determination of the results of the actual indicators that were achieved (Si)

Table 3. SCOR Model Key Performance Indicator (KPI)

Compone	Atribut	Key Performance Indicator	Snorm	Katagori
Plan	Reability	Sales and Operation Planning - Commercial demand forecast information	50.00	Average
		Supply Review Meeting - Ensure the forecast received is in accorddance with SNOP-Sales and Opreation Planning	25.00	Poor
		Master Production Schedule - Creating production schedule base on production capacity	100.00	Axcellent
		MPS - Creating testing inspection schedule for raw material and packaging material	100.00	Axcellent
		MPS - Creating release schedule for raw material and packaging material	100.00	Axcellent
		Material Requirement Planning - Creating procurement schedule and material allocation for production needs	100.00	Axcellent
		Material Requirement Planning - Creating ofn material purchase schedule	100.00	Axcellent
		Creating PM - Preventive Maintanance schedule Creating waste hadling schedule for Non Hazardous waste	100.00	Axcellent
	Responsiveness	The time period for making the production schedule	50.00	Average
		The time period for revising the production schedule	50.00	Average
		The period of receipt of RM / PM	50.00	Average
		The period of inspection is RM / PM	100.00	Axcellent
		Release period is RM / PM	66.67	Average
		Time period of production	100.00	Axcellent
		The duration of the FG Solid release	100.00	Axcellent
Source	Reability	RM / PM documentation in accordance with compliance requirements	62.50	Average
		RM / PM packaging according to RM / PM requirements specifications	62.50	Average
		The amount of RM / PM received is in accordance with PO	100.00	Axcellent
		RM meet specification	100.00	Axcellent
		PM meet specification	100.00	Axcellent
	Responsiveness	Lead time RM testing 10 days	90.00	Good
		Lead time PM testing 8 days	100.00	Axcellent
		Lead time release RM testing 3 days	100.00	Axcellent
		Lead time release PM testing 3 days	100.00	Axcellent
		Lead time Production 10 days	100.00	Axcellent
		Lead time FG testing 5 days	100.00	Axcellent
		Lead time release FG 7 days	85.71	Good
	Flaxibility	Campaign testing material process	50.00	Average
		Campaign production process	50.00	Average
	Cost	Kemasan RM/PM	90.00	Good
	Aset	5 bacth RM stock	100.00	Axcellent
		2 bacth PM stock	100.00	Axcellent
Make	Reability	Adjustment production schedule	100.00	Axcellent
		Granulasi process	100.00	Axcellent
		Compressing prosess	100.00	Axcellent
		Primary packaging process	100.00	Axcellent
		Secondary packaging process	100.00	Axcellent
		Jumlah primary packaging material yang cacat	0.95	Poor
		Jumlahsecondary packaging material yang cacat	0.95	Poor

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Table 3. SCOR Model Key Performance Indicator (KPI) (cont'd)

Compone	*Atribut*	*Key Performance Indicator*	*Snorm*	*Katagori*
Make	Responsiveness	Lead time manufacturing process for finish goods	82.61	*Good*
		Production responsiveness with a variety of products	66.67	*Average*
		Responsiveness of production with changes in production schedules	100.00	*Axcellent*
	Flaxibility	Campaign production process	100.00	*Axcellent*
		Campaign testing FG	100.00	*Axcellent*
	Cost	Product cost	25.00	*Poor*
	Aset	Average length of life of a production machine	100.00	*Axcellent*
Deliver	Reability	RM/PM readiness	100.00	*Axcellent*
		FG readiness	100.00	*Axcellent*
	Responsiveness	Laadtime FG	100.00	*Axcellent*
Return	Reability	Customer complain	100.00	*Axcellent*
	Responsiveness	OOS product replacement time	100.00	*Axcellent*

2. AHP calculation

The next step is weighting with the AHP (Analytical Hierarchy Process) method. Determining the scale of 1 to 9 is the best scale in expressing opinions. At this stage pairwise comparisons are discussed with the Head of Commercial, Head of Procurement, Head of Logistics, Manager Planner, Material Management Manager, Warehouse Manager, Quality Control Manager, Quality Assurance Manager, Head of Operation, Value Stream Solid-Semi Solid Manager , Head of Engineering, Head of Environment Health and Safety by assessing the importance of one element to other elements. If an element is compared with itself, it is given a value of 1. If element A compared to element B gets a certain value, then element A compared to element B is the opposite. Then the matrix is squared and then count the number of values from each row, then normalize the matrix. Normalization results are shown in the "Eigen 1" column. Logical consistency needs to be taken into account to see whether the comparison matrix is consistent or not. The method is as follows:

a. Multiply the matrix with Eigen 1, where the results are shown in the WSV column
b. Add up the product by line.
c. The sum of each row is divided by priority and the results are summed.
d. Results c divided by the number of elements, will be obtained λ max.
e. Calculate the Consistency Index (CI)
f. Calculate Consistency Ratio

This is done to determine the level of importance of each level and KPI with the aim of calculating the total value of the performance of Green SCOR. This weighting is carried out for each KPI and its components and attributes by: Pairwise Comparison Matrix Measurement

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Table 5. AHP Calculation

Component/ Process	*Atribut/Dimensi*	*KPI*	*KPI*
Plan	Reability	Sales and Operation Planning - Commercial demand forecast information	**0.296486**
		Supply Review Meeting - Ensure the forecast received is in accorddance with SNOP-Sales and Opreation Planning	**0.098829**
		Master Production Schedule - Creating production schedule base on production capacity	**0.098829**
		MPS - Creating testing inspection schedule for raw material and packaging material	**0.088580**
		MPS - Creating release schedule for raw material and packaging material	**0.098829**
		Material Requirement Planning - Creating procurement schedule and material allocation for production needs	**0.098829**
		Material Requirement Planning - Creating ofn material purchase schedule	**0.098829**
		Creating PM - Preventive Maintanance schedule Creating waste hadling schedule for Non Hazardous waste	**0.120791**
	Responsiveness	The time period for making the production schedule	**0.091090**
		The time period for revising the production schedule	**0.261790**
		The period of receipt of RM / PM	**0.248415**
		The period of inspection is RM / PM	**0.019135**
		Release period is RM / PM	**0.093391**
		Time period of production	**0.157953**
		The duration of the FG Solid release	**0.128225**
Source	Reability	RM / PM documentation in accordance with compliance requirements	**0.129288**
		RM / PM packaging according to RM / PM requirements specifications	**0.277045**
		The amount of RM / PM received is in accordance with PO	**0.593668**
		RM meet specification	**0.500000**
		PM meet specification	**0.500000**
Source	Responsiveness	Lead time RM testing 10 days	**0.142857**
		Lead time PM testing 8 days	**0.142857**
		Lead time release RM testing 3 days	**0.142857**
		Lead time release PM testing 3 days	**0.142857**
		Lead time Production 10 days	**0.142857**
		Lead time FG testing 5 days	**0.142857**
		Lead time release FG 7 days	**0.142857**
	Flaxibility	Campaign testing material process	**0.750000**
		Campaign production process	**0.250000**
	Cost	Kemasan RM/PM	**1.000000**
	Aset	5 bacth RM stock	**0.500000**
		2 bacth PM stock	**0.500000**
Make	Reability	Adjustment production schedule	**0.140155**
		Granulasi process	**0.071233**
		Compressing prosess	**0.071233**
		Primary packaging process	**0.061568**
		Secondary packaging process	**0.102332**
		Jumlah primary packaging material yang cacat	**0.233873**
		Jumlahsecondary packaging material yang cacat	**0.319605**
	Responsiveness	Lead time manufacturing process for finish goods	**0.277045**
		Production responsiveness with a variety of products	**0.593668**
		Responsiveness of production with changes in production schedules	**0.129288**
	Flaxibility	Campaign production process	**0.833333**
		Campaign testing FG	**0.166667**
	Cost	Product cost	**1.000000**
	Aset	Average length of life of a production machine	**1.000000**
Deliver	Reability	RM/PM readiness	**0.250000**
		FG readiness	**0.750000**
	Responsiveness	Laadtime FG	**1.000000**
Return	Reability	Customer complain	**1.000000**
	Responsiveness	OOS product replacement time	**1.000000**

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3. KPI Calculation

The next calculation is to calculate the final value of the performance of *Green SCOR*. This calculation is done by multiplying each normalization score that has been obtained from the *Snorm De Boer* normalization formula with the weights of each *key performance indicator*, attribute, and component. Here are the results of the calculation: Examples of calculating performance value on KPIs "Adding supplier using milkrum delivery are follows:

Table 6. KPI Calculation

Component/ Process	*Atribut/Dimensi*	*KPI*	*Snorm*	*KPI*	*Performance*
Plan	Reability	Sales and Operation Planning - Commercial demand forecast information	50.00	**0.296486**	**14.824305**
		Supply Review Meeting - Ensure the forecast received is in accorddance with SNOP-Sales and Opreation Planning	25.00	**0.098829**	**2.470717**
		Master Production Schedule - Creating production schedule base on production capacity	100.00	**0.098829**	**9.882870**
		MPS - Creating testing inspection schedule for raw material and packaging material	100.00	**0.088580**	**8.857980**
		MPS - Creating release schedule for raw material and packaging material	100.00	**0.098829**	**9.882870**
		Material Requirement Planning - Creating procurement schedule and material allocation for production needs	100.00	**0.098829**	**9.882870**
		Material Requirement Planning - Creating ofn material purchase schedule	100.00	**0.098829**	**9.882870**
		Creating PM - Preventive Maintanance schedule Creating waste hadling schedule for Non Hazardous waste	100.00	**0.120791**	**12.079063**
	Responsiveness	The time period for making the production schedule	50.00	**0.091090**	**4.554525**
		The time period for revising the production schedule	50.00	**0.261790**	**13.089481**
		The period of receipt of RM / PM	50.00	**0.248415**	**12.420761**
		The period of inspection is RM / PM	100.00	**0.019135**	**1.913548**
		Release period is RM / PM	66.67	**0.093391**	**6.226059**
		Time period of production	100.00	**0.157953**	**15.795293**
		The duration of the FG Solid release	100.00	**0.128225**	**12.822537**
Source	Reability	RM / PM documentation in accordance with compliance requirements	62.50	**0.129288**	**8.080475**
		RM / PM packaging according to RM / PM requirements specifications	62.50	**0.277045**	**17.315303**
		The amount of RM / PM received is in accordance with PO	100.00	**0.593668**	**59.366755**
		RM meet specification	100.00	**0.500000**	**50.000000**
		PM meet specification	100.00	**0.500000**	**50.000000**
	Responsiveness	Lead time RM testing 10 days	90.00	**0.142857**	**12.857143**
		Lead time PM testing 8 days	100.00	**0.142857**	**14.285714**
		Lead time release RM testing 3 days	100.00	**0.142857**	**14.285714**
		Lead time release PM testing 3 days	100.00	**0.142857**	**14.285714**
		Lead time Production 10 days	100.00	**0.142857**	**14.285714**
		Lead time FG testing 5 days	100.00	**0.142857**	**14.285714**
		Lead time release FG 7 days	85.71	**0.142857**	**12.244898**
	Flaxibility	Campaign testing material process	50.00	**0.750000**	**37.500000**
		Campaign production process	50.00	**0.250000**	**12.500000**
	Cost	Kemasan RM/PM	90.00	**1.000000**	**90.000000**
	Aset	5 bacth RM stock	100.00	**0.500000**	**50.000000**
		2 bacth PM stock	100.00	**0.500000**	**50.000000**
Make	Reability	Adjustment production schedule	100.00	**0.140155**	**14.015549**
		Granulasi process	100.00	**0.071233**	**7.123345**
		Compressing prosess	100.00	**0.071233**	**7.123345**
		Primary packaging process	100.00	**0.061568**	**6.156756**
		Secondary packaging process	100.00	**0.102332**	**10.233242**
		Jumlah primary packaging material yang cacat	0.95	**0.233873**	**0.222736**
		Jumlahsecondary packaging material yang cacat	0.95	**0.319605**	**0.304386**
	Responsiveness	Lead time manufacturing process for finish goods	82.61	**0.277045**	**22.886314**
		Production responsiveness with a variety of products	66.67	**0.593668**	**39.577836**
		Responsiveness of production with changes in production schedules	100.00	**0.129288**	**12.928760**
	Flaxibility	Campaign production process	100.00	**0.833333**	**83.333333**
		Campaign testing FG	100.00	**0.166667**	**16.666667**
	Cost	Product cost	25.00	**1.000000**	**25.000000**
	Aset	Average length of life of a production machine	100.00	**1.000000**	**100.000000**
Deliver	Reability	RM/PM readiness	100.00	**0.250000**	**25.000000**
		FG readiness	100.00	**0.750000**	**75.000000**
	Responsiveness	Laadtime FG	100.00	**1.000000**	**100.000000**
Return	Reability	Customer complain	100.00	**1.000000**	**100.000000**
	Responsiveness	OOS product replacement time	100.00	**1.000000**	**100.000000**

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4. Attribute Calculation

The next calculation is to calculate the final attribute value from *Green SCOR*. This calculation is done by adding up all the performance values of each attribute. Here are the results of the calculation:

Table 7. Calculation of Final KPI

Component/ Process	*Atribut/Dimensi*	*KPI*	*Snorm*	*KPI*	*Performance*	*Total Performnace*
Plan	Reability	Sales and Operation Planning - Commercial demand forecast information	50.00	**0.296486**	**14.824305**	**77.763543**
		Supply Review Meeting - Ensure the forecast received is in accorddance with SNOP-Sales and Opreation Planning	25.00	**0.098829**	**2.470717**	
		Master Production Schedule - Creating production schedule base on production capacity	100.00	**0.098829**	**9.882870**	
		MPS - Creating testing inspection schedule for raw material and packaging material	100.00	**0.088580**	**8.857980**	
		MPS - Creating release schedule for raw material and packaging material	100.00	**0.098829**	**9.882870**	
		Material Requirement Planning - Creating procurement schedule and material allocation for production needs	100.00	**0.098829**	**9.882870**	
		Material Requirement Planning - Creating ofn material purchase schedule	100.00	**0.098829**	**9.882870**	
		Creating PM - Preventive Maintanance schedule Creating waste hadling schedule for Non Hazardous waste	100.00	**0.120791**	**12.079063**	
	Responsiveness	The time period for making the production schedule	50.00	**0.091090**	**4.554525**	**66.822204**
		The time period for revising the production schedule	50.00	**0.261790**	**13.089481**	
		The period of receipt of RM / PM	50.00	**0.248415**	**12.420761**	
		The period of inspection is RM / PM	100.00	**0.019135**	**1.913548**	
		Release period is RM / PM	66.67	**0.093391**	**6.226059**	
		Time period of production	100.00	**0.157953**	**15.795293**	
		The duration of the FG Solid release	100.00	**0.128225**	**12.822537**	
Source	Reability	RM / PM documentation in accordance with compliance requirements	62.50	**0.129288**	**8.080475**	**184.762533**
		RM / PM packaging according to RM / PM requirements specifications	62.50	**0.277045**	**17.315303**	
		The amount of RM / PM received is in accordance with PO	100.00	**0.593668**	**59.366755**	
		RM meet specification	100.00	**0.500000**	**50.000000**	
		PM meet specification	100.00	**0.500000**	**50.000000**	

Table 7. Calculation of final KPI (cont'd)

Component/ Process	*Atribut/Dimensi*	*KPI*	*Snorm*	*KPI*	*Performance*	*Total Performnace*
Source	Responsiveness	Lead time RM testing 10 days	90.00	**0.142857**	**12.857143**	**96.530612**
		Lead time PM testing 8 days	100.00	**0.142857**	**14.285714**	
		Lead time release RM testing 3 days	100.00	**0.142857**	**14.285714**	
		Lead time release PM testing 3 days	100.00	**0.142857**	**14.285714**	
		Lead time Production 10 days	100.00	**0.142857**	**14.285714**	
		Lead time FG testing 5 days	100.00	**0.142857**	**14.285714**	
		Lead time release FG 7 days	85.71	**0.142857**	**12.244898**	
	Flaxibility	Campaign testing material process	50.00	**0.750000**	**37.500000**	**50.000000**
		Campaign production process	50.00	**0.250000**	**12.500000**	
	Cost	Kemasan RM/PM	90.00	**1.000000**	**90.000000**	**90.000000**
	Aset	5 bacth RM stock	100.00	**0.500000**	**50.000000**	**100.000000**
		2 bacth PM stock	100.00	**0.500000**	**50.000000**	
Make	Reability	Adjustment production schedule	100.00	**0.140155**	**14.015549**	**45.179359**
		Granulasi process	100.00	**0.071233**	**7.123345**	
		Compressing proses	100.00	**0.071233**	**7.123345**	
		Primary packaging process	100.00	**0.061568**	**6.156756**	
		Secondary packaging process	100.00	**0.102332**	**10.233242**	
		Jumlah primary packaging material yang cacat	0.95	**0.233873**	**0.222736**	
		Jumlahsecondary packaging material yang cacat	0.95	**0.319605**	**0.304386**	
	Responsiveness	Lead time manufacturing process for finish goods	82.61	**0.277045**	**22.886314**	**75.392910**
		Production responsiveness with a variety of products	66.67	**0.593668**	**39.577836**	
		Responsiveness of production with changes in production schedules	100.00	**0.129288**	**12.928760**	
	Flaxibility	Campaign production process	100.00	**0.833333**	**83.333333**	**100.000000**
		Campaign testing FG	100.00	**0.166667**	**16.666667**	
	Cost	Product cost	25.00	**1.000000**	**25.000000**	**25.000000**
	Aset	Average length of life of a production machine	100.00	**1.000000**	**100.000000**	**100.000000**
Deliver	Reability	RM/PM readiness	100.00	**0.250000**	**25.000000**	**100.000000**
		FG readiness	100.00	**0.750000**	**75.000000**	
	Responsiveness	Laadtime FG	100.00	**1.000000**	**100.000000**	**100.000000**
Return	Reability	Customer complain	100.00	**1.000000**	**100.000000**	**100.000000**
	Responsiveness	OOS product replacement time	100.00	**1.000000**	**100.000000**	**100.000000**

5. *Calculation of the Value of Green Manufacturing Work*

The next calculation is to calculate the Green Manufacturing performance value from *Green SCOR*. This calculation is done by adding up all the total values of component performance. Here are the results of the calculation:

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Tabel8. Calculation of Green Manufacturing

Component	*Total Component*	*Wight of Component*	*AHP Component*
Plan	0.14518419	72.29287337	10.49578219
Source	0.44241392	105.51378716	46.68076799
Make	0.04697602	59.33924508	2.78752147
Deliver	0.29086861	100.00000000	29.08686100
Return	0.07455726	100.00000000	7.45572645
GREEN SCOR			96.50665910

In table 8 the *Green Manufacturing* performance value is calculated where the performance value of the component *plan, source, make, deliver* and *return is* obtained by multiplying "Total Each Component" multiplied by "Weight of Components :, then the results of the overall performance value of the components are added up. The result of the sum is the performance value of *Green* SCOR. *Green* SCOR performance value for *Green Manufacturing* obtained is 96.5067 which according to the monitoring system work indicator table included in the category of "*Excellent* ". These results indicate that PT XYZ Indonesia is already good in carrying out *green manufacturing* activities and this performance should continue to be improved. To facilitate the evaluation of strategies from the calculation results of the performance value of the *green supply chain the* researchers made 2 performance boards namely the daily performance board and the weekly performance board to monitor the achievement of KPIs in 2019.

1. Daily Performance Board

Is a daily performance board that functions as a communication tool between departments that is directly related to operations or not directly related to operations carried out every day after the *department daily meeting*, attended by representatives of each department or functions directly related to operations, representatives involved in daily coordination meetings this is a group leader, supervisor and or manager, it aims to get information from other departments or functions. Daily performance board consists of

- Top 3 Issue, Is a performance board that shows problems that have a direct impact on quality, compliance, safety and business. This issue is a top priority in its resolution.
- Deviation, is a performance board that shows all nonconformities of activities carried out against the applicable procedures and or regulations.
- Out of Specification, Is a performance board that shows all nonconformities of activities in the area of *quality control* that directly affect the quality and safety of the product.
- Customer Complaint, Is a performance board that shows all *complaints* both from internal and external
- Accountability Board, is a performance board that shows the activities needed to solve a problem

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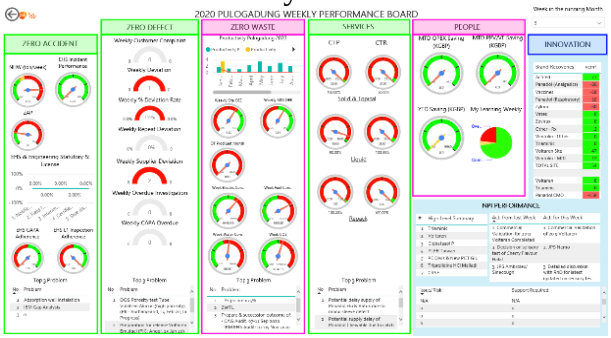
Table 9. Daily Performance Board

2. Weekly Performance Board

Is a weekly performance board that serves as a tool to monitor the achievement of KPIs every week. This weekly performance board is reviewed every week (Monday), the weekly performance board aims to ensure the KPI target is achieved every month. Below is an example of a part of the weekly performance board:

Table 10. Weekly Performance Board



4. Discussion

PT XYZ Indonesia has never taken measurements of the performance of *green manufacturing*. In this study the performance of manufacturing activities, namely *Commercial, Logistics, Production, Quality, Procurement, Engineering and Environment Health and Safety* with performance using the green SCOR method. Based on direct observation and verification to the *supply chain*, namely the *Commericial Manager, Logistic Manager, Planner Manager, Material Management Manager, Warehouse Manager, Quality Control Manager, Quality Assurance Manager, Head of Operation, Head of Value Stream Solid-Semi Solid, Producer Manager, Manager Engineering, Manager of Environment Health and Safety* and *Site Director* , selected 51 KPIs used to calculate *green manufacturing* . These 51 selected KPIs are indicators that are monitored and controlled on a daily performance board and weekly performance board:

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1. Daily Performance Board.

The performance board is stored on the server where the *folder* is *shared* with all employees so that the *file* can be *accessed* by every employee directly involved in PT XYZ's *supply chain management activities* , starting from *the line leader level* to the *manager* , this daily performance board is *updated* , the *review* , in *the monitor* and control each day after the *daily coordination within* each department to get the latest information from the still-individual departments and then conducted *daily meetings* involving all the departments (*cross department*), board daily performance in the form of *an excel file* which is stored difolder, This form is part of the *green manufacturing* implementation program in this case is *paper less*, which each department representative brings a paper report of activities that must be informed at the *daily meeting* .

Figure 12. Daily Meeting after Implementation Green Manufacturing PT. XYZ (Author 2020)

2. Weekly Performance Board.

Weekly Performance Board. The performance board is stored in a server which is then connected to the system in the Power BI-Business Interaction team site and web site where this Power BI system can be accessed by every employee directly and indirectly involved in PT XYZ's supply chain management activities, starting from the level of operators, analysts, technicians, staff to the site director by using a smartphone , this weekly performance board is updated , reviewed , monitored and controlled every Monday after daily coordination in each department to get the latest information from each department and then conducted weekly meetings involving all managers and department heads (cross department) by bringing their respective smartphones , this weekly performance board in the form of a Power BI web base that is connected to the excel database stored on the server, this form is part of the green implementation program manufacturing in this case is ah paper less which previously each department had to print several sheets of reports which were then posted on the walls of the performance reports of each department which had to be informed at the weekly meeting.

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Figure13. Weekly Meeting after Implementation Green Manufacturing PT. XYZ (Author 2020)

After obtaining 51 KPIs from the FGD with department heads and managers, the normalization process is carried out on 51 KPIs. From the results of the normalization process carried out using the Snorm De Boer normalization formula , a working indicator monitoring system is obtained, there are 4 KPIs that are categorized as " Poor ", 10 KPIs that are categorized as " Average ", 4 KPIs that are categorized as " Good ", 33 KPIs which belongs to the " Excellent " category .

Furthermore, by using the Analytical Hierarchy Process - AHP method through the focus group discussion - FGD process in determining the level of importance with the Commericial Manager, Logistics Manager, Planner Manager, Material Management Manager, Warehouse Manager, Quality Control Manager, Quality Assurance Manager, Head of Opretaion, Manager Value Stream Solid-Semi Solid, Manager of Procurement, Manager of Engineering, Manager of Environment Health and Safety and Site Director. This weighting is carried out on each KPI, as well as each attribute and component. In the AHP method there is also a Consistentcy Ratio calculation, where all results are less than 0.1 which can be said to be consistent.

In the Plan component there are 2 attributes, namely reliability and responsiveness, which have a higher importance is reliability compared to responsiveness. In the Source component there are 5 attributes, namely reliability, responsiveness, faxibility, cost and assets where the higher level of importance to the lower level is responsiveness, reability, cost, assets, and faxibility.

In the Make component, there are 5 attributes, namely reliability, responsiveness, faxibility, cost and assets where those that have a higher level of importance to a lower level are responsiveness, assets, cost, reability, faxibility. Deliver components have 2 attributes, namely reliability and responsiveness, which have the same level of importance. In the Return component there are 2 attributes, namely reliability and responsiveness, which have the same level of importance.

From the calculations performed, it can be seen that the highest weight for the process at level one is the source process with a weight of 0.442. Then the second priority is the delivery process of 0.290. Then the third priority is the process plan of 0.145. The next priority is the return process by 0.074 and make by 0.049. In Table 25. Shows that the green manufacturing performance value is 96,506 and refers to the monitoring system performance indicator table is as follows: a monitoring system that is less than 40 then the performance indicator is Poor , the monitoring system is between 40-50 then the indicator is Marginal performance , monitoring system between 50-70 then the performance indicator is Average, the monitoring system is between 70-90 then the performance indicator is Good and

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the monitoring system is between> 90 then the performance indicator is Excellent . This is due to the implementation and control carried out by PT XYZ on green supply chain management activities on a daily and weekly basis through performance papak that can be assessed, reviewed and controlled by all employees.

Figure14. KPI Service - Weekly Meeting PT. XYZ (Author 2020)

Figure15. KPI Defect - Weekly Meeting PT. XYZ(Author 2020)

Figure16. KPI Waste - Weekly Meeting PT. XYZ (Author 2020)

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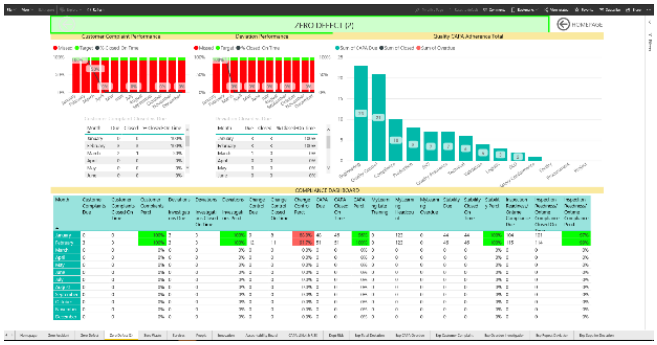

Figure17. KPI Service - Weekly Meeting PT. XYZ(Author 2020)

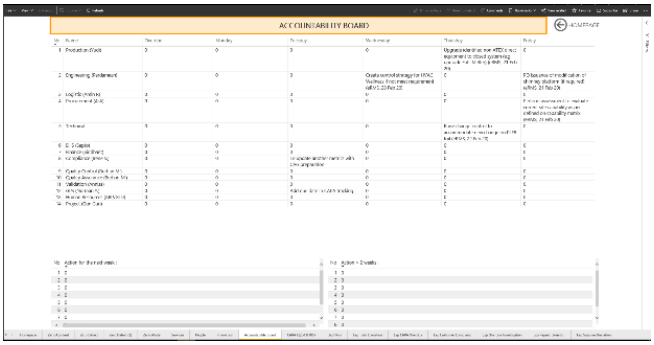

Figure18. Accountability board - Weekly Meeting PT. XYZ (Author 2020)

When compared with the achievement of KPIs of PT XYZ in table 11 namely the achievement of the 2019 KPIs in the actual improvement, are:

Tabel 11. KPI Actual(Author 2020)

Defect	2016 Actual	2017 Actual	2018 Actual	2019 Actual
Proses Deviation	2.73%	3.40%	2.87%	2.14%
Supplier Deviation	3.65%	5.94%	5.80%	3.15%
Document Error	3.71%	5.25%	2.75%	2.70%
Complaints	70	33	212	14
Reject	1	0	1	1

Waste	2016 Actual	2017 Actual	2018 Actual	2019 Actual
Energy CO2	-8.50%	1.20%	13.90%	11.30%
Water H2O	17.00%	-19.40%	-22.40%	-21.30%
Non-Hazardous Waste	5.20%	-28.10%	-38.00%	-40.00%
Landfill Waste	0.079	-0.12	-0.326	-0.3

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This improvement also has an impact on the costs incurred by the company PT. XYZ are:

Figure19. Grafik Waste Cost

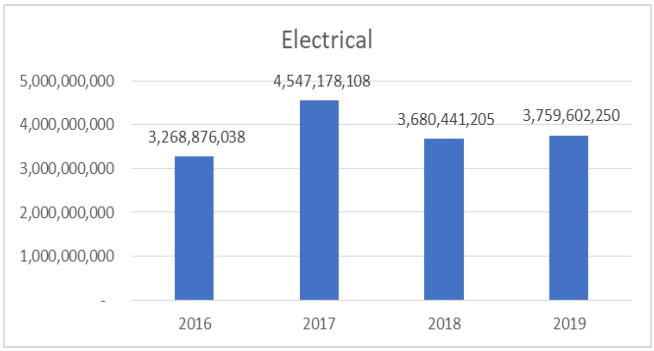

Figure20. Grafik Electrical Cost

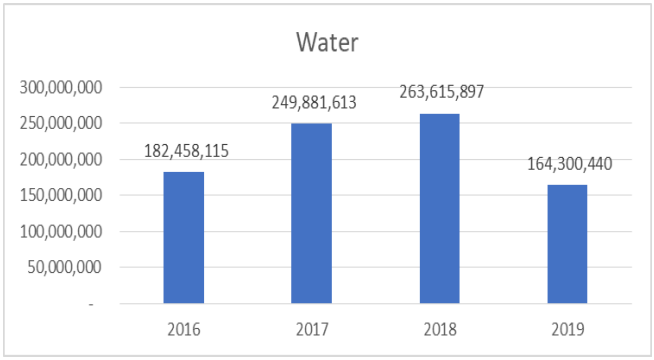

Figure21.Grafik Water Cost

Figure 19 points to a reduction in costs for Waste, which was previously 4.3 billion to 1.2 billion due to the implementation of cost reduction in several programs including

1. Purchasing with Supplier

3R programs namely Reduce, Reuse and Recycle include

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a) The use of pallets used for material handling and transportation before using wooden pallets was changed to using plastic pallets, with this change the company does not need to pay for waste pallet management, because the pallets used for material handling and transportation material can be returned back to the material supplier.

Figure 22. Replace wood pallet with plastic pallet (Author 2020)

b) Changing the use of cardboard or shipper for small materials such as reflets, PVC, aluminum, label stickers with autor boxes and trays that are used to protect material during material handling and transportation, but can also be used again.

Figure 23. Replace card board/shippr with Autor boxes (Author 2020)

2. Purchasing the Environment Healt and Safety is reduction of wet and dry waste from the cafeteria that is by way of replacing the packaging for snacks and drinks from the individual into a bulk box, and make a deal with catering services to bring wet garbage after the lunch service employees.

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Figure 24. Replacing individual box to bulk container (Author 2020)

3. Planner with Quality Control and Production. The creation of a Master Production Schedule that prioritizes and extends the sampling process, material inspection and production in a campaign has a positive impact on the amount of waste generated from the sampling process, material inspection and production. Based on CPOB - Good Manufacturing Practices for each manufacturing process, it must be ensured that there is no cross-contamination from previous drugs unless the drug has the same dose, raw material used from the same manufacturing source and the same lot or lot. Campaign process is the process of making drugs more than one lot or batch with the same dose, the same coloring, the same flavor and drug material from the same manufacturing source and the same lot or batch, if there is a difference, total sanitation must be done to the room, tools and machines used for the manufacturing process of the drug. The impact of this total sanitation process has a profound effect on the waste generated from the process, especially hazardous waste, so high costs are needed for treatment. Besides having an impact on the waste generated, it also impacts on the use of energy and water.

The impact on management in making decisions based on the proposed priority strategy based on the value of the prioritized performance weights are as follows:

Table 12. Usulan Strategi Prioritas

Component	*Strategy*
Source	Improve communication regarding compliance reqirement for RM / PM
	Improve on time delivery
	Improve the timeliness of document testing testing
	Shortening leadtime inspection of finished products
	Improve communication with steakholders
Deliver	Increase the fulfillment of the finished product
Plan	Improve coordination between manufacturing and commercial
	Improve the company's internal coordination
	Understand the market situation
	Improves the timeliness of loading / unloading RM / PM
	Improve the timeliness of sampling and checking of RM / PM
	Improve the timeliness of document release examinations
	Improve on time delivery of finished products
Return	Open complaint service
Make	Improve the timeliness of MPS revisions
	Increase production capacity
	Increase supplier loyalty
	Increase the accuracy of the number and time according to customer demand
	Increase QC capacity
	Increase productivity
	Improve equipment maintenance

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CONCLUSION & RECOMMENDATION

1. Conclusion

After measuring and analyzing the calculation of the *green manufacturing* performance value, the conclusions that can be drawn from this study are as follows:

1. The results of performance measurements with PT XYZ's Supply Chain Operation Reference (SCOR) show that the processes that exist in the company include *Plan, Source, Make, Deliver, and Return.* Based on the indicator determination questionnaire, all of the existing *Key Performance Indicators (KPI)* totaled 51 KPIs. Also based on the results of interviews and discussions obtained a new communication channel. In Table 8. Shows that the green manufacturing performance value is 96.506 shows the monitoring system and performance indicators are *Excellent*.
2. As for improvements that should be done to improve the performance value of the Green Model Supply Chain Operation Reference is by proposing a more focused strategy that is decision making at the management level and for the long term. This proposed strategy is in the form of a strategy map and is intended to improve GSCM performance management:
   - Improve coordination between *manufacturing* and *commercial* and company internal coordination.
   - Understand the market situation and improve communication with *steakholders*.
   - Improve the timeliness of *loading / unloading* RM / PM, and improve the timeliness of sampling and inspection of finished products
   - Improve the timeliness of *document release* checks Increase production capacity, shorten inspection lead times for finished products

2. Suggestion

1. It is recommended that the implementation of *Green Supply Chain Management* be communicated not only at the Managerial level but to all employees who are directly and indirectly involved in *Green Manufacturing* activities.
2. The application of Green Manufacturing is not only done on Value Steam Solid-Semi Solid alone but on all lines and products in PT XYZ.
3. Daily performance boards and weekly performance boards were standardized to maintain green manufacturing performance at PT XYZ

3. Recommendation

Life Cycle Assessment - LCA needs to be carried out to identify and analyze the environmental impacts caused by products or activities throughout the life cycle starting from taking raw materials, followed by production and use processes, and ending with waste or waste management. Which is caused by the activities of *green manufacturing* in other chemical companies.

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